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ORIGINAL RESEARCH

Dietary Patterns Associated With Heat Retention in Blood Vessel Syndrome (HRBVS) in Coronary Heart Disease: A Cross-Sectional Study

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Background: Western dietary patterns are well-established risk factors for coronary heart disease (CHD); however, the potential role of Traditional Chinese Medicine (TCM) dietary theory in exacerbating specific TCM syndromes among CHD patients remains a significant knowledge gap. To address this gap, our study aimed to investigate the relationship between dietary patterns, encompassing diet tastes and eating habits, and the occurrence of Heart-Related Blood Vessel Syndromes (HRBVS) in Chinese patients with CHD.

Methods: Data from 4428 patients with CHD were collected, including 2,973 stable angina pectoris (SAP) cases, 614 acute coronary syndrome (ACS) cases, and 841 heart failure (HF) cases. The Coronary Heart Disease HRBVS Scale and the Patient Self-Assessment of Dietary Habits Scale were used. Logistic regression analysis and a backward stepwise regression strategy were employed to identify dietary factors affecting HRBVS.

Results: Individuals with a preference for salty, greasy, and spicy foods and those with irregular eating habits were more likely to experience HRBVS. Good dietary habits and regular meal timing were associated with a lower incidence of HRBVS. In the multivariate regression analysis, individuals who preferred spicy, greasy, and cold foods and those who kipped or had no breakfast had a higher risk of HRBVS. Conversely, individuals with good dietary habits had a lower risk of HRBVS.

Conclusion: HRBVS in patients with coronary heart disease is closely related to dietary habits. Positive dietary interventions may play a significant role in improving HRBVS and enhancing prognosis. Identifying and intervening in these dietary factors may improve the overall prognosis in patients with coronary heart disease.

Trial Registration: ClinicalTrials.gov (NCT02967718).

Keywords: coronary heart disease, acute coronary syndrome, heart failure, HRBVS, dietary habits, cross-sectional study, logistic regression, Traditional Chinese Medicine, Cardiovascular disease

Coronary heart disease, a prevalent chronic non-communicable disease worldwide, poses a significant health burden. The mortality rate among coronary heart disease (CHD) patients has steadily increased in recent years. According to the American Heart Association, the overall prevalence of cardiovascular diseases (including coronary heart disease, heart failure, etc.) in US adults over 20 is 48.6%.[1] The escalating mortality trend underscores the urgent need for a comprehensive understanding of CHD and the development of effective strategies to improve patient outcomes. In 2019, the prevalence of CVD in China was 120 million, up 140.02% compared with 1990.[2] Disturbingly, recent projections[3,4] indicate that China is expected to witness an alarming annual increase of over 50% in cardiovascular events from 2020 to 2030. Traditional Chinese Medicine (TCM) has demonstrated noteworthy insights into the prevention and treatment of CHD, as evidenced by some high-quality published research.[5,6] Notably, during the active phase of CHD, inflammation has garnered increasing attention in the underlying mechanisms, particularly dietary factors.[7] Poor eating habits and specific dietary preferences are common among high-risk populations.

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Epidemiological studies have consistently affirmed the close association between dietary factors and HRBVS. Specifically, a preference for a high-salt diet has been strongly linked to the occurrence of CHD.[8] Over 30 studies have consistently demonstrated that a high-salt diet significantly increases the risk of CHD, with each additional gram of daily salt intake corresponding to a 3% elevation in risk.[9] Moreover, a comprehensive study[10] has revealed that a mere 5% increase in saturated fat intake as a proportion of total calories leads to a substantial 17% rise in the incidence of CHD. These findings underscore the critical importance of dietary factors in the development and progression of CHD. As such, further exploration of dietary modifications and interventions may hold promising potential in mitigating the burden of this debilitating condition.

