

# Body Constitution and Unhealthy Lifestyles in a Primary Care Population at High Cardiovascular Risk: New Insights for Health Management

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**Background:** Adherence to lifestyle recommendations remains insufficient in cardiovascular (CV) health management globally. Body constitution, from the perspective of traditional Chinese medicine, is primarily influenced by an individual's internal metabolism and susceptibility to external pathogenic factors. Nevertheless, less is known about whether body constitutions may play a role in the presence of unhealthy lifestyles. We aimed to explore the associations between body constitutions and unhealthy lifestyles among Chinese individuals at high CV risk.

**Methods:** Computerised data were retrieved from a primary care population-based health record for all 1739 eligible individuals at high CV risk who attended routine check-up in an urbanised, medium-size district in Guangzhou, China. Unhealthy lifestyles were determined in accordance with guideline recommendations. The body constitution was assessed on the basis of physical signs, personality, body symptoms, and the susceptibility to environmental changes, following nationally standard procedure. Binary logistic regression analyses were performed using marginal standardisation method.

**Results:** The participants ranged in age from 20 to 96 years, with a mean age of 69.55 years. There were slightly more females than males (52.3% vs 47.7%). Current smoking, regular drinking, and physical inactivity were most common. Participants with a body constitution of phlegm-and-dampness type (adjusted odds ratio [aOR]=1.999, 95% confidence interval [CI]=1.003–3.984;  $p=0.049$ ) tended to be current smokers, and those assessed with special diathesis type (aOR=2.166, 95% CI=1.029–4.559;  $p=0.042$ ) had a higher likelihood of being regular drinkers. Having a body constitution type of blood stasis (aOR=1.375, 95% CI=1.029–1.838;  $p=0.031$ ) or qi deficient (aOR=1.711, 95% CI=1.080–2.709;  $p=0.022$ ) was associated with physical inactivity.

**Conclusion:** Our findings add to current evidence suggesting that an individual's body constitution is closely related to the presence of unhealthy lifestyles. This offers new insights for health management through body constitution-based strategies to target those at high CV risk who need tailor-made attention in lifestyle modifications during routine primary care.

**Keywords:** body constitution, unhealthy lifestyles, association, primary care, cardiovascular health management

## Introduction

Cardiovascular disease (CVD) represents enormous challenges to global population health.<sup>1</sup> Evidence confirms that healthy lifestyle choices could substantially reduce cardiovascular (CV) risks,<sup>2</sup> and that effective lifestyle modifications can delay subsequent need for pharmacological treatment or augment the CV risk-lowering effect.<sup>3,4</sup>

Smoking cessation, reduction of alcohol consumption, and regular aerobic exercises may probably serve as the most effective and cornerstone approaches to tackle CVD.<sup>5</sup>

However, the constancy of lifestyle recommendations over time remains insufficient worldwide.<sup>6–8</sup> Barriers may include a lack of social support, insufficient knowledge, negative emotions or health beliefs, resource constraints, underestimation of risk perception, and unfavourable culture preferences.<sup>9,10</sup> Beyond these commonly reported triggers, a wealth of literature has also documented the contribution of complementary and alternative medicine in the prevention and control of CVD.<sup>11,12</sup> Body constitution, from the perspective of traditional Chinese medicine, is influenced by one's internal metabolism and susceptibility to external pathogenic factors, manifesting individual health state. It differentiates how individuals feel and behave, and ultimately affects how different bodies respond to causes of disease.<sup>13–15</sup> Given the continuing challenges towards primary prevention and control of CVD, it remains largely unknown whether body constitutions may play a role in the presence of unhealthy lifestyles.

The study aimed to explore the associations between body constitutions and unhealthy lifestyles among primary care population at high CV risk. The study tested the null hypothesis that body constitutions were not associated with current smoking, regular drinking, or physical inactivity.

## Methods

### Study Design and Data Source

This study was a cross-sectional analysis of a Chinese population-based health record routinely managed in the context of the national basic public health (BPH) service delivery in primary care settings.<sup>16–18</sup> The National Health Commission of China requires all community health centres (CHCs) to provide free-of-charge, annual check-up with lifestyle advices offered to adults diagnosed with hypertension or type 2 diabetes, and 65-and-older population, who are primary care service users in the neighbourhood. The check-up reports were documented electronically by CHC public health staff. Computerised data were retrieved at a CHC in an urbanised, medium-size district in Guangzhou, China. The CHC serves a total of 22 neighbourhoods with a resident population size of 84 thousand, including approximately 5% who are eligible for annual check-up.

