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Original Article

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Traditional Chinese medicine body constitution and sleep quality

Peng Gao[1,†], Ji Wang[2,†], Yi-Hsuan Wu[1], Minghua Bai[2], April Myers[1], Qi Wang[2,*], Elizabeth Delzell[1], Clete A. Kushida[3], Dan Huang[4], Fei Yang[5,6], Wei He[5,6], Ying Lu[7], Shankuan Zhu[5,6] and Ann W. Hsing[1,8,9,*]

[1]Stanford Prevention Research Center, Department of Medicine, Stanford School of Medicine, Stanford University, Stanford, CA, USA, [2]National Institute of Traditional Chinese Medicine Constitution and Preventive Medicine, Beijing University of Chinese Medicine, Beijing, China, [3]Division of Sleep Medicine, Department of Psychiatry and Behavioral Sciences, Stanford School of Medicine, Stanford University, Stanford, CA, USA, [4]Binjiang Institute of Zhejiang University, Hangzhou, Zhejiang, China, [5]Chronic Disease Research Institute, The Children's Hospital, and National Clinical Research Center for Child Health, School of Public Health, School of Medicine, Zhejiang University, Hangzhou, China, [6]Department of Nutrition and Food Hygiene, School of Public Health, School of Medicine, Zhejiang University, Hangzhou, China, [7]Department of Biomedical Data Science, Stanford School of Medicine, Stanford University, Stanford, CA, USA, [8]Department of Epidemiology and Population Health, Stanford School of Medicine, Stanford, CA, USA and [9]Stanford Cancer Institute, Stanford School of Medicine, Stanford University, Stanford, CA, USA

*Corresponding authors. Qi Wang, National Institute of Traditional Chinese Medicine Constitution and Preventive Medicine, Beijing University of Chinese Medicine, Beijing 10029, China. Email: wangqi710@126.com; Ann W. Hsing, Stanford Prevention Research Center, Department of Medicine, Department of Epidemiology and Population Health, Stanford Cancer Institute, Stanford School of Medicine, Stanford University, 3180 Porter Drive, Palo Alto, CA 94304, USA. Email: annhsing@stanford.edu.
†These authors contributed equally to this work.

Abstract

Study Objectives: To investigate the relationships between Traditional Chinese Medicine (TCM) body constitution and sleep quality in a large population-based cohort.
Methods: This cross-sectional study included 8517 participants from the WELL China cohort. We used the Wang Qi Nine Body Constitution Questionnaire (WQ-9BC) to assess TCM body constitution and the Pittsburgh Sleep Quality Index (PSQI) to assess sleep quality. We used multivariable logistic regression analyses to estimate odds ratios (ORs) for the association between body constitution and poor sleep quality (PSQI score > 5), adjusting for demographics, lifestyle factors, and comorbidities.
Results: Compared with a balanced body constitution (1898; 22%), individuals with an unbalanced constitution had a 2.6-fold risk (95% CI = 2.3% to 3.0%), and those with an unbalanced tendency had a 1.5-fold risk of poor sleep quality (95% CI = 1.3% to 1.8%). All eight unbalanced constitutions were associated with a higher risk of poor sleep quality, with Qi stagnation (OR 4.0 [95% CI = 3.0% to 5.5%]) and blood stasis (OR 3.8 [95% CI = 2.3% to 6.2%]) having the highest ORs. About 52% of participants had multiple unbalanced constitutions and/or tendencies. The OR for poor sleep quality increased with the composite number of Yang deficiency, Yin deficiency, Qi deficiency, heat dampness, blood stasis, and Qi stagnation constitutions and/or tendencies.
Conclusions: All eight unbalanced constitutions are associated with poor sleep quality in a dose-dependent manner, with Qi stagnation and blood stasis displaying the strongest associations. Multiple unbalanced constitutions and/or tendencies are cumulatively associated with poor sleep quality. Identifying TCM body constitution could help in detecting high-risk groups and designing targeted interventions.

Key words: sleep quality; traditional Chinese medicine (TCM) body constitution; Pittsburgh Sleep Quality Index (PSQI); cerebral blood flow (CBF)

Statement of Significance

Poor sleep is a global public health concern with high prevalence and many adverse effects. Traditional Chinese medicine (TCM) body constitution has been widely used to personalize health care in China. Our study is the first to discover a dose–response relationship between the degree of imbalance in constitution and sleep quality, and a cumulative relationship between multiple unbalanced constitutions and/or tendencies and sleep quality. Considering that a large percentage of the population has unbalanced constitutions and/or tendencies, our findings have significant public health implications. Identifying TCM body constitutions may help target populations with an increased risk of poor sleep quality and guide the design of personalized interventions to improve sleep.

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Introduction

Poor sleep can negatively affect cognition, mood, and productivity, as well as workplace and road safety [1, 2]. Poor sleep quality (i.e. fragmented and/or light sleep despite allowing adequate time in bed for sleep) impairs immunity [3] and is associated with mental health disorders such as anxiety and depression [4], chronic health conditions such as cardiovascular disease, diabetes, and cancer, and higher overall mortality [3, 5]. Globally, poor sleep quality is a significant concern [6]. In Western countries, 36% of adults in Germany [7] and 32% in Australia [8] report poor sleep quality, and 28% of United States adults report insufficient sleep for 14–30 days per month [9]. In China, the prevalence of poor sleep quality varies across populations, with reported rates ranging from 21% to 50% depending on age and region [10–12]. A recent nationwide web-based survey of more than 100 000 adults found an age-adjusted prevalence of 21% [13]. Collectively, these findings underscore the urgent global need for effective strategies to improve sleep quality.