Of particular interest is the evidence suggesting a correlation between the activity of CHD and the presence of heat-related symptoms.[11] External fire and cardiovascular disease are closely related.[12] From an insight into traditional Chinese medicine, the pathogenesis of CHD is believed to follow a progression from "phlegm-damp stasis" to "heat-retention" stages.[13,14] Recognizing the significant role of "heat-retention" in the pathogenesis of cardiovascular diseases, particularly during periods of heightened activity, researchers have introduced the concept of "a fire within" to elucidate its importance in the pathophysiology of CHD. This concept highlights the presence of an internal fire, metaphorically referring to the accumulation of inflammation factors and imbalances within the body that contribute to the development and exacerbation of CHD. By considering the concept of "fire",[15,16] we can gain valuable insights into the intricate interplay between inflammatory processes, blood stasis, and heat-related symptoms, ultimately influencing CHD's pathophysiological course.[15] Heat Retention in Blood Vessel Syndrome (HRBVS) refers to the stagnation and unresolved accumulation of tangible substances such as pathogenic heat and stagnant blood within the blood vessels. This mutually causal relationship leads to a detrimental cycle of secondary heat accumulation, toxin generation, pattern formation, and vascular injury. The primary pathological mechanism involves the interaction between the pathogenic heat and tangible substances such as "blood stasis" and "phlegm-dampness" within the blood vessels, with the disease primarily affecting the "blood vessels."

To further investigate the relationship between HRBVS and dietary patterns in patients with different stages of CHD, this study thoroughly analyzed clinical data from 4,428 patients in China. The aim was to identify the typical characteristics of blood syndromes in CHD and determine the associated risk factors. Additionally, the study aimed to explore the correlation between dietary habits and the occurrence of HRBVS in CHD patients. The findings of this study provide a scientific basis for early identification and intervention strategies in CHD patients. By elucidating these connections, this study contributes to a deeper understanding of the pathophysiology of CHD and offers valuable insights for developing effective interventions and treatment strategies.

Methods

Source and Grouping of Cases

A convenient sampling method was employed in this study, conducted simultaneously across six regions in China, spanning from October 2016 to April 2018. 48 clinical research centers from 23 provinces, municipalities, and autonomous regions participated in the investigation. The study population consisted of individuals at different stages of coronary heart disease (CHD), including outpatient and inpatient populations of healthy individuals and patients with CHD. The study population was categorized into different stages according to the clinical epidemiological characteristics of CHD development. The cross-sectional analysis included three patient groups: stable phase of CHD, acute coronary syndrome, and CHD with heart failure (HF). This study was registered on the WHO International Clinical Trials Registry Platform (ClinicalTrial.gov) with the identifier NCT02967718 and received ethical approval from the Ethics Committee of the Institute of Basic Theory for Chinese Medicine, China Academy of Chinese Medical Sciences, in September 2016 (2016EC_KY_001). All patients included in this study are aware of and have signed informed consent forms, and strictly comply with the Helsinki Declaration.

Diagnostic Criteria

The diagnostic criteria for CHD were referenced from the "Diagnosis and Treatment Guidelines for Chronic Stable Angina"[17] and the "Diagnosis and Treatment Guidelines for Stable Coronary Artery Disease"[18] The criteria for CHD diagnosis include evidence from coronary angiography or coronary CT angiography indicating at least 50% stenosis in the lumen diameter of one or more major coronary branches, previous coronary revascularization treatment, or a documented history of old myocardial infarction. The diagnostic criteria for the "HRBVS in Coronary Heart Disease" were referenced from the group standard published by the *China Association of Chinese Medicine* in 2022.[19] Detailed criteria for HRBVS are provided in the supplementary material 1.

Inclusion Criteria

1) Age of participants between 35 and 85 years old. 2) Patients with coronary heart disease [diagnosed based on criteria such as confirmed coronary artery stenosis of at least 50% in one coronary vessel through coronary angiography, confirmation through coronary computed tomography angiography (CTA), documented history of old myocardial infarction, presence of pathological Q waves on electrocardiogram (ECG), or support from ECG stress test and radionuclide imaging]. 3) Willingness to sign an informed consent form and voluntarily participate in the study. 4) Patients must adhere to follow-up visits for at least one year.

