



## Research article

# Personality and sleep quality among nursing interns: Traditional Chinese medicine constitution as a mediator and sedentary time as a moderator

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## ABSTRACT

**Aims:** This study investigated whether the relationship between neuroticism and sleep quality in nursing interns is mediated by traditional Chinese medicine (TCM) constitution. In addition, the study examined whether sedentary behaviour affects this mediating model.

**Background:** The importance of sleep quality for nursing interns cannot be overstated. Previous studies have demonstrated that neuroticism negatively affects sleep quality. However, little is known about the path of the relationship between neuroticism and sleep quality among nursing interns.

**Design:** A cross-sectional study was conducted in Central and South China.

**Methods:** A total of 630 nursing interns participated in this study. Neuroticism, TCM constitution, sleep quality, and sedentary behaviour were measured using reliable and valid questionnaires. Data were analysed using the PROCESS macro in SPSS.

**Results:** Neuroticism significantly predicted the Pittsburgh Sleep Quality Index (PSQI;  $\beta = 0.144$ ,  $P < 0.001$ ). Neuroticism exerted a significant indirect effect on the PSQI through gentleness and damp heat constitution ( $\beta = 0.265$ , 95 % CI [0.214, 0.315]). In addition, sedentary time moderated this mediation model. Sedentary time marginally moderated the direct pathway from neuroticism to the PSQI ( $B = -0.025$ , 95 % CI [-0.046, -0.004]) and the pathway from neuroticism to the damp heat constitution ( $B = 0.175$ , 95 % CI [0.021, 0.329]) in the nursing interns.

**Conclusion:** TCM constitution mediates the relationship between neuroticism and sleep quality. Given the moderating effect of sedentary behaviour, targeting sedentary behaviour can be an effective approach to improve the sleep quality of nursing interns.

## 1. Introduction

Clinical nursing practice represents an important transitional stage for nursing students as they move from academic settings to

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clinical environments [1]. During this phase, they are designated as nursing interns. Nursing interns frequently encounter stressful events, such as patient emergencies, deaths, and shifts that include late nights [2]. These events can significantly affect nursing interns' sleep quality, leading to sleep disorders [3]. The prevalence of sleep problems among nursing interns ranges from 27 % to 64.1 % [4,5]. In China, the prevalence of inadequate sleep quality among nursing interns ranges from approximately 47.0 %–72.3 % [6–8]. Compared with other college students, nursing interns experience shorter sleep durations, considerably lower sleep efficiency, and significantly more sleep disruptions [9,10]. Poor sleep quality is associated with depression and work-related burnout among nursing interns, potentially reducing their willingness to continue in the profession [11,12]. Thus, ensuring sufficient sleep is essential for maintaining the health of nursing interns and increasing their willingness to continue in the profession [13,14].

In addition to the influence of external environmental factors such as hospitals on the sleep of nursing interns, previous research has shown that personality trait may play an important role in sleep health [15,16]. Personality is a distinctive manifestation of cognitive, emotional, behavioural, and motivational characteristics. Both Eysenck's personality theory and the Big 5 personality traits identify neuroticism as a fundamental component of individuals' personalities [17]. Among various personality traits, neuroticism was found to be highly predictive of subjective sleep perceptions [18,19]. A high level of neuroticism is associated with poor self-reported sleep quality [20,21]. However, the specific pathways through which personality affects sleep quality remain unclear.

In addition to personality traits, traditional Chinese medicine (TCM) constitution theory describes individual differences in physiological states and susceptibility to disease. This theory originated from the earliest Chinese medical book, the *Yellow Emperor's Book of Internal Medicine*, and was further developed into a comprehensive framework in 1970 [22]. TCM constitution is divided into two main categories: gentleness constitution and biased constitution. Gentleness constitution is generally associated with better health. Biased constitution is further subdivided into eight types, each reflecting a specific physiological state that may increase susceptibility to certain diseases [23]. Research has shown that a biased constitution increases the risks of difficulty falling asleep and early waking [25]. For example, the blood stasis constitution type is significantly associated with poor sleep quality [24]. Dysfunctional psychological states, including emotions and personality, play a crucial role in the formation of a biased constitution [26]. A study involving college students found that those with a higher level of neuroticism were more likely to report having a biased constitution [27]. Although bilateral associations among neuroticism, TCM constitution, and sleep quality have been established, the trilateral relationships among these variables have rarely been explored.

In China, the majority of nursing interns are aged between 17 and 23 years [28]. On average, these young individuals engage in sedentary behaviour for  $12.7 \pm 5.6$  h a day [29,30]. Sedentary behaviour includes not only sitting for extended periods to work or study but also lying down and participating in screen-based recreational activities [31]. The World Health Organization (WHO) recommends reducing sedentary behaviour due to its associated health risks, such as cardiovascular disease and mortality [32]. Another study indicated that prolonged sedentary behaviour increases the risks of insomnia and sleep disruption [33]. In particular, sedentary behaviour interacts with neuroticism [34], suggesting that both neuroticism and sedentary behaviour influence sleep quality.