### Sample Size and Study Participants

The minimum sample size of the source population, from which the target participants were drawn, was estimated based on a single proportion formula:  $N = z^2 p(1-p)/d^2$  where  $z$  is the upper  $\alpha/2$  point of the normal distribution,  $p$  is the population proportion, and  $d$  is the precision.<sup>19</sup> The parameters ( $\alpha=0.05$ ,  $z=1.96$ ,  $p=0.103$ , and  $d=10\%$  of  $p$ ) were set based on a recent nationwide, population-based, large cohort study in China which reported a standardised prevalence of 10.3% of Chinese adults having high CV risk.<sup>20</sup> From the above calculation, a source population having a sample size of 3346 would be sufficient to meet the criteria.

A total of 3852 individuals attended the annual check-up in 2019. The target participants were primary care population at high (including very high) CV risk assessed in accordance with the clinical guideline.<sup>21</sup> Participants with any of the following were regarded as having high CV risk: (i) Systolic blood pressure (SBP)/diastolic blood pressure (DBP) 130–159/85–99 mmHg with co-presence of any physician-diagnosed hypertension-mediated organ damage, or  $\geq 3$  CV risk factors, or chronic kidney disease grade  $\geq 3$ , or diabetes mellitus; (ii) SBP/DBP 160–179/100–109 mmHg with  $\geq 1$  CV risk factors; or (iii) SBP/DBP  $\geq 180/110$  mmHg. Computerised data of a total of 1739 participants who fulfilled the eligibility criteria were retrieved from the routine BPH data platform.

### Study Variables and Data Collection

A standard questionnaire derived from the national guideline was administered by the CHC healthcare staff to collect information on age, sex, and unhealthy lifestyles determined following national guidelines.<sup>16,21</sup> Current smokers were defined as people who smoked at least one cigarette per day.<sup>21</sup> Regular drinkers referred to those who frequently engaged in alcohol drinking for more than an equivalent of 25 g (for male) or 15 g (for female) of daily alcohol consumption,<sup>21</sup> or for  $\geq 4$  days per week.<sup>16</sup> Participants who did not achieve  $\geq 30$  minutes of active, moderate aerobic exercise in leisure time with faster heart beats and heavier breathing on 5 days per week on average were regarded as physical inactivity.<sup>21</sup>

BP was measured at a seated position using routinely validated automatic sphygmomanometers. The arm with the higher BP values was used. An average of two BP readings, 1–2 min apart, was recorded. The fasting plasma glucose was determined by enzymatic methods based on routine operating procedures. Lipid profiles were directly

measured using an automated analyzer (Mindray BS-800 Analyzer, China). All the anthropometric measurements and laboratory tests were subject to internal quality control in accordance with clinical standard.

## Assessment of Body Constitution

The assessment of body constitution was based on physical signs, personality, body symptoms, and the susceptibility to environmental changes. A standard set of questionnaire items with a 5-point Likert-type scale has been widely used in routine primary care following the guideline implementation.<sup>22</sup> Individuals can be classified into one or more constitution types. All item scores reported by participants were inputted by the attending practitioner into a software for immediate results. A brief example of the body constitution assessment is shown in Appendix A ([Supplementary Tables S1](#) and [S2](#)). The concise descriptions of the nine body constitution types are as follows:

- Neutral type: Individuals who are physically fit, emotionally stable, energetic, adaptable to environmental changes, and have good sleep habits and healthy appetite. This is the most balanced body constitution.
- Yin deficient type: Individuals who often complain about feeling warm in the palms of the hands and soles of the feet, especially at night, and have dry mouth and nose, dry stools or constipation, and an aversion to hot and dry weather.
- Yang deficient type: Individuals who have an aversion to cold and humidity, often complain about feeling cold at the hands, feet and abdomen, and feel unwell after eating cold food.
- Phlegm-dampness type: Individuals who are prone to excessive sebum secretions on the face and scalp, excessive phlegm production, heavy limbs, lethargy, chest tightness, cravings for food rich in fat and sugars, and have an aversion to humid and wet weather.
- Blood stasis type: Individuals who are prone to forgetfulness, irritability, bleeding disorders and abnormal growths in the body, and often have dull complexion and pigmentation on the skin, dark-coloured lips, unknown bruising, and an aversion to cold weather.
- Qi deficient type: Individuals who are prone to panting, easily fatigued, susceptible to the common cold or flu bug, and are easily affected by changes in weather or perspiring easily with little physical

activity. These individuals usually take a longer time to recover from illness.