Exclusion Criteria

1) Patients with a recent history (within the past week) of infection, fever, trauma, burns, surgery, active tuberculosis, or rheumatic immune diseases. 2) Patients with severe cardiac arrhythmias (eg, rapid atrial fibrillation, atrial flutter, paroxysmal ventricular tachycardia) accompanied by hemodynamic changes. 3) Patients with chronic heart failure. 4) Patients with acute or subacute cerebrovascular disease. 5) Patients with valvular heart disease (moderate involvement of one or more valves) or primary cardiomyopathy. 6) Patients in the acute exacerbation phase of chronic obstructive pulmonary disease, pulmonary heart disease, or respiratory failure. 7) Known renal insufficiency with serum creatinine levels >221 μmol/L in males or >177 μmol/L in females. 8) Hepatic insufficiency with glutamic-pyruvic transaminase (GPT) levels >3 times the normal value or with concurrent liver cirrhosis. 9) Patients with severe primary diseases such as hematological disorders or malignant tumors. 10) Organ transplant recipients. 11) Patients with severe mental disorders. 12) Pregnant or breastfeeding women. 13) Other conditions deemed unsuitable for participation in the study, as determined by the researchers.

Statistical methods

Descriptive statistical analyses were employed to characterize the baseline features of the participants. This analysis included calculating the mean, median, standard deviation, range, and quartiles for continuous variables and frequency tables for categorical variables. Normality tests were performed to assess the data distribution, and appropriate descriptive statistical methods were applied for normally and non-normally distributed variables. All statistical analyses in our study were performed using R software (version 4.2.2).

Preliminary associations between continuous variables were assessed using Pearson correlation analysis and univariate and multivariate logistic regression analysis. This method allows for examining relationships between various predictor variables and a binary outcome variable, providing regression coefficients, confidence intervals, and p-values to assess the statistical significance of each variable's association with the outcome. Potential confounding factors were adjusted for. The backward stepwise regression method, particularly the "stepAIC" function in the "MASS" package in R, was used to select the best combination of variables from the univariate analysis to be included in the multivariate analysis model. The selection process was based on minimizing the Akaike information criterion (AIC), which measures the model's goodness of fit and complexity. The backward stepwise regression procedure starts with a model containing all potential variables and iteratively removes variables to find the optimal combination that minimizes the AIC value. This method optimizes model selection based on AIC criteria using backward elimination and provides insight into the complex relationships between variables. The "HRBVS" outcome variable was coded as 1 for present and 0 for absent, while baseline information, dietary habits, and other factors were considered predictor variables. A logistic regression model was constructed to assess the significance of various dietary habit variables to the "HRBVS". Univariate analysis was used for preliminary screening of relevant influencing factors, and multivariate analysis was conducted to determine the impact of a specific factor on the outcome variable while controlling for other variables.

Results

Baseline Characteristics

After performing data processing and excluding cases with a high number of missing values, this study included a final sample of 2,973 individuals with stable angina pectoris (SAP), 614 individuals with acute coronary syndrome (ACS), and 841 individuals with heart failure (HF). Among them, 1,952 individuals were diagnosed with heat-blood stasis syndrome, while 2,476 individuals did not have heat-blood stasis syndrome. Baseline characteristics were analyzed descriptively, stratifying by heat-blood stasis syndrome and disease, and the results are presented in Table 1.

Baseline data analysis revealed that participants who had a preference for spicy (17%), greasy (19%), and irregular dietary habits (16%) were more likely to have heat-blood stasis syndrome, with corresponding P-values of <0.001, 0.015, and <0.001, respectively. Conversely, good dietary habits (89%) and regular meal times (16%) were more prevalent among coronary heart disease patients without heat-blood stasis syndrome ($P < 0.001$). These findings highlight the association between certain dietary characteristics and the presence of HRBVS.