Traditional Chinese Medicine (TCM) interprets health from a holistic and systemic perspective through the frameworks of yin-yang, opposing energies that are complementary, interconnected, and interdependent, and the five elements (wood, fire, earth, metal, and water), which are dynamic states arising from yin-yang transformations [14, 15]. The five elements interact through the principles of mutual generation (*sheng*) and mutual restriction (*ke*), a continuous process of balance, transformation, and interdependence [16]. In this framework, the five *zang* (solid) organs (heart, liver, spleen, lung, and kidney) are fundamental functional systems regulated by Qi (vital energy), blood, and *jinye* (body fluids) [17]. These systems interact with innate (genetic) and acquired (environmental, lifestyle, etc.) factors to produce a relatively stable body state. This state is defined in TCM as the "body constitution," based on the body's morphological structure, physiological function, psychological state, and adaptive capabilities [18]. TCM defines optimal health as a state where yin and yang are balanced, and Qi and blood circulate smoothly [19]. Based on these factors, individuals can be classified into having a balanced body constitution, characterized by yin-yang balance and smooth circulation of Qi and blood, and eight unbalanced constitutions (Supplementary Table S1): Yang deficiency (insufficient warming of Qi), Yin deficiency (insufficient blood and/or body fluids), Qi deficiency (insufficient Qi), Phlegm dampness (abnormal water accumulation), heat dampness (abnormal heat and water accumulation), blood stasis (slowed or obstructed blood flow), Qi stagnation (blocked Qi flow), and allergic (dysregulation of the Qi involved in immune surveillance) [20, 21]. Unbalanced constitutions are suboptimal health states that leave one more susceptible to pathogens, noncommunicable diseases, and suboptimal drug responses [22]. Body constitution serves as the foundation for personalized healthcare, prevention, and treatment in TCM, determining the starting point for interventions by predicting how individuals may respond differently to the same pathogenic factor or therapeutic strategy [23]. Disease is believed to occur when a pathogen or environmental factors disrupt normal communication and unity among organs, tissues, and cells [15]. Body constitution acts as the "background" state of the overall body system, shaping disease susceptibility, symptom manifestation, response to treatment, and prognosis. Therefore, identifying an individual's constitution is essential for prescribing tailored lifestyle adjustments and medical interventions in TCM [23]. From a systems biology perspective, body constitution can be viewed as TCM's unique characterization of the fundamental steady states of a living system [24]. This framework has been increasingly applied in modern research, demonstrating the utility of TCM body constitution classification for disease risk prediction, health maintenance, and precision medicine [25].

Previous studies have explored the associations between body constitution and sleep quality. A case–control study of 169 participants classified individuals into balanced, Qi stagnation, and other unbalanced constitution groups and found that Qi stagnation was dose-dependently associated with difficulty falling asleep and early waking, and having another unbalanced constitution was associated with excessive dreaming [26]. A study of 411 elderly nursing home residents found that those with a balanced constitution had the lowest prevalence of poor sleep quality (33%), while higher prevalences were reported in those with heat dampness (83%), Qi stagnation (77%), and Qi deficiency (67%). However, after adjusting for multiple factors, only Qi stagnation remained associated with poor sleep quality [27]. A longitudinal study of 250 pregnant women assessed TCM constitution in the first trimester and found that women with an unbalanced constitution had a higher risk of nausea, vomiting, and poor sleep during pregnancy compared to those with a balanced constitution [28]. However, in this study, all eight unbalanced constitutions were combined into a single category, and the relationships between specific constitutions and sleep quality were not evaluated. Collectively, these studies were limited by relatively small sample sizes, were conducted in specialized populations, and did not clarify the relationships between specific TCM constitutions and sleep quality in general community populations or explore potential dose–response associations. They also did not examine the effects of having tendencies toward certain body constitutions. While having multiple unbalanced constitutions or tendencies, termed "composite constitutions," is common (prevalence >50% in some studies [29]), few studies have examined the cumulative effect of multiple constitutions or tendencies on sleep quality.

To better examine the associations of the eight individual TCM body constitutions with sleep quality in a general community population, and to investigate the cumulative effect of composite constitutions, we analyzed baseline data from a large population-based cohort of over 10 000 individuals in Hangzhou, China. We also performed stratified analyses to further explore potential variations by demographic subgroups.

Materials and Methods

Study population

Participants were from the WELL China cohort, a collaboration between Stanford University and Zhejiang University. Details of the baseline study are reported elsewhere [30]. Briefly, from November 2016 to May 2019, a total of 10 268 participants aged 18–80 years were recruited from Hangzhou, China. In Hangzhou, three districts (Xihu, Shangcheng, and Gongshu) were chosen due to their demographic characteristics and support from the local communities. Subdistricts and communities from each district were sampled using quota sampling according to the local household registration system, which covers all long-term residents (≥6 months). Participants for each district were stratified by sex (equal male and female quotas) and age group (18–39, 40–59, and 60–80 years), proportional to the age distribution of the community population.