- Qi stagnation type: Individuals who are prone to mood swings, anxiety and depression, excessive sighing, palpitations, and have an aversion to autumn, winter and rainy seasons, and cope poorly to stress.
- Damp heat type: Individuals who are prone to excessive secretions or dampness at reproductive organs, feel fatigued and exhaustion; have acne on the face and neck, a sense of incomplete defecation or dry stools, and an aversion to warm and humid weather, and often complain of a bitter taste in the mouth.
- Special diathesis type (or intrinsic type): Individuals who have inherent sensitivity to certain drugs, foods, scents, or other allergens, and often have allergies that affect the respiratory system and skin, and are often sensitive to changes in temperature, weather, and seasons.

## Statistical Analyses

Frequencies, percentages, and mean values with standard deviation (SD) were used for descriptive analysis. Binary logistic regression analysis was conducted to examine associations between body constitutions and each of the three commonly reported unhealthy lifestyles in the study. Following a conventional technique, the univariate analysis was performed in the first instance. Predictor variables with respect to demographics, lifestyles, anthropometric and clinical parameters that were statistically significant in the univariate model, as well as all body constitution types, were entered into the multivariable model. Sensitivity analyses for binary logistic regression models were also performed with all predictor variables included to examine whether the inclusion of additional variables could improve model fit. Both crude and adjusted odds ratios (aORs) were reported with 95% confidence interval (CI). A  $p$  value  $<0.05$  was considered statistically significant. The predicted probabilities of unhealthy lifestyles were calculated using the marginal standardisation approach, which was considered appropriate for making inference on the overall source population where the study sample was drawn.<sup>23</sup> All analyses were conducted in Stata 15.1 (StataCorp, TX).

## Ethics Consideration

All participants provided written consent. Data anonymisation was performed by removing all subject identifiers from the dataset prior to data analysis. Ethics approval was

granted from the School of Public Health Biomedical Research Ethics Review Committee at Sun Yat-Sen University (Ref: SYSUSPH-2019067) in accordance with the Declaration of Helsinki 2013.

## Results

### Characteristics of Participants

The analysis included data of 1739 primary care participants with complete information. Participants ranged in age from 20 to 96 years, with a mean age of 69.55 (SD 8.31) years. There were slightly more females than males (52.3% vs 47.7%). Approximately one in ten (9.3%) participants were current smokers, whilst nearly one fifth (17.4%) were regular drinkers. More than one fourth (26.3%) were physical inactive. The mean SBP and DBP were 143.09 (SD 12.97) mmHg and 84.45 (SD 9.63) mmHg, respectively. The mean body mass index (25.01 kg/m<sup>2</sup>) was slightly above the normal range<sup>21</sup> (18.5–23.9 kg/m<sup>2</sup>), and the control of plasma lipid levels with regard to the triglycerides (1.75 mmol/L; reference range<sup>21</sup> <1.7 mmol/L) and plasma cholesterol levels (5.43 mmol/L; reference range<sup>21</sup> <5.2 mmol/L) were suboptimal (Table 1).

### Characteristics of Body Constitutions

Among all participants, less than one fifth (17.0%) had a neutral type of body constitution deemed as physically fit, emotionally stable, energetic, and adaptable to external environmental changes. The most prevalent type of non-neutral body constitution was phlegm-and-dampness, which was found in nearly two thirds (61.7%) of participants, followed by the yin deficient type (22.7%) and blood stasis type (17.4%) (Figure 1).

### Factors Associated with Commonly Reported Unhealthy Lifestyles

Fitting univariate and multivariable binary logistic regression models, current smoking was used as the dichotomous dependent variable and it was found that a phlegm-and-dampness constitution type (aOR=1.999, 95% CI=1.003–3.984; *p*=0.049) was associated with the presence of current smoking after adjusting for the effect of other predictor variables (Table 2). Similarly, in the regression model where regular drinking was used as the dichotomous dependent variable, it was found that participants with the special diathesis type (aOR=2.166, 95% CI=1.029–4.559; *p*=0.042) were more likely to be regular