Table 1 Baseline Data

Characteristic	HRBVS (N=1952)	NO HRBVS (N=2476)	P-Value[a]
Disease classification			<0.001
Heart failure	379 (19%)	462 (19%)	
Stable angina pectoris	1,258 (64%)	1,715 (69%)	
Acute coronary syndrome	315 (16%)	299 (12%)	
Age			0.640
Median (IQR)	67 (60, 74)	67 (60, 75)	
Sex			0.187
Female	887 (45%)	1,076 (43%)	
Male	1,065 (55%)	1,400 (57%)	
Education			0.364
University	356 (18%)	458 (18%)	
High school	592 (30%)	795 (32%)	
Illiterate	233 (12%)	247 (10.0%)	
Middle school	501 (26%)	629 (25%)	
Elementary school	265 (14%)	338 (14%)	
Graduate school	5 (0.3%)	9 (0.4%)	
Drinking alcohol			0.466
Non-drinker	1,509 (77%)	1,903 (77%)	
Former drinker	213 (11%)	297 (12%)	
Drinker	230 (12%)	276 (11%)	
Smoking			0.033
Non-smoker	1,380 (71%)	1,715 (69%)	
Former smoker	312 (16%)	465 (19%)	
Smoker	260 (13%)	296 (12%)	
BMI			0.009
Median (IQR)	24.2 (22.2, 26.3)	24.5 (22.5, 26.6)	
Hypertension			0.276
No	558 (29%)	745 (30%)	
Yes	1,394 (71%)	1,731 (70%)	
Diabetes mellitus			0.608
No	1,392 (71%)	1,783 (72%)	
Yes	560 (29%)	693 (28%)	
Hyperlipoidemia			0.047
No	1,463 (75%)	1,790 (72%)	
Yes	489 (25%)	686 (28%)	

(*Continued*)

Table 1 (Continued).

Characteristic	HRBVS (N=1952)	NO HRBVS (N=2476)	P-Value[a]
HRBVS Score			<0.001
Median (IQR)	8.0 (6.0, 9.0)	3.0 (2.0, 5.0)	
No bias (Diet taste)			0.001
No	1,271 (65%)	1,493 (60%)	
Yes	681 (35%)	983 (40%)	
Light taste (Diet taste)			0.178
No	1,597 (82%)	1,986 (80%)	
Yes	355 (18%)	490 (20%)	
Salty taste (Diet taste)			0.007
No	1,418 (73%)	1,886 (76%)	
Yes	534 (27%)	590 (24%)	
Sweet taste (Diet taste)			0.321
No	1,813 (93%)	2,280 (92%)	
Yes	139 (7.1%)	196 (7.9%)	
Sour taste (Diet taste)			0.095
No	1,883 (96%)	2,410 (97%)	
Yes	69 (3.5%)	66 (2.7%)	
Spicy taste (Diet taste)			<0.001
No	1,614 (83%)	2,162 (87%)	
Yes	338 (17%)	314 (13%)	
Bitter taste (Diet taste)			0.228
No	1,937 (99%)	2,464 (100%)	
Yes	15 (0.8%)	12 (0.5%)	
Raw and cold (Diet taste)			0.012
No	1,916 (98%)	2,452 (99%)	
Yes	36 (1.8%)	24 (1.0%)	
Hot foods (Diet taste)			0.075
No	1,811 (93%)	2,330 (94%)	
Yes	141 (7.2%)	146 (5.9%)	
Roasted foods (Diet taste)			0.015
No	1,866 (96%)	2,401 (97%)	
Yes	86 (4.4%)	75 (3.0%)	
Greasy foods (Diet taste)			<0.001
No	1,574 (81%)	2,131 (86%)	
Yes	378 (19%)	345 (14%)	
Good eating habits (Eating habits)			<0.001
No	224 (11%)	189 (7.6%)	
Yes	1,728 (89%)	2,287 (92%)	
No breakfast (Eating habits)			0.590
No	1,829 (94%)	2,310 (93%)	
Yes	123 (6.3%)	166 (6.7%)	
Late-night snacks (Eating habits)			0.059
No	1,841 (94%)	2,366 (96%)	
Yes	111 (5.7%)	110 (4.4%)	
Eat and drink too much (Eating habits)			0.318
No	1,910 (98%)	2,433 (98%)	
Yes	42 (2.2%)	43 (1.7%)	
Choosy in food (Eating habits)			0.168
No	1,895 (97%)	2,420 (98%)	
Yes	57 (2.9%)	56 (2.3%)	

(*Continued*)

Table 1 (Continued).