The WELL China cohort study received Institutional Review Board (IRB) approval at Stanford University (protocol number IRB-35020) and approval from the Ethics Committee at Zhejiang

University School of Public Health (protocol number ZGL201507-3). Written informed consent was obtained from all participants.

Data collection

The baseline survey was conducted through face-to-face interviews by trained interviewers. The survey included questions on demographic factors (age, sex, education, income, work status, marital status), lifestyle behaviors (smoking status, drinking status, physical activity, sleep), medical history (diabetes, hypertension, cardiovascular disease, stroke, cancer), and TCM body constitution. Physical activity was assessed using the International Physical Activity Questionnaire [31], which categorized physical activity into low, moderate, and high levels. Height and weight were measured by trained professionals using standardized procedures. Measurements were taken three times per person, with the average value used for analysis. Height was measured to the precision of 0.1 cm. Weight was measured to the precision of 0.1 kg. Body mass index (BMI, kg/m^2) was calculated as weight (kg) divided by height (m) squared.

Assessment of sleep quality

We used the Pittsburgh Sleep Quality Index (PSQI) to assess sleep quality [32]. The PSQI has 19 items that contribute to an overall sleep quality index and seven component scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, sleep medication use, and daytime dysfunction. The score for each component ranges from 0 to 3, totaling to a PSQI score ranging from 0 to 21. A PSQI score greater than 5 is considered poor sleep quality [32]. For analyses of individual components of sleep quality, a component score of 1 or higher was defined as "poor." The Chinese version of the PSQI has been validated and shows good internal consistency (Cronbach's $\alpha = 0.82$–0.83) and test–retest reliability ($r = 0.77$–0.85), supporting its adaptation for use in Chinese populations [33–34].

Assessment of TCM body constitution

We used the 57-item Wang Qi Nine Body Constitution Questionnaire (WQ-9BC) to assess study participants' TCM body constitution [35]. The WQ-9BC questionnaire consists of nine subscales: balanced, Yang deficiency, Yin deficiency, Qi deficiency, Phlegm dampness, heat dampness, blood stasis, Qi stagnation, and Allergic constitution. Each item has five potential responses, ranging from "none" to "always" and scored from 1 to 5. Scores are calculated separately for each sub-scale. The sum of the items in each of the nine sub-scales results in the raw scores for each of the nine constitutions, which are then converted using the following formula:

$$\text{Converted Score} = \left[(\text{Raw Score} - \text{Number of Items}) / (\text{Number of Items} \times 4)\right] \times 100$$

The converted scores for each subscale range from 0 to 100 points, with higher scores indicating a more severe imbalance. The WQ-9BC was originally developed in China, and its psychometric properties are well-established, with internal consistency (Cronbach's $\alpha = 0.72$–0.80), test–retest reliability ($r = 0.76$–0.90), and criterion validity demonstrated through significant correlations with the SF-36 health survey ($r = 0.38$–0.58) [36].

Based on the converted scores and according to established TCM standards [21], the balanced constitution is defined as having a balanced constitution score of 60 or higher and scores under 30 for each of the eight unbalanced constitutions. An unbalanced constitution is defined as having an unbalanced constitution score of 40 or more, and an unbalanced tendency is defined as having an unbalanced constitution score between 30 and 39. In those with composite constitutions (multiple unbalanced constitutions and/or tendencies), the primary body constitution is defined as the one with the highest score. Figure 1 presents the flowchart of body constitution classification.

Exclusions

We excluded 1293 (12.6%) participants from the analysis due to missing data on the PSQI (N = 327), the WQ-9BC (N = 810), BMI (N = 13), income (N = 2), smoking status (N = 1), physical activity (N = 69), or comorbidity (N = 71), and 458 (4.5%) participants who could not be classified into any TCM body constitution or tendency, leaving 8517 participants for final analysis. To evaluate potential bias from missing data, we compared baseline characteristics between participants with complete vs. missing WQ-9BC data.

Statistical analysis

We used mean and standard deviation to describe continuous variables and percentage to describe categorical variables. To assess statistical differences, we used t-test for continuous variables and chi-squared test for categorical variables. We evaluated the primary TCM body constitutions' relationships with sleep quality using multivariable logistic regression models to estimate odds ratios (ORs). In these models, sleep quality was categorized as a binary (good or poor sleep quality) and treated as the dependent variable, and the primary TCM body constitution was treated as the independent variable. For the primary body constitution variable, the balanced constitution was used as the reference category, and the eight unbalanced constitutions/tendencies were incorporated as dummy variables. We also performed analyses stratified by sex and age.

To examine the relationship between multiple (composite) body constitutions/tendencies and sleep quality, we first categorized the eight unbalanced constitutions into three risk levels based on ORs for the primary body constitutions. Primary constitutions with an OR of 3 or higher were classified as high-risk, those with an OR between 2 and 2.9 as moderate-risk, and those with an OR under 2 as minimal-risk. Given the direct correlation between the risk associated with a constitution and with its corresponding tendency, the risk level of each tendency was assigned based on its associated constitution. Participants were then classified into risk groups based on their body constitution or tendency with the highest risk.