**Table 1** Demographics, Lifestyles and Clinical Parameters of Study Participants

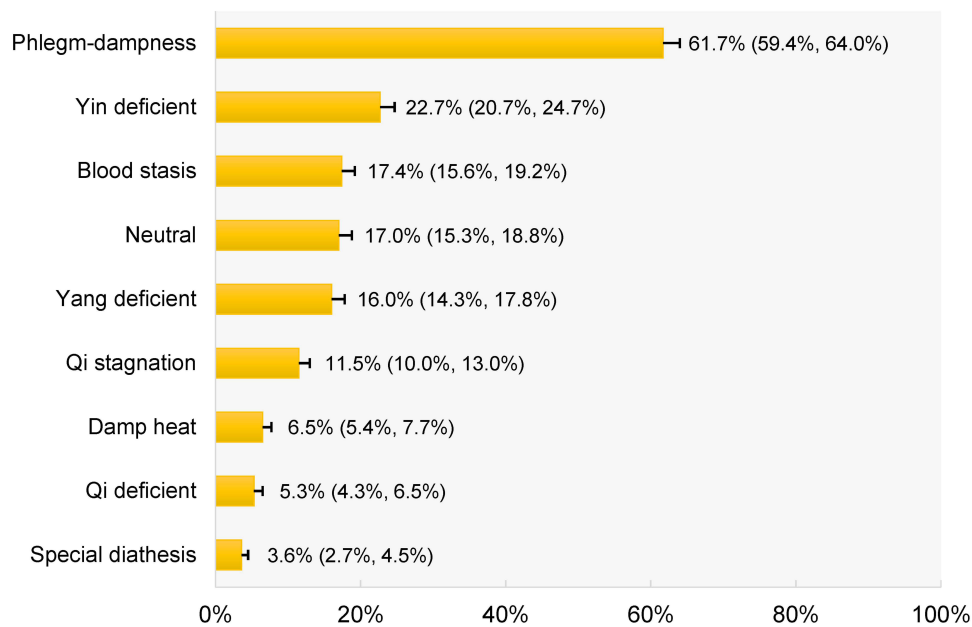
Variables	All Participants
<b>Demographics and lifestyles</b>	
Age, mean (SD), years	69.55 (8.31)
Female, n (%)	910 (52.3)
Current smoking, n (%)	161 (9.3)
Regular drinking, n (%)	302 (17.4)
Physical inactivity, n (%)	458 (26.3)
<b>Anthropometric measurements</b>	
Height, mean (SD), cm	160.63 (9.00)
Weight, mean (SD), kg	64.74 (10.88)
Waist, mean (SD), cm	88.32 (8.43)
BMI, mean (SD), kg/m <sup>2</sup>	25.01 (3.08)
<b>Blood pressure</b>	
Systolic BP, mean (SD), mmHg	143.09 (12.97)
Diastolic BP, mean (SD), mmHg	84.45 (9.63)
<b>Fasting lipid profile</b>	
TC, mean (SD), mmol/L	5.43 (1.12)
TG, mean (SD), mmol/L	1.75 (1.20)
LDL cholesterol, mean (SD), mmol/L	3.29 (0.91)
HDL cholesterol, mean (SD), mmol/L	1.37 (0.37)
<b>Fasting blood glucose</b>	
FPG, mean (SD), mmol/L	6.44 (1.97)

**Abbreviations:** SD, standard deviation; BMI, body mass index; BP, blood pressure; TC, total cholesterol; TG, triglycerides; LDL, low density lipoprotein; HDL, high density lipoprotein; FPG, fasting plasma glucose.

drinkers (Table 3). It was also found that the blood stasis type (aOR=1.375, 95% CI=1.029–1.838; *p*=0.031) and qi deficient type (aOR=1.711, 95% CI=1.080–2.709; *p*=0.022) were significantly associated with physical inactivity in the fitted univariate and multivariable binary logistic regression models (Table 4). Sensitivity analyses with all predictor variables included in the binary logistic regression models did not improve model fit. The strength and direction of the associations determined from the main analysis remained largely unchanged in the sensitivity analysis.

### Body Constitutions and Predicted Probabilities of Unhealthy Lifestyles

The predicted probabilities (%) of different types of body constitutions falling into categories of current smoking, regular drinking, or physical inactivity, respectively, were yielded from the aforementioned multivariable logistic regression models fitted in the main analysis (Tables 2–4).



**Figure 1** Profile of body constitutions of participants.

**Notes:** The sum of percentages exceeded 100% as one or more body constitutions may present concurrently within an individual. Error bars indicated the upper boundary of the 95% confidence intervals.

The raw data on predicted probabilities reported for three decimal places ([Supplementary Table S3](#); [Appendix B](#)) were multiplied by 100 and rounded to the nearest integer. Results were presented in a three-colour scale drawing where all cells were coloured proportionally from green (ie, the lowest probability) to red (ie, the highest probability). For example, a qi deficient woman had a predicted probability of physical inactivity about 2 times that of a man with damp heat type of body constitution ([Figure 2](#)).