Characteristic	HRBVS (N=1952)	NO HRBVS (N=2476)	P-Value[a]
Apocleisis (Eating habits)			0.301
No	1,938 (99%)	2,451 (99%)	
Yes	14 (0.7%)	25 (1.0%)	
Irregular and inconsistent eating habits (Eating habits)			<0.001
No	1,630 (84%)	2,215 (89%)	
Yes	322 (16%)	261 (11%)	

Notes: [a]Pearson's Chi-squared test; Wilcoxon rank sum test.

Logistic Regression Analysis

Univariate and multivariate logistic regression analyses examined the association between dietary factors and HRBVS (Table 2). In the univariate analysis, individuals who preferred spicy and greasy foods and those with irregular dietary

Table 2 Univariate and Multivariate Analysis of Influencing Factors

Characteristic	Univariable					Multivariable				
	N	Event N	OR[a]	95% CI[a]	P-value	N	Event N	OR[a]	95% CI[a]	P-value
No bias (Diet taste)										
No	2,764	1,271	—	—						
Yes	1,664	681	0.81	0.72, 0.92	0.001					
Light taste (Diet taste)										
No	3,583	1,597	—	—						
Yes	845	355	0.90	0.77, 1.05	0.178					
Salty taste (Diet taste)										
No	3,304	1,418	—	—						
Yes	1,124	534	1.20	1.05, 1.38	0.007					
Sweet taste (Diet taste)										
No	4,093	1,813	—	—						
Yes	335	139	0.89	0.71, 1.12	0.321					
Sour taste (Diet taste)										
No	4,293	1,883	—	—						
Yes	135	69	1.34	0.95, 1.89	0.096					
Spicy taste (Diet taste)										
No	3,776	1,614	—	—		3,776	1,614	—	—	
Yes	652	338	1.44	1.22, 1.70	<0.001	652	338	1.29	1.08, 1.53	0.005
Bitter taste (Diet taste)										
No	4,401	1,937	—	—						
Yes	27	15	1.59	0.74, 3.47	0.233					
Raw and cold (Diet taste)										
No	4,368	1,916	—	—		4,368	1,916	—	—	
Yes	60	36	1.92	1.15, 3.27	0.014	60	36	1.75	1.04, 3.00	0.036
Hot foods (Diet taste)										
No	4,141	1,811	—	—						
Yes	287	141	1.24	0.98, 1.58	0.075					
Roasted foods (Diet taste)										
No	4,267	1,866	—	—						
Yes	161	86	1.48	1.08, 2.03	0.016					
Greasy foods (Diet taste)										
No	3,705	1,574	—	—		3,705	1,574	—	—	
Yes	723	378	1.48	1.26, 1.74	<0.001	723	378	1.26	1.06, 1.49	0.008

(*Continued*)

Table 2 (Continued).

Characteristic	Univariable					Multivariable				
	N	Event N	OR[a]	95% CI[a]	P-value	N	Event N	OR[a]	95% CI[a]	P-value
Good eating habits (Eating habits)										
No	413	224	—	—		413	224	—	—	
Yes	4,015	1,728	0.64	0.52, 0.78	<0.001	4,015	1,728	0.75	0.60, 0.95	0.019
No breakfast (Eating habits)										
No	4,139	1,829	—	—		4,139	1,829	—	—	
Yes	289	123	0.94	0.73, 1.19	0.590	289	123	0.74	0.57, 0.96	0.022
Late-night snacks (Eating habits)										
No	4,207	1,841	—	—						
Yes	221	111	1.30	0.99, 1.70	0.060					
Eat and drink too much (Eating habits)										
No	4,343	1,910	—	—						
Yes	85	42	1.24	0.81, 1.91	0.319					
Choosy in food (Eating habits)										
No	4,315	1,895	—	—						
Yes	113	57	1.30	0.89, 1.89	0.169					
Apocleisis (Eating habits)										
No	4,389	1,938	—	—						
Yes	39	14	0.71	0.36, 1.35	0.303					
Irregular and inconsistent eating habits (Eating habits)										
No	3,845	1,630	—	—		3,845	1,630	—	—	
Yes	583	322	1.68	1.41, 2.00	<0.001	583	322	1.35	1.11, 1.65	0.003