The *Yellow Emperor's Book of Internal Medicine* states that maintaining a certain posture for a prolonged period depletes the essence of the five organs and causes an imbalance in their functions [35]. Sedentary behaviour, which involves maintaining a single posture for a long time, may thus lead to an imbalance in TCM constitution. A previous study suggested that reducing sedentary time could improve individuals' biased constitutions [36]. This implies that sedentary behavior and neuroticism may interact and influence TCM constitution.

It is crucial to address the sleep problems experienced by nursing interns. This study investigated the sleep quality of nursing interns, examined the mediation effect of TCM constitution on the relationship between neuroticism and sleep quality, and analysed the impact of sedentary behaviour on sleep. Accordingly, we propose the following four hypotheses (H1–H4), as illustrated in Fig. 1:

- H1. Neuroticism is negatively associated with sleep quality.
- H2. The relationship between neuroticism and sleep quality is mediated by TCM constitution.
- H3. Sedentary time moderates the direct relationship between neuroticism and sleep quality.
- H4. Sedentary time moderates the path of neuroticism to TCM constitution.

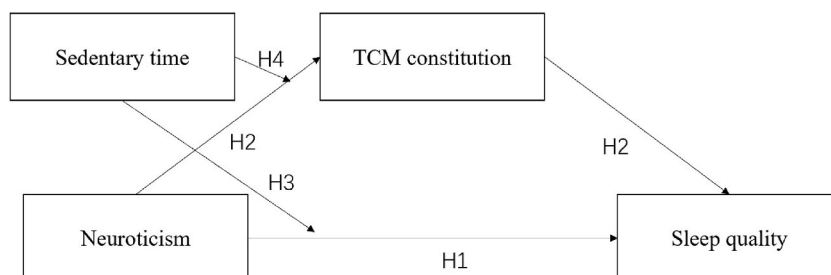


Fig. 1. The hypothetical model.

## 2. Methods

### 2.1. Design

A cross-sectional study was conducted between 14 and July 22, 2023 at the Third Xiangya Hospital of Central South University in central and southern China. This study was designed and reported in accordance with the STROBE guidelines [37]. In addition, a mediation model was developed to illustrate relationships between the study variables.

### 2.2. Participants and setting

Convenience sampling was used to recruit nursing interns from the Third Xiangya Hospital of Central South University. The eligibility criteria for participants were as follows: (1) being a nursing student with prior experience in a Chinese hospital, (2) being proficient in spoken Chinese, and (3) voluntarily agreeing to participate in this study. We excluded individuals with acute ailments that significantly impacted their daily functioning, those with psychiatric disorders, or those currently using medication or undergoing treatment for sleep disorders. The sample size was determined on the basis of a priori calculations, with a Z value (corresponding to a significance level of  $P = 0.05$ ) of 1.96 [38]. The d value was 0.04, and a proportion of 47.0 % was used [6]. Using the formula  $n = \frac{Z^2 P(1-P)}{d^2}$ , the sample size was calculated as 598.

### 2.3. Instruments

The data collection methods used in this study included a general information questionnaire and instruments to assess TCM constitution, neuroticism, and sleep quality.

#### 2.3.1. General information

The general information questionnaire collected data on the demographic characteristics of nursing interns, namely age, sex, only child status, education level, internship duration in the hospital, and registered residence. In addition, the questionnaire evaluated risk factors for sleep disorders, including inadequate physical activity [39] and sedentary time [40]. Inadequate physical activity was defined as either no physical activity or physical activity performed no more than three times a week.

#### 2.3.2. TCM constitution

TCM constitution was assessed using the Constitution in Chinese Medicine Questionnaire (CCMQ), which was reported to be reliable and effective [41]. The CCMQ is a self-assessment scale with 60 items, divided into nine sub-scales: gentleness, Qi deficiency, Yang deficiency, Yin deficiency, phlegm dampness, damp heat, blood stasis, Qi depression, and special diathesis constitutions. All subscales, except gentleness, describe biased constitutions. Each person's score on the subscales is summed and then standardised on a scale from 0 to 100 using the following formula:  $(\text{sum} - \text{lowest score}) / (\text{highest score} - \text{lowest score}) \times 100$  [41]. For the CCMQ scores, if the gentleness constitution score is 60 points or more and the scores for all eight categories of biased constitution are below 30 points, the result indicates 'yes'. If the gentleness constitution score is 60 points or more and the scores for the other eight categories are below 40 points, the result is 'basically yes'; otherwise, the result is 'no'. A score exceeding 40 points indicates a biased constitution, whereas a score between 30 and 39 points suggests a tendency towards a biased constitution. Scores below 30 points are considered insufficient. The CCMQ demonstrated good internal consistency (Cronbach's alpha = 0.76 to 0.90) and good test-retest reliability (Cronbach's alpha = 0.76 to 0.90) across the nine subscales [42]. In this study, Cronbach's alpha was 0.97.