Logistic regression analyses adjusted for the following potential confounding factors: age range (18–39, 40–49, 50–59, 60–69, 70–80), sex (male, female), BMI (underweight, BMI <18.5 kg/m^2; normal, BMI 18.5–23.9 kg/m^2; overweight, BMI 24–27.9 kg/m^2; obese, BMI >28 kg/m^2), education (elementary school, secondary school, college and above), annual income (<$3000, $3000–$7499, $7500–$11 999, and ≥$12 000, converted from Chinese yuan to US dollars), employment (employed, retired, unemployed), marital status (single, married, divorced or widowed), smoking (never, former, current), drinking (never, former, current), physical activity (low, moderate, high), and number of the following comorbidities: cardiovascular disease, diabetes, hypertension, stroke, and cancer (0, 1, 2, 3+). p-values are reported as exact values unless <.001, in which case they are shown as "<.001." We assessed multicollinearity among covariates using the generalized variance inflation factor (GVIF).

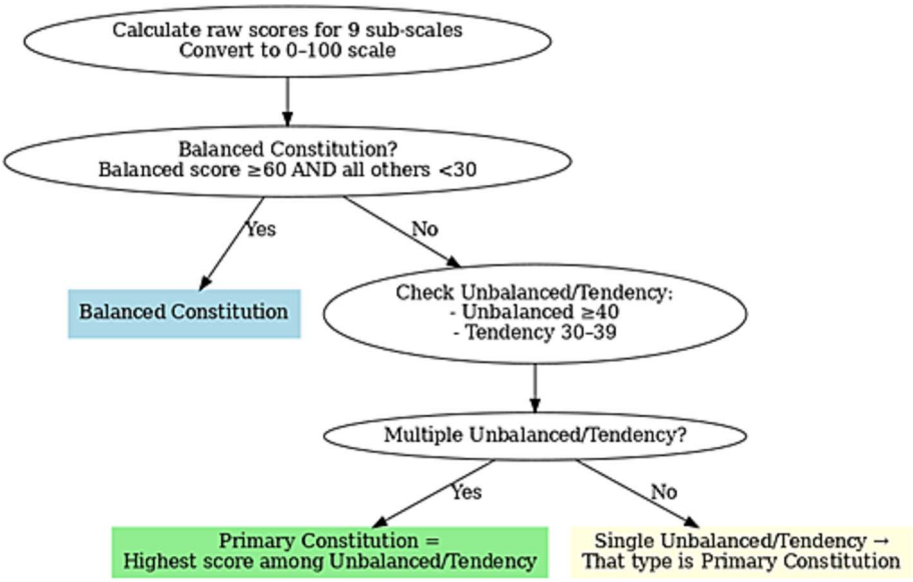


Figure 1. Flowchart of body constitution classification.

Sensitivity analysis

Considering the potential influence of comorbidity on the associations between TCM body constitutions and sleep quality, we conducted a sensitivity analysis on participants without comorbid conditions. To determine if the association between primary body constitution and sleep quality was consistent across the seven components of sleep quality, we also examined the associations between each sleep component and primary body constitution. Additionally, to address the issue of multiple comparisons, we conducted sensitivity analyses applying the Benjamini–Hochberg false discovery rate (FDR) correction within each outcome family. We also conducted trend tests to evaluate dose–response relationships across increasing numbers of moderate- and high-risk constitutions/tendencies.

Results

Among the 8517 participants included in the final analysis, we first examined baseline characteristics, then the distribution of TCM body constitutions, and finally the associations between constitutions and sleep quality.

Baseline characteristics of participants

The prevalence of poor sleep quality was 34%. Table 1 shows the characteristics of the participants by sleep quality status. Compared to participants with good sleep quality, those with poor sleep quality tended to be older, were more likely to be female, and had lower BMI, education, and income. They were less likely to be employed, be married, smoke, or drink. They also engaged in less physical activity and had a higher prevalence of comorbidities.

Participants with missing constitution data were slightly younger, more likely to be male, had lower BMI, education, and income, were more likely to be current smokers, and reported higher physical activity levels. The distributions of marital status, drinking, and comorbidities were similar between groups (Supplementary Table S2).

Distribution of TCM body constitution

Of the 8517 participants, 22% were classified as having a balanced constitution, 52% as having an unbalanced constitution, and 26% as having an Unbalanced tendency. For unbalanced constitutions, the prevalences were 16.3% for Qi deficiency, 11.1% for Phlegm dampness, 9.4% for Yang deficiency, 6.1% for Yin deficiency, 4.5% for heat dampness, 2.5% for Qi stagnation, 1.1% for allergic, and 0.8% for blood stasis. For unbalanced tendencies, the prevalences were 9.7% for Qi deficiency, 5.4% for Phlegm dampness, 2.9% for Yang deficiency, 3.1% for Yin deficiency, 2.0% for heat dampness, 1.0% for Qi stagnation, 1.2% for blood stasis, and 0.5% for allergic.