Notes: [a]OR = Odds Ratio, CI = Confidence Interval. Number in dataframe = 4428, Number in model = 4428, Missing = 0, AIC = 6026.3, C-statistic = 0.56, H&L = Chi-sq (8) 4.54 (p=0.806).

habits had a higher risk of heat-blood stasis syndrome. This association remained significant in the multivariate analysis for individuals who preferred spicy foods and had irregular dietary habits. Additionally, having good dietary habits and eating breakfast were associated with a reduced risk of heat-blood stasis syndrome. However, behaviors such as picky eating, loss of appetite, frequent late-night snacking, and binge eating did not correlate with the risk of HRBVS.

Regarding diet tastes, liking spicy and greasy foods showed a significant association with HRBVS in both univariate and multivariate regression analyses. The preference for raw and cold foods (cooling foods) was also related to HRBVS in univariate analysis, although the association was slightly weaker in the multivariate regression analysis. Among the multivariate regression analysis, patients with a preference for spicy foods had a 1.29-fold increased risk of HRBVS (95% CI 1.08–1.53; *P*=0.005). A preference for raw and cold foods increased the risk by 1.75 times (95% CI 1.04–3.00; *P*=0.036). A preference for greasy foods increased the risk by 1.26 times (95% CI 1.06–1.49; *P*=0.008).

Regarding eating habits, frequent late-night snacking, excessive eating or drinking, picky eating, and loss of appetite showed no correlation with HRBVS in univariate and multivariate analyses. In univariate and multivariate regression analyses, good eating habits and regular meal timings were negatively correlated with HRBVS. Skipping breakfast showed no association with HRBVS in the univariate analysis, but the multivariate analysis showed a reduced risk, with a 0.74-fold decrease in the risk of HRBVS (95% CI 0.57–0.96; *P*=0.022) among individuals. In the multivariate regression analysis, patients with irregular eating patterns had a 1.35-fold increased risk of HRBVS (95% CI 1.11–1.65; *P*=0.003).

In addition, we conducted subgroup analyses based on different stages. We found that among heart failure (Supplementary Material 2), those with a preference for hot foods had a higher risk of developing HRBVS than those without, and this relationship remained significant in the multivariate regression analysis. Patients with a preference for hot foods had a higher risk of developing HRBVS was 2.22 times higher (95% CI 1.31–3.82) than patients without a preference for hot foods. Overall, the dietary habit of preferring salty and greasy foods is associated with the occurrence of HRBVS in coronary heart disease patients, and the dietary habit of preferring spicy foods also shows a significant predictive role in the multivariate regression analysis. Good eating habits are negatively correlated with HRBVS, indicating a lower risk of HRBVS in individuals with good eating habits. The multivariate regression analysis shows that skipping breakfast or eating breakfast infrequently is positively correlated with HRBVS, indicating a higher risk of HRBVS in individuals who skip breakfast or eat breakfast infrequently.