#### 2.3.3. Neuroticism personality

Neuroticism was measured using the Eysenck Personality Questionnaire Short Scale for Chinese (EPQ-RSC). The EPQ-RSC includes four subscales: E (extraversion), N (neuroticism), P (psychoticism), and L (lie) [43]. These subscales assess individuals' internal and external dispositions, emotional stability, mental deviation, and tendency to lie. The Cronbach's alpha coefficient of this scale ranged from 0.67 to 0.88 [43], and in this study, it was 0.91.

#### 2.3.4. Sleep quality

The Pittsburgh Sleep Quality Index (PSQI) was used to assess the sleep quality of nursing interns. The PSQI is a subjective assessment tool consisting of 19 self-reported items, which are used to calculate the global score [44]. This score is derived by summing seven components, resulting in a value ranging from 0 to 21. Lower scores indicate better overall sleep quality, whereas a global score of 5 or higher typically indicates poor sleep quality [45]. The PSQI is suitable for evaluating sleep quality in individuals aged between 18 and 80 years [46]. The Chinese version of the PSQI had a Cronbach's alpha of 0.71 and an intraclass correlation coefficient of 0.90 [47]. In this study, the Cronbach's alpha was 0.78.

### 2.4. Data collection

This study used convenience sampling and was conducted between 14 and July 22, 2023. Initially, an online questionnaire link and a QR code were generated using Tencent Questionnaire and distributed through the WeChat platform. The researchers provided

nursing interns with a detailed explanation of the survey's objectives and the completion process for the questionnaire. In addition, they emphasised the voluntary nature of participation. All participants were invited to complete the questionnaire. The first page contained consent information regarding the study purpose and process, which participants needed to acknowledge before proceeding. Finally, data were collected from 647 nursing interns. After screening, 630 valid questionnaires were deemed suitable for analysis. A flow chart of the study is shown in Fig. A1. The questionnaire's response rate was 97.4 %.

## 2.5. Data analysis

Initially, the data were subjected to a cleaning process. The mean completer method was used to impute missing values. Outliers beyond the range of  $Q1 - 3 \times \text{interquartile range (IQR)}$  and  $Q3 + 3 \times \text{IQR}$  were removed. Subsequently, the data were analysed using IBM SPSS Statistics 26 software. Initially, continuous variables were tested for normality. Descriptive analyses included calculating the mean and standard deviation (SD) for continuous variables. Other analyses included the chi-square test and Pearson correlation [48]. A P value of  $<0.05$  was considered significant. Significant demographic variables were controlled as covariates [49].

The PROCESS macro for SPSS was used to conduct mediation studies and moderated mediation analyses [50]. The mediating effect of TCM constitution on the relationship between personality traits and sleep quality was tested using model 4 of the PROCESS macro. To investigate the effect of moderated mediation, model 8 was used. This study included sedentary time as a moderating variable (W) in the relationships between personality traits (an independent variable, X) and the PSQI (a dependent variable, Y) and between personality traits and TCM constitution (a mediating variable, M). A 95 % confidence interval (CI) that excluded zero indicated significant mediation (indirect) and moderation (interaction) effects. All variables were standardised prior to analysis. The study investigated the mediation effect and moderated mediation using 5000 bootstrap samples.

## 3. Results

### 3.1. Demographic characteristics

The demographic characteristics of 630 nursing interns are listed in Table 1. The participants' ages ranged from 19 to 28 years. The study found that 85.1 % ( $n = 536$ ) of the participants were women, 81.6 % ( $n = 511$ ) had completed at least an undergraduate degree, and 79.4 % ( $n = 500$ ) had been actively practicing for 1–3 months. In addition, the findings indicated that sedentary time was significantly correlated with the PSQI.