## Discussion

### Main Findings

This study adds to the evidence suggesting that unhealthy lifestyles inclusive of current smoking, regular drinking, and physical inactivity were closely related to individual's body constitutions. Participants with a body constitution of phlegm-and-dampness type tended to be current smokers, and those who were assessed with special diathesis type had a higher likelihood of being regular drinkers. The blood stasis type and qi deficient type of body constitutions were associated with inadequate physical activities.

### Relationship with Other Studies

The relationships between unhealthy lifestyles and increased CV risks have been demonstrated in different populations worldwide.<sup>24–27</sup> A number of CVD prevention

programmes, such as the Public Health England CVD Ambitions,<sup>28</sup> have placed equivalent emphasis on long-term lifestyle management and health behaviour change as core and fundamental components.<sup>29</sup> Personalised support and access to stop smoking, physical activity and alcohol reduction services are actively available in the National Health Service Health Check to support early diagnosis and disease management.<sup>28</sup> Compared to the US National Health Interview Survey (NHIS),<sup>30</sup> the Dutch Monitoring Project on Risk Factors for Chronic Diseases (MORGEN),<sup>31</sup> and the China Health and Retirement Longitudinal Study (CHARLS),<sup>32</sup> our study population reported a relatively lower prevalence of smoking, drinking, and physical inactivity. This, however, implies that the use of body constitutions, when extended to the general population at large, may carry greater public health implications for informing unhealthy lifestyles.

Previous investigations have elaborated on the physiological and psychological mechanism by which body constitution relates to the development and prognosis of diseases.<sup>13–15,33</sup> However, it is noteworthy that our main purpose is not to replicate existing findings or re-evaluate the relationship between body constitutions and CVD events per se. Instead, from the standpoint of preventive healthcare, our interest is to assess whether body constitutions may be associated with unhealthy lifestyles that are most prevalent in primary care population at high CV risk.

**Table 2** Binary Logistic Regression Analysis of Factors Associated with Current Smoking

	Univariate Model		Multivariable Model*	
	cOR (95% CI)	P	aOR (95% CI)	P
Age, yrs*	0.948 (0.932, 0.965)	<0.001	0.962 (0.940, 0.984)	0.001
Female*	0.005 (0.001, 0.033)	<0.001	0.005 (0.001, 0.039)	<0.001
Regular drinking*	7.230 (5.140, 10.172)	<0.001	3.004 (2.067, 4.366)	<0.001
Physical inactivity*	1.513 (1.072, 2.136)	0.019	2.195 (1.456, 3.309)	<0.001
Waist, cm*	1.024 (1.005, 1.044)	0.013	0.962 (0.937, 0.989)	0.005
BMI, kg/m <sup>2</sup>	0.978 (0.927, 1.031)	0.412	–	–
SBP, mmHg	0.992 (0.979, 1.005)	0.210	–	–
DBP, mmHg*	1.033 (1.016, 1.050)	<0.001	0.985 (0.962, 1.007)	0.180
TG, mmol/L	1.072 (0.952, 1.207)	0.251	–	–
LDL-C, mmol/L	0.930 (0.776, 1.116)	0.437	–	–
FPG, mmol/L	0.992 (0.912, 1.079)	0.849	–	–
Neutral	0.710 (0.440, 1.144)	0.159	1.332 (0.589, 3.016)	0.491
Yin deficient	1.186 (0.815, 1.726)	0.372	1.437 (0.907, 2.276)	0.122
Yang deficient	0.592 (0.352, 0.996)	0.048	1.103 (0.572, 2.126)	0.769
Phlegm-dampness	1.972 (1.350, 2.880)	<0.001	1.999 (1.003, 3.984)	0.049
Blood stasis	0.862 (0.552, 1.348)	0.516	1.322 (0.774, 2.257)	0.306
Qi deficient	0.426 (0.154, 1.175)	0.099	0.676 (0.216, 2.114)	0.501
Qi stagnation	0.429 (0.215, 0.855)	0.016	0.597 (0.272, 1.311)	0.198
Damp heat	1.061 (0.557, 2.021)	0.858	1.144 (0.528, 2.478)	0.733
Special diathesis	0.667 (0.239, 1.863)	0.440	1.079 (0.329, 3.540)	0.900

**Notes:** \*Independent variables pertaining to demographics, lifestyles, anthropometric measures, and clinical parameters that were statistically significant in the univariate logistic regression model, as well as all body constitution types, were entered into the multivariable logistic regression model. Dependent variable: the presence of current smoking (yes versus no).