Associations between primary TCM body constitutions and poor sleep quality

Table 2 presents ORs for poor sleep quality in relation to primary TCM body constitutions. Compared with participants having a balanced constitution, those with an unbalanced constitution (OR 2.6 [95% CI = 2.3% to 3.0%]) or an unbalanced tendency (OR 1.5 [95% CI = 1.3% to 1.8%]) had a higher risk of poor sleep quality. All eight unbalanced constitutions were significantly associated with a higher risk of poor sleep quality, with most displaying ORs greater than 2. Notably, Qi stagnation constitution was associated with the highest risk (OR 4.0 [95% CI = 3.0% to 5.5%]), followed closely by blood stasis constitution (OR 3.8 [95% CI = 2.6% to 6.2%]). Excluding heat dampness and allergic, the other six unbalanced tendencies were significantly and positively associated with poor sleep quality, with Qi stagnation tendency having the highest risk (OR 3.2 [95% CI = 2.1% to 4.9%]). The association for allergic tendency (OR 0.5, 95% CI = 0.2% to 1.3%) should be interpreted with caution, given the very small subgroup size ($N = 42$, including only five participants with poor sleep quality). As expected, ORs for each constitution were generally higher than those for the corresponding tendency. No evidence of multicollinearity was observed (all GVIF <1.5), and the results remained consistent after FDR correction (Supplementary Table S3).

Association between multiple TCM body constitutions/tendencies and poor sleep quality

In our study, 51.5% of participants had more than one unbalanced constitution and/or tendency. To analyze combinations of body constitutions and tendencies, we used ORs for primary body constitutions as the basis for classifying Phlegm dampness and allergic constitutions and tendencies as the minimal-risk group

Table 1. Characteristics of participants by sleep quality

Characteristics	Sleep quality*				*p*
	Good		Poor		
	N	%†	*N*	%†	
Total, *n* (%)	5624	100	2893	100	
Age (years), mean (SD)	53.6	(13.3)	55.9	(13.7)	<.001
Age category					<.001
18–39	982	17.5	429	14.8	
40–49	992	17.6	374	12.9	
50–59	1481	26.3	706	24.4	
60–69	1593	28.3	968	33.5	
70–80	576	10.2	416	14.4	
Sex, *n* (%)					<.001
Male	2338	41.6	982	34.0	
Female	3286	58.4	1911	66.0	
BMI category‡					.001
Underweight	184	3.3	138	4.8	
Normal	2903	51.6	1533	53.0	
Overweight	1999	35.5	954	33.0	
Obese	538	9.6	268	9.3	
Education					<.001
Elementary school	1017	18.1	616	21.3	
Secondary school	3109	55.3	1627	56.3	
College or above	1498	26.7	648	22.4	
Annual income (USD)§					<.001
<3000	603	10.7	409	14.1	
3000–7499	2767	49.2	1586	54.8	
7500–11 999	1375	24.5	571	19.7	
> = 12 000	879	15.6	327	11.3	
Employment					<.001
Employed	2918	51.9	1194	41.3	
Retired	2585	46.0	1638	56.6	
Unemployed	121	2.1	61	2.1	
Marital status					<.001
Single	295	5.3	175	6.1	
Married	5016	89.2	2455	84.9	
Divorced or widowed	313	5.6	263	9.1	
Smoking status					<.001
Never	4122	73.3	2233	77.2	
Former	419	7.5	187	6.5	
Current	1083	19.3	473	16.4	
Drinking status					<.001
Never	2998	53.3	1621	56.0	
Former	91	1.6	77	2.7	
Current	2535	45.1	1195	41.3	
Physical activity					.020
Low	947	16.8	539	18.6	
Moderate	2735	48.6	1432	49.5	
High	1942	34.5	922	31.9	
Comorbidity‖					<.001
0	2612	46.4	1183	40.9	
1	1806	32.1	976	33.7	
2	1010	18.0	579	20.0	
3 or more	196	3.5	155	5.4	

*Sleep quality is measured by the PSQI; scores ≤5 were defined as good sleep quality and scores >5 as poor sleep quality. †Percentages may not total 100% due to rounding. ‡BMI (kg/m^2) was categorized into four groups: underweight (<18.5 kg/m^2), normal (18.5–23.9 kg/m^2), overweight (24.0–27.9 kg/m^2), and obese (≥28 kg/m^2). §Income has been converted into US dollars. ‖Comorbidities include diabetes, hypertension, cardiovascular disease, stroke, and cancer.

(ORs <2); heat dampness, Yin deficiency, Yang deficiency, and Qi deficiency as moderate-risk (ORs 2–2.9); and Qi stagnation and blood stasis as high-risk (ORs ≥3).

Table 3 shows the ORs for poor sleep quality across various combinations of body constitutions and tendencies. Having a high-risk constitution or tendency was associated with an increased risk of poor sleep quality, with ORs nearly doubling when two high-risk constitutions (OR 3.1 vs. OR 5.9) or tendencies (OR 2.1 vs. OR 4.0) were present. Furthermore, ORs escalated with the number of moderate-risk constitutions. The ORs reached up to 7.2 or 6.2, respectively, when one high-risk constitution or tendency was combined with three or four moderate-risk

Table 2. OORs for poor sleep quality in relation to primary TCM body constitutions and tendencies*