Discussion

This groundbreaking study provides novel evidence linking adverse dietary factors to the development of HRBVS. The analysis revealed that specific dietary habits, such as consuming spicy, and greasy foods, increased the risk of HRBVS, while irregular eating patterns were also associated with a higher risk. Spicy and greasy foods are commonly associated with heat-inducing properties and can potentially trigger hot symptoms. Spicy foods, for instance, can cause vascular dilation, promoting increased blood circulation. The stimulation of sympathetic nerve activity by spicy foods can lead to elevated blood pressure, accelerated heart rate, and other physiological responses, ultimately exacerbating the inflammatory burden.[20,21] High-fat and greasy diets, rich in saturated fatty acids, contribute to elevated levels of low-density lipoprotein cholesterol (LDL-C) in the blood, increasing the risk of atherosclerosis.[22,23] Furthermore, these food choices can induce an inflammatory response by stimulating the immune system and endothelial cells to release inflammatory mediators.[24] These inflammatory processes can further exacerbate vascular damage, impair endothelial cell function, and accelerate the progression of atherosclerosis.[25,26] Additionally, the spicy taste of certain foods can induce sweating and vasodilation. Capsaicin is a major component in spicy foods that can stimulate the nervous system and immune response, promoting inflammation.[27] The induced inflammatory reaction and potential vasoconstriction effects of capsaicin may lead to endothelial cell injury and atherosclerosis by disrupting vascular homeostasis.[28,29]

Moreover, spicy and greasy foods often lack essential vitamins and trace elements crucial for cardiovascular health. Vitamins such as E and C possess antioxidant properties, which can reduce oxidative damage to vascular endothelial cells and inhibit vascular inflammatory reactions. Trace elements like magnesium, calcium, and potassium play vital roles in myocardial function, blood pressure regulation, heart rate control, and other physiological processes. The diet also significantly influences the balance of intestinal microecology.[30] Spicy and greasy foods can disrupt the balance of intestinal flora, leading to an imbalance in the gut microbiota and triggering an inflammatory response.[31,32] This inflammatory response accelerates vascular endothelial cell damage and promotes vascular wall proliferation and fibrous tissue synthesis, ultimately worsening atherosclerosis and intensifying the inflammatory response within the cardiovascular system. Moreover, the majority of these foods are ultra-processed foods, often high in calories and low in nutritional value, contributing to obesity and metabolic disorders, which are independent risk factors for cardiovascular disease.[33–35]

Our subgroup analysis observed that heart failure (HF) patients tend to worsen their condition by consuming cold and hot foods. The main pathological mechanisms[36] underlying HF include reduced cardiac contractility, impaired cardiac diastolic function, cardiac hypertrophy, cardiac muscle fiber remodeling, and cardiomyocyte apoptosis. Since HF patients already have compromised cardiac function and inadequate compensatory mechanisms within the circulatory system, they are more susceptible to local ischemia and hypoxia, triggering inflammatory and oxidative stress responses.[37,38] Consumption of raw and cold foods by these patients can stimulate vascular endothelial cells, leading to vasoconstriction and a sluggish blood circulation response.[39] This reaction can result in reduced oxygen and nutrient supply to tissues, exacerbating the severity of vascular lesions. Conversely, a preference for hot foods can cause vascular dilation and accelerated blood circulation. Stimulating vascular endothelial cells in response to hot foods leads to vasodilation and increased blood flow.[40,41] This reaction can result in excessive blood circulation, facilitating the spread of metabolites and inflammatory factors. Furthermore, hot foods often contain high levels of capsaicin and oil, and excessive intake can lead to gastrointestinal and digestive problems.[42,43] These issues can further impair metabolic and nutritional status, increasing the risk of HF.

Poor dietary habits have been associated with an increased risk of cardiovascular events, and excessive fat intake is linked to higher risks of hypertension and high cholesterol. Conversely, adopting healthy eating habits and regularly consuming breakfast may benefit cardiovascular health. It is crucial to develop tailored dietary interventions for individuals with different types of coronary artery disease (CAD) to improve their dietary habits and reduce the risk of complications. The preference for spicy and greasy foods, which was associated with an increased risk of HRBVS in our study, is also inconsistent with the principles of healthy eating advocated by the Mediterranean diet and DASH diet. The Mediterranean diet has been consistently shown to reduce the risk of cardiovascular diseases.[44] Similarly, the DASH diet has been proven effective in lowering blood pressure and reducing the risk of heart disease.[45] While our study focuses on the unique TCM concept of HRBVS, the dietary factors identified as significant in our analysis are widely recognized as important contributors to cardiovascular health in the broader medical community. By drawing parallels with established dietary frameworks such as the Mediterranean diet and DASH diet, we hope to emphasize the universal relevance of our findings and encourage the adoption of healthy eating habits to prevent and manage CHD.