**Abbreviations:** cOR, crude odds ratio; aOR, adjusted odds ratio; CI, confidence interval; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; TG, triglycerides; LDL-C, low density lipoprotein-cholesterol; FPG, fasting plasma glucose.

To our knowledge, such an association has not been thoroughly investigated. Our data exhibited a positive correlation between cigarette smoking and alcohol drinking. This is consistent with data from other populations worldwide, such as the Latin Americans and Caucasians,<sup>34–36</sup> which may suggest a possible wider generalisability of our study findings.

## Meaning of the Study

In our study, we speculate that the underlying nature of certain body constitutions might play a role in presenting character traits, which predispose one to unhealthy lifestyles. The qi deficient type of body constitution is often characterised by breathlessness, feeling tired easily, sweating spontaneously, perspiring easily with little physical activity, and a tendency to catch cold. This echoes the findings of our study, which indicated that qi deficient participants tended to have inadequate exercises. Recommendations therefore include efforts to ensure adequate sleep and keep warm at all times; avoid windy areas after strenuous exercises, and practice mild exercises such as brisk walks regularly. Meanwhile, our results also

revealed that blood stasis individuals were prone to have physical inactivity. This might be explained by the difficulty in maintaining a smooth flow of energy in meridian pathways throughout the body.<sup>22</sup> Advice offered to participants of this group may include carrying out activities, such as Tai Chi or dancing that help promote blood circulation.

The special diathesis constitution is often characterised by a predisposition of the body to allergens-induced conditions.<sup>13,14</sup> The significant association observed between the special diathesis constitution and regular drinking is in line with a recent UK investigation, which reported that patients with inflammatory skin diseases tended to be frequent heavy alcohol drinkers, and were consequently at risk of developing alcohol use disorders.<sup>37</sup> A bidirectional relationship may exist, meaning that regular drinking could be either a consequence or a trigger of psychological distress. Special diathesis participants may suffer from impaired quality of life due to the propensity to skin allergies, and this could promote alcohol abuse. Maintaining good personal hygiene and a well-ventilated, clean living environment are equally important as countermeasures.

**Table 3** Binary Logistic Regression Analysis of Factors Associated with Regular Drinking

	Univariate Model		Multivariable Model*	
	cOR (95% CI)	P	aOR (95% CI)	P
Age, yrs*	0.951 (0.938, 0.965)	<0.001	0.975 (0.956, 0.993)	0.008
Female*	0.099 (0.070, 0.141)	<0.001	0.162 (0.109, 0.241)	<0.001
Current smoking*	7.334 (5.485, 9.805)	<0.001	3.023 (2.185, 4.182)	<0.001
Physical inactivity*	0.729 (0.541, 0.981)	0.037	0.720 (0.510, 1.015)	0.061
Waist, cm*	1.035 (1.020, 1.051)	<0.001	1.004 (0.984, 1.025)	0.691
BMI, kg/m <sup>2</sup>	1.024 (0.984, 1.066)	0.245	–	–
SBP, mmHg*	0.983 (0.973, 0.993)	0.001	0.987 (0.975, 0.999)	0.040
DBP, mmHg*	1.035 (1.021, 1.048)	<0.001	1.015 (0.996, 1.035)	0.132
TG, mmol/L	1.078 (0.982, 1.184)	0.115	–	–
LDL-C, mmol/L	0.927 (0.806, 1.065)	0.284	–	–
FPG, mmol/L	0.998 (0.937, 1.063)	0.953	–	–
Neutral	0.704 (0.492, 1.009)	0.056	0.624 (0.348, 1.117)	0.112
Yin deficient	0.840 (0.617, 1.142)	0.265	0.734 (0.506, 1.065)	0.104
Yang deficient	0.665 (0.457, 0.967)	0.033	0.862 (0.536, 1.384)	0.537
Phlegm-dampness	1.609 (1.223, 2.117)	0.001	0.844 (0.522, 1.366)	0.490
Blood stasis	0.804 (0.570, 1.136)	0.216	1.094 (0.730, 1.641)	0.664
Qi deficient	0.625 (0.329, 1.188)	0.152	0.887 (0.424, 1.859)	0.751
Qi stagnation	0.587 (0.373, 0.924)	0.021	0.734 (0.432, 1.248)	0.254
Damp heat	1.164 (0.718, 1.887)	0.539	1.287 (0.721, 2.297)	0.393
Special diathesis	1.276 (0.683, 2.383)	0.445	2.166 (1.029, 4.559)	0.042

**Notes:** \*Independent variables pertaining to demographics, lifestyles, anthropometric measures, and clinical parameters that were statistically significant in the univariate logistic regression model, as well as all body constitution types, were entered into the multivariable logistic regression model. Dependent variable: the presence of regular drinking (yes versus no).