TCM body constitution†	Sleep quality‡					
	Good		Poor			
	N	%	N	%	OR§	95% CI
Balanced constitution	1485	78.2	413	21.8	1.0	Reference
Unbalanced tendency	1543	70.1	657	29.9	1.5	1.3–1.8
Allergic	37	88.1	5	11.9	0.5	0.2–1.3
Phlegm dampness	349	75.4	114	24.6	1.2	1.0–1.6
Qi deficiency	572	69.6	250	30.4	1.6	1.3–1.9
Yang deficiency	157	64.1	88	35.9	1.9	1.4–2.5
Yin deficiency	184	69.7	80	30.3	1.5	1.1–1.9
Heat dampness	129	75.9	41	24.1	1.3	0.9–1.9
Blood stasis	68	64.8	37	35.2	1.7	1.1–2.6
Qi stagnation	47	52.8	42	47.2	3.2	2.1–4.9
Unbalanced constitution	2596	58.7	1823	41.3	2.6	2.3–3.0
Allergic	66	68.0	31	32.0	1.9	1.2–2.9
Phlegm dampness	640	67.7	305	32.3	1.9	1.6–2.3
Qi deficiency	802	57.7	588	42.3	2.7	2.3–3.1
Yang deficiency	426	53.5	371	46.5	2.8	2.4–3.4
Yin deficiency	289	55.3	234	44.7	2.8	2.3–3.5
Heat dampness	237	61.2	150	38.8	2.9	2.2–3.6
Blood stasis	33	47.8	36	52.2	3.8	2.3–6.2
Qi stagnation	103	48.8	108	51.2	4.0	3.0–5.5

*Primary Body Constitution: When an individual exhibits multiple unbalanced constitutions and/or tendencies, the one with the highest score is designated as the primary body constitution. †For each constitution type, the corresponding "tendency" indicates borderline scores (30–39), while "constitution" indicates an established imbalance (≥40). ‡Sleep quality is measured by the PSQI; scores ≤5 were defined as good sleep quality and scores >5 as poor sleep quality. §Adjusted for age category, sex, BMI category, income, work status, marital status, drinking, smoking, physical activity, and comorbidities.

constitutions. Notably, the OR for one high-risk tendency exceeded that of one moderate-risk constitution (OR 2.1 vs. OR 1.8), and the OR for one high-risk constitution exceeded that of two moderate-risk constitutions (OR 3.1 vs. OR 2.7). Among participants in the moderate-risk groups, the ORs increased with the number of moderate-risk constitutions. Compared to having one moderate-risk constitution, having three or four moderate-risk constitutions doubled the OR (OR 1.8 vs. OR 3.6). Having only minimal-risk constitutions or tendencies was not associated with poor sleep quality. As a sensitivity analysis, we also tested dose–response trends for the number of moderate- and high-risk constitutions/tendencies, consistently yielding significant results ($p < .001$).

Stratified and sensitivity analysis

We found that the association between primary constitution and poor sleep quality was consistent across different sex and age groups and in participants without comorbidities (Supplementary Tables S4–S6). Compared with men, women had a higher prevalence of blood stasis (1.1% vs. 0.4%) and Qi stagnation (3.0% vs. 1.7%). These constitutions had the highest ORs for poor sleep quality in both sexes. In women, the OR for blood stasis (3.9) was slightly higher than that for Qi stagnation (3.8), and heat dampness also showed a strong association (OR = 3.3). Across age groups, Qi stagnation and blood stasis consistently remained among the strongest predictors of poor sleep quality. Notably, in the youngest age group (18–34 years), blood stasis had an extremely high OR (17.5), although this subgroup included only nine individuals and should be interpreted with caution. The ORs for Qi stagnation increased with age, reaching 5.4 in those aged 65–80. Importantly, according to our predefined threshold (OR ≥ 3.0), both Qi stagnation and blood stasis consistently qualified as high-risk constitutions across all sex and age strata. Other constitutions reached high-risk status only in specific subgroups—heat dampness in women and in the 18–34 and 50–64 age groups, Yin deficiency and Yang deficiency in the 18–34 and 65–80 age groups, and Qi deficiency in the 35–49 age group.

For individual sleep components, all primary unbalanced constitutions other than Allergic were associated with poorer outcomes in all components, except for the use of sleep medicine (Supplementary Table S7). The use of sleep medicine was associated with four of the eight unbalanced constitutions.

Discussion

In this large population-based study, having any unbalanced TCM body constitution was associated with poor sleep quality. Composite constitutions/tendencies were common, with the risk of poor sleep quality increasing in a dose-dependent manner with the number of moderate and high-risk constitutions/tendencies.

Of the eight unbalanced constitutions, the risk was highest for Qi stagnation and blood stasis (almost four-fold compared to the balanced constitution). This is consistent with data from clinical studies showing that 50% of insomnia patients have either Qi stagnation or blood stasis [37], and that Qi stagnation is the most common body constitution among insomnia patients (21%–44%) [25]. It is biologically plausible that these constitutions are strongly related to poor sleep quality, since they are linked to dysregulation of cerebral blood flow (CBF), which may disrupt sleep architecture and thereby affect sleep quality [38]. Poor sleep quality has been associated with a decline in CBF in patients with heart failure and in firefighters with sleep complaints [39–40], and those with chronic insomnia exhibit significant CBF differences across various brain regions during wakefulness compared to healthy controls [41].