Despite the exhaustive data analysis and rigorous statistical processing conducted in this study, several limitations warrant mention. Firstly, a primary limitation of this study lies in the diagnostic criteria for HRBVS, which are based on the standards issued by the China Association of Traditional Chinese Medicine in 2022, tailored primarily for the Chinese population. Consequently, the universality of these diagnostic criteria across different races and populations has not been adequately validated. In particular, certain symptoms, such as a red tongue, yellow coat, and tongue with petechiae or ecchymoses, although considered typical manifestations of HRBVS, may also be associated with other conditions (eg, infections), potentially introducing diagnostic confusion. Although we have employed comprehensive assessments, strict exclusion criteria, standardized diagnostic procedures, and provided detailed training to minimize the influence of these confounding factors, future validation in a broader population is necessary. Secondly, the cross-sectional design of this study limits our ability to infer causality. Although multivariate regression analysis revealed associations between dietary patterns and HRBVS, it remains uncertain whether these dietary factors are direct causes of HRBVS. Prospective studies or randomized controlled trials are needed to further validate these findings. Furthermore, although the sample size of this study is relatively large, encompassing patients from multiple regions in China, there may still be some selection bias. This bias may stem from convenience sampling methods during patient recruitment and the uneven geographical distribution of clinical research centers involved in the study. These factors may limit the broad applicability of the study results. Lastly, despite considering various potential confounding factors in our analysis, there may still be other unmeasured or unknown confounding variables influencing the results. These factors may include genetic factors, environmental factors, and physiological differences among individuals. Therefore, caution is needed when interpreting and generalizing the findings of this study, taking into account these potential limitations.

In summary, while this study provides valuable insights into the relationship between dietary patterns and HRBVS in coronary heart disease, further research is required to validate and expand upon these findings. Future studies should focus particularly on the universality of diagnostic criteria, inference of causality, sample representativeness, and control of potential confounding variables.

Conclusions

This cross-sectional study demonstrates that dietary habits are closely associated with the occurrence of Heat Retention in Blood Vessel Syndrome (HRBVS) in coronary heart disease patients. Preference for spicy, greasy, and cold foods, as well as irregular eating habits, significantly increases HRBVS risk. Conversely, good dietary habits and regular meal timings reduce this risk. Identifying and intervening in these dietary factors could improve CHD prognosis.

Highlights

1. Irregular Eating Habits Elevate HRBVS Risk in CHD Patients: Our study reveals that individuals with irregular eating habits exhibit a higher risk of developing HRBVS compared to those with regular meal timings.
2. Spicy and Greasy Foods Significantly Increase HRBVS Risk: Consumption of spicy and greasy foods is associated with a notably elevated risk of HRBVS, with odds ratios ranging from 1.29 to 1.75 times higher compared to individuals who do not frequently consume these foods.
3. Good Eating Habits and Regular Meal Timings Reduce HRBVS Risk: Positive dietary habits and consistent meal timings are associated with a substantially lower risk of HRBVS among CHD patients.
4. Skipping Breakfast and Irregular Eating Patterns Heighten HRBVS Risk: Our findings underscore that skipping breakfast or maintaining irregular eating patterns increases the risk of HRBVS by 1.35 times.

Data Sharing Statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding authors.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the Institute of Basic Theory for Traditional Chinese Medicine, China Academy of Chinese Medical Sciences, in September 2016 (2016EC_KY_001). We obtained written informed consent from the family members of competent patients who understood the trial description.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors have no conflicts of interest to disclose in this work.

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