**Abbreviations:** cOR, crude odds ratio; aOR, adjusted odds ratio; CI, confidence interval; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; TG, triglycerides; LDL-C, low density lipoprotein-cholesterol; FPG, fasting plasma glucose.

Lethargy, heavy limbs, phlegm production, chest tightness, and an aversion to humid and wet weather are common characteristics of phlegm-and-dampness constitution. Our results revealed a close relationship between phlegm-and-dampness constitution and smoking. As smoking could lead to significant side effects such as phlegm production and chest tightness, symptoms seen in phlegm-and-dampness participants may be attributable to frequent tobacco consumption. It may be reasonable to speculate that participants who often feel lethargy or heavy limbs may experience enjoyment of smoking as a self-medication for boredom.<sup>38</sup> They may necessitate close attention from primary care physicians to understand smoking initiation and relapse, and could be targeted as a priority group in smoking cessation interventions.

## Strengths and Weaknesses of the Study

We collected data from a population sample of primary care service users of all ages to yield new insights for cardiovascular health management through body constitution-based strategies. Our results offer an innovative

approach towards targeting those who need tailor-made attention in CV health-related lifestyle modifications in routine primary care. All data were retrieved from a computerised routine BPH platform to ensure data completeness and accuracy. However, our study had several limitations. First, the study was conducted in a single, medium-size district with a dense population. This may affect the generalisability of our findings, although we ensured a full age spectrum of participants. Second, we did not capture lifestyle behaviours that are not routinely evaluated in primary care, such as dietary intake, recreational drug use, and sleep history. Third, the reliance on self-report of lifestyles may be subject to recall bias, although we used dichotomous outcomes to minimise the extent to which information may deviate from objective measures. Fourth, factors such as education, socio-economic status, and patients' engagement in healthcare may also play a role but were not captured in the study due to the absence of these variables in the data source. Moreover, a cause-and-effect relationship could not be established given the cross-sectional nature. The

**Table 4** Binary Logistic Regression Analysis of Factors Associated with Physical Inactivity

	Univariate Model		Multivariable Model*	
	cOR (95% CI)	P	aOR (95% CI)	P
Age, yrs	0.994 (0.981, 1.007)	0.336	–	–
Female*	1.387 (1.118, 1.721)	0.003	1.597 (1.220, 2.091)	0.001
Current smoking*	1.513 (1.072, 2.136)	0.019	2.279 (1.531, 3.395)	<0.001
Regular drinking*	0.729 (0.541, 0.981)	0.037	0.727 (0.518, 1.021)	0.066
Waist, cm*	1.025 (1.012, 1.039)	<0.001	1.019 (0.997, 1.041)	0.098
BMI, kg/m <sup>2</sup> *	1.084 (1.047, 1.122)	<0.001	1.048 (0.987, 1.112)	0.125
SBP, mmHg	1.004 (0.995, 1.012)	0.386	–	–
DBP, mmHg	1.009 (0.998, 1.020)	0.127	–	–
TG, mmol/L	1.046 (0.960, 1.139)	0.304	–	–
LDL-C, mmol/L	1.009 (0.897, 1.135)	0.885	–	–
FPG, mmol/L	1.010 (0.957, 1.065)	0.722	–	–
Neutral	0.791 (0.589, 1.063)	0.120	1.507 (0.975, 2.330)	0.065
Yin deficient	1.145 (0.891, 1.471)	0.290	1.234 (0.924, 1.649)	0.155
Yang deficient	1.309 (0.989, 1.731)	0.059	1.390 (0.993, 1.944)	0.055
Phlegm-dampness	1.418 (1.128, 1.782)	0.003	1.256 (0.872, 1.808)	0.221
Blood stasis	1.468 (1.123, 1.920)	0.005	1.375 (1.029, 1.838)	0.031
Qi deficient	1.988 (1.296, 3.051)	0.002	1.711 (1.080, 2.709)	0.022
Qi stagnation	1.277 (0.926, 1.760)	0.136	1.130 (0.796, 1.604)	0.494
Damp heat	1.096 (0.717, 1.675)	0.671	0.843 (0.535, 1.326)	0.459
Special diathesis	1.043 (0.591, 1.842)	0.883	0.852 (0.465, 1.563)	0.605

**Notes:** \*Independent variables pertaining to demographics, lifestyles, anthropometric measures, and clinical parameters that were statistically significant in the univariate logistic regression model, as well as all body constitution types, were entered into the multivariable logistic regression model. Dependent variable: the presence of physical inactivity (yes versus no).