Table 3. ORs for poor sleep quality in relation to primary TCM body constitutions and tendencies

	Sleep quality[†]					
	Good		Poor			
Groups[*]	**N**	**%**	**N**	**%**	**OR**[‡]	**95% CI**
Balanced constitution	1485	78.2	413	21.8	1.0	Reference
Minimal-risk groups[§]						
[*Phlegm dampness, allergic*]						
Minimal-risk tendency						
MinR-T 1–2	330	77.6	95	22.3	1.1	0.8–1.4
Minimal-risk constitution						
MinR-C 1–2	227	80.2	56	19.8	0.9	0.7–1.3
Moderate-risk groups[§]						
[*Heat dampness, Yin deficiency, Yang deficiency, Qi deficiency*]						
Moderate-risk tendency						
MR-T 1	935	71.4	374	28.6	1.4	1.2–1.7
MR-T 2–4	232	65.0	125	35.0	2.1	1.6–2.7
Moderate-risk constitution						
MR-C 1	515	66.2	263	33.8	1.8	1.5–2.2
MR-C 1 + MR-T 1	332	64.1	186	35.9	2.1	1.7–2.6
MR-C 1 + MR-T 2–3	102	65.4	54	34.6	2.0	1.4–2.8
MR-C 2	150	57.5	111	42.5	2.7	2.1–3.6
MR-C 2 + MR-T 1–2	119	56.7	91	43.3	3.0	2.2–4.0
MR-C 3–4	64	51.6	60	48.4	3.6	2.5–5.2
High-risk groups[§]						
[*Qi stagnation, blood stasis*]						
High-risk tendency						
HR-T 1	242	63.2	141	36.8	2.1	1.6–2.6
HR-T 1 + MR-C 1	224	59.4	153	40.6	2.7	2.1–3.4
HR-T 1 + MR-C 2	125	49.4	128	50.6	4.1	3.1–5.4
HR-T 1 + MR-C 3–4	51	39.8	77	60.2	6.2	4.2–9.1
HR-T 2	81	48.5	86	51.5	4.0	2.9–5.6
High-risk constitution						
HR-C 1	62	55.9	49	44.1	3.1	2.1–4.6
HR-C 1 + MR-C 1	112	47.5	124	52.5	4.4	3.3–5.9
HR-C 1 + MR-C 2	102	47.9	111	52.1	4.4	3.3–5.9
HR-C 1 + MR-C 3	59	41.0	85	59.0	6.1	4.2–8.7
HR-C 1 + MR-C 4	23	38.3	37	61.7	7.2	4.1–12.5
HR-C 2	52	41.3	74	58.7	5.9	4.0–8.5

[*]Participants were classified according to the highest risk body constitutions or tendencies they exhibited. High-risk body constitutions included Qi stagnation and blood stasis; moderate-risk body constitutions included heat dampness, Yin deficiency, Yang deficiency, and Qi deficiency; minimal-risk body constitutions included Phlegm dampness and allergic. [†]Sleep quality is measured by the PSQI; scores ≤5 were defined as good sleep quality and scores >5 as poor sleep quality. [‡]Adjusted for age category, sex, BMI category, income, work status, marital status, drinking, smoking, physical activity, and comorbidity. [§]Numbers (e.g. 1, 2, 3–4) indicate the number of constitutions/tendencies in that risk group. For example, "HR-C 1 + MR-C 4" denotes one high-risk constitution plus four moderate-risk constitutions. Abbreviations: MinR, minimal-risk; MR, moderate-risk; HR, high-risk; C, constitution; T, tendency.

Beyond CBF-related mechanisms, psychological factors and pain may contribute to the close link between poor sleep quality and Qi stagnation and blood stasis. Qi stagnation has been closely associated with emotional distress and depressive symptoms [42], whereas blood stasis is often characterized by fixed or localized pain that often worsens at night [43]. Both depression and pain are established contributors to poor sleep quality [44, 45], which may partly explain the strong associations of these constitutions with poor sleep that were observed in our study.

Other unbalanced constitutions/tendencies that involve abnormal Qi and blood flow, including Qi deficiency (insufficient Qi), Yang deficiency (insufficient warming of Qi), and Yin deficiency (insufficient blood and/or body fluids), are also linked poor sleep quality, further supporting the importance of Qi and CBF in sleep. In addition, heat dampness and Phlegm dampness, two constitutions/tendencies characterized by abnormal internal heat and water accumulation, had a modest impact on sleep quality. The abnormal heat and water accumulation associated with these constitutions/tendencies can disrupt Qi and/or blood flow, thereby affecting sleep quality. The Allergic constitution/-tendency, which involves dysregulation of the Qi involved in immune surveillance, was also moderately associated with poor sleep quality. Allergy is well-established to disrupt sleep through chronic inflammation and has been associated with alterations in CBF, so having an Allergic constitution/tendency may negatively affect sleep through these pathways [46–48].

These differences in the risks of poor sleep associated with the eight unbalanced constitutions/tendencies suggest a dose-dependent effect of Qi and blood flow disruption on sleep quality. The dose-dependent nature of this relationship is further supported by our finding that the OR for every unbalanced tendency was lower than that for the corresponding unbalanced constitution. Because unbalanced tendencies reflect a less severe imbalance with less disruption in Qi and blood flow compared to unbalanced constitutions, this indicates a dose-dependent relationship where the severity of imbalance is proportional to the

magnitude of effect on sleep quality. In TCM terms, the more severe the disruption in Qi and blood flow, the higher the risk for poor sleep. Aberrations in CBF patterns are a plausible biological mechanism for this, given that the degree of CBF disruption is linearly associated with the severity of poor sleep quality [41].