**Abbreviations:** cOR, crude odds ratio; aOR, adjusted odds ratio; CI, confidence interval; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; TG, triglycerides; LDL-C, low density lipoprotein-cholesterol; FPG, fasting plasma glucose.

possibility of the bidirectional relationships between body constitutions and unhealthy lifestyles cannot be ruled out, despite the fact that it carries social and behavioural implications to assume that unhealthy lifestyles serve as the consequences. This would necessitate future prospective, nationally representative studies that extend the coverage of participants with the assistance of remote symptom monitoring to capture various components of CV health-related lifestyles in long-term follow-up. Last but not least, our study results should be interpreted with caution as the concept of body constitution types may be debatable and current guidelines with respect to these concepts are based mainly on expert opinions, position statements and unpublished knowledge. For example, the term “blood stasis” is understood differently in the Western medicine compared to that in the traditional Chinese medicine, which may be due to physiological variations, terms used and language translations, and cultural differences in medical practices.<sup>39</sup> However, it is worth noting that a comparison in the classification modalities of body constitution per se was not the aim of our

study. Instead, we are more interested in determining whether body constitutions were associated with unhealthy lifestyles among individuals at high CV risk given the continuing challenges in primary prevention and control of CVD.<sup>2</sup>

## Implications for Clinical Practice

Individuals' non-adherence to healthy lifestyles could jeopardise the efficiency of healthcare and predispose patients to CV disease progressing. The body constitutions determined from a rapid, easily performed assessment suggested a likelihood of individuals having unhealthy lifestyles. Furthermore, it provides early indications that could be linked to the mechanism for the difficulties experienced in maintaining recommended lifestyles. Alongside routine clinical assessment and regular health education, additional primary care efforts could be made to examine patients' body constitutions. This approach could be delivered in a manner whereby individuals at greater risks of unhealthy lifestyles are prioritised. Our work sheds light, furthermore, on the opportunity to ensure that individuals at high CV risk are



MEN				WOMEN		
Current Smoking	Regular Drinking	Physical Inactivity		Current Smoking	Regular Drinking	Physical Inactivity
23	25	30	Neutral	<1	3	37
23	27	26	Yin deficient	<1	3	33
22	29	29	Yang deficient	<1	4	35
24	31	24	Phlegm-dampness	<1	4	32
21	32	28	Blood stasis	<1	5	35
13	29	34	Qi deficient	<1	4	41
15	27	25	Qi stagnation	<1	4	31
22	38	21	Damp heat	<1	6	27
22	46	21	Special diathesis	<1	8	27

#### Interpretation

- A man with Phlegm-dampness type of body constitution had a predicted probability of current smoking about 2 times that of a man with Qi deficient type of body constitution (24% vs 13%).
- A woman with Special diathesis type of body constitution had a predicted probability of regular drinking about 3 times that of a woman with Neutral type of body constitution (8% vs 3%).
- A woman with Qi deficient type of body constitution had a predicted probability of physical inactivity about 2 times that of a man with Damp heat type of body constitution (41% vs 21%).

**Figure 2** Predicted probabilities of current smoking, regular drinking, and physical inactivity by body constitutions.

**Notes:** Predicted probabilities (%) of unhealthy lifestyles were estimated using the marginal standardisation method from the multivariable logistic regression models, which adjusted for the effects of other predictor variables.

offered timely attention and tailor-made health management, helping to achieve the national and international goals in CVD prevention and control.

## Conclusion

This study adds value to the evidence suggesting that an individual's body constitution is related to the presence of unhealthy lifestyles in a sample of primary care population with high CV risk. Participants with a body constitution of phlegm-and-dampness type tended to be current smokers, and those who were assessed with a special diathesis type had a higher likelihood of being regular drinkers. The blood stasis type and qi deficient type of body constitutions were associated with inadequate physical activities. Our results offer new insights for health management through body constitution-based strategies to target those who need tailor-made attention in lifestyle modifications during routine primary care.

## Data Sharing Statement

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

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## Disclosure

The authors report no conflicts of interest in this work.

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