We also found that multiple unbalanced constitutions or tendencies have cumulative effects on sleep quality. For instance, the OR for co-existing Qi stagnation and blood stasis constitution was nearly double that of one of these high-risk constitutions alone (3.1 vs. 5.9). Moreover, When Qi stagnation or blood stasis occur alongside Qi deficiency, Yang deficiency, Yin deficiency, or heat dampness, the OR increases progressively with the number of co-occurring unbalanced constitutions, reaching 7.2 when all four constitutions are present. This indicates that different disruptions in Qi and blood flow can have additive effects on sleep, further supporting the dose-dependent nature of this relationship. Given that over half of individuals have composite constitutions and/or tendencies, this finding is highly relevant for identifying high-risk populations and developing targeted interventions.

Stratified analyses provided additional insights into demographic variations in the constitution–sleep association. Women had a higher prevalence of Qi stagnation and blood stasis, although Qi stagnation and blood stasis consistently emerged as high-risk constitutions (OR $\geq$ 3.0) across all sex and age strata, underscoring their robust and universal association with sleep disturbances. Other constitutions reached high-risk status only in specific subgroups—for example, heat dampness in women and in younger and middle-aged adults, and Yin and Yang deficiency in the youngest and oldest groups—suggesting that demographic factors may modify the impact of certain constitutions on sleep quality. Taken together, these findings highlight the importance of considering age- and sex-specific patterns in both body constitution research and targeted interventions.

Our results have important implications for future research and health promotion. First, we demonstrated that TCM body constitution/tendency classification is useful for identifying high-risk populations and can potentially be used to design and target interventions. Second, we established that disruptions in the flow of Qi and blood affect sleep quality in a dose-dependent manner, and therefore improving Qi and blood flow could improve sleep quality. Further research is needed to investigate whether CBF patterns are involved in this relationship, and if there are significant differences in CBF patterns associated with unbalanced constitutions/tendencies.

This study has several strengths. First, its large sample size allowed for in-depth subgroup analysis of constitutions/tendencies and their combinations, yielding unique insight into dose–response relationships and cumulative effects of constitutions/-tendencies on sleep quality. Second, the study has very rich data and variables, which allowed us to adjust for multiple covariates, including BMI, socioeconomic factors, lifestyle factors, and comorbidities, to minimize confounding. Third, the study's community-based probability samples enhance the representativeness of the data and results as well as the generalizability of the findings. Several limitations of the study should also be noted. First, the cross-sectional nature of our study limits the ability to infer causality. Second, the data on body constitution and sleep quality were based on self-report. Although we used standardized, validated questionnaires, this may still introduce recall bias. Third, participants with missing WQ-9 BC data differed somewhat in age, sex, socioeconomic status, and lifestyle factors; however, given that our models adjusted for these factors and stratified analyses yielded generally consistent findings, these differences are unlikely to materially affect the conclusions. Finally, our study sample was exclusively from Hangzhou, an economically developed urban region in eastern China. The distributions of TCM constitutions/tendencies and their associations with sleep quality may differ in other populations with different climates, lifestyles, and socioeconomic conditions [20]. For example, Yang deficiency, which is characterized by intolerance to cold, may more strongly affect sleep quality in northern regions with colder climates, whereas heat dampness may be more strongly associated with poor sleep in hot and humid southern regions. Future studies in rural areas, other regions of China, and in non-Chinese populations are needed to confirm the generalizability of our findings.

Conclusion

Sleep quality is associated with imbalances in TCM body constitution in a dose-dependent manner. The prevalence of poor sleep quality was increased in those with any of the eight unbalanced constitutions compared to the balanced constitution, with Qi stagnation and blood stasis displaying the strongest associations. The impact of multiple unbalanced constitutions and/or tendencies on sleep quality is cumulative. Analyzing TCM body constitutions may be highly useful for identifying high-risk populations and designing targeted interventions.

Supplementary material

Supplementary material is available at *SLEEP Advances* online.

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Author contributions

Peng Gao (Conceptualization, Data curation, Formal analysis [lead], Investigation [equal], Methodology, Project administration, Software, Visualization, Writing—original draft, Writing—review & editing [lead]), Ji Wang (Conceptualization [lead], Formal analysis [equal], Methodology [lead], Writing—review & editing [equal]), Yi-Hsuan Wu (Conceptualization [equal], Data curation, Formal analysis, Methodology [lead], Writing—review & editing [equal]), Minghua Bai (Conceptualization [equal], Formal analysis [supporting], Methodology, Writing—review & editing [equal]), April Myers (Writing—original draft [supporting], Writing—review & editing [equal]), Qi Wang (Conceptualization, Methodology [lead], Writing—review & editing [supporting]), Elizabeth Delzell (Writing—review & editing [equal]), Clete A. Kushida (Writing—review & editing [equal]), Dan Huang (Writing—review & editing [equal]), Fei Yang (Writing—review & editing [equal]), Wei He (Writing—review & editing [equal]), Ying Lu (Formal analysis, Methodology [equal]), Shankuan Zhu (Funding acquisition, Investigation [lead], Writing—review & editing [equal]), and Ann W. Hsing (Conceptualization [lead], Data curation [supporting], Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation [lead], Visualization, Writing—original draft [equal], Writing—review & editing [lead])

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Data availability

The data supporting the findings of this study are available upon reasonable request from the corresponding author.

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