**Table 1**  
The demographic characteristics of 630 nursing interns and its association with PSQI.

Variable	n (%)			P
	All participant	Participant with PSQI score <5 135(21.4)	Participant with PSQI score $\geq$ 5 495(78.6)	
Age				0.909
$\leq$ 20	236(37.5)	50(37.0)	186(37.6)	
$>$ 20	394(62.5)	85(63.0)	309(62.4)	
Sex				0.392
Male	94(14.9)	17(12.6)	77(15.5)	
Female	536(85.1)	118(87.4)	418(84.5)	
Education				0.334
Junior college or below	116(18.4)	21(15.5)	95(19.2)	
Bachelor's degree or above	514(81.6)	114(84.5)	400(80.8)	
Internship duration				0.784
Less than a month	84(13.3)	18(13.3)	66(13.3)	
1–3 months	500(79.4)	109(80.7)	391(79.0)	
$\geq$ 4 months	46(7.3)	8(6.0)	38(7.7)	
Only child or not				0.579
Yes	137(21.7)	27(20.0)	110(22.2)	
No	493(78.3)	108(80.0)	385(77.8)	
Registered residence				0.448
City	175(27.8)	41(30.4)	134(27.1)	
Countryside	455(72.2)	94(69.6)	361 ( 72.9 )	
Physical activity				0.113
Inadequate	540(85.7)	110(81.5)	430(86.9)	
adequate	90(14.3)	25(18.5)	65(13.1)	
Sedentary time				<0.001***
Less than 3 h	175(27.7)	57(42.2)	118(23.8)	
3–6 h	287(45.6)	54(40.0)	233(47.1)	
More than 6 h	168(26.7)	24(17.8)	144(29.1)	

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

### 3.2. Correlation analysis

Of the 630 participants, 495 (78.6 %) had poor sleep quality, as indicated by a PSQI score of 5 or higher. Table 2 presents the relationship between the main study variables and continuous variables along with their means and SDs. The correlation analysis revealed a significant association of TCM constitution and neuroticism with the PSQI. Neuroticism was negatively associated with sleep quality.

### 3.3. Multiple stepwise regression analysis

The stepwise multiple regression model included several study variables. The dependent variable was the PSQI score. The independent variables included eight demographic characteristics, namely age, sex, education, internship duration, only child status, registered residence, physical activity, and sedentary time; nine items from the CCMQ; and four personality traits from the EPQ-RSC. The results are displayed in Table 3. PSQI scores were negatively associated with gentleness constitution ( $t = -12.940$ ,  $P < 0.001$ ), yang deficiency constitution ( $t = -3.280$ ,  $P = 0.001$ ), education ( $t = -2.673$ ,  $P = 0.008$ ), and sex ( $t = -2.149$ ,  $P = 0.032$ ). Furthermore, PSQI scores were positively associated with neuroticism ( $t = 2.977$ ,  $P = 0.003$ ), sedentary time ( $t = 3.221$ ,  $P = 0.001$ ), damp heat constitution ( $t = 2.741$ ,  $P = 0.006$ ), extraversion ( $t = 2.629$ ,  $P = 0.009$ ), and Yin deficiency constitution ( $t = 2.182$ ,  $P = 0.029$ ). These nine factors explained 44.5 % of the observed variation in PSQI scores.

### 3.4. Mediation analysis

The paths of neuroticism, TCM constitution, and PSQI scores among the nursing interns are shown in Table 4. After controlling for the covariates of sex and education level, the impact of neuroticism on the PSQI was found to be statistically significant. The study found that neuroticism had an indirect effect on PSQI through the gentleness constitution, with an estimated value of 0.060 ( $\beta = 0.221$ , 95 % CI [0.173, 0.272]). Additionally, the indirect effect through the damp heat constitution was estimated to be 0.012 ( $\beta = 0.043$ , 95 % CI [0.016, 0.073]). The overall indirect impact of neuroticism personality on PSQI through the gentleness constitution and the damp heat constitution was shown to be significant ( $\beta = 0.265$ , 95 % CI [0.214, 0.315]). The results suggest that neuroticism directly affects PSQI and also indirectly influences PSQI through the mediating elements of the gentleness constitution and the damp heat constitution. Moreover, the total effect of neuroticism on PSQI was also significant ( $B = 0.110$ , 95 % CI [0.091, 0.130]). As shown in Fig. 2A, the direct path from neuroticism to the PSQI was significant ( $\beta = 0.144$ ,  $P < 0.001$ ). Moreover, the pathways from neuroticism to gentleness constitution ( $\beta = -0.441$ ,  $P < 0.001$ ) and from neuroticism to the damp heat constitution ( $\beta = 0.356$ ,  $P < 0.001$ ) were significant. The pathway from gentleness constitution to the PSQI was significant ( $\beta = -0.502$ ,  $P < 0.001$ ). And The pathway from damp heat constitution to the PSQI was also significant ( $\beta = 0.122$ ,  $P < 0.001$ ). These results suggest that gentleness and damp heat constitution mediate the association between neuroticism and the PSQI.

### 3.5. Moderated mediation analysis

The mediation model was found to be moderated by sedentary time. The moderated mediation model is illustrated in Table 5 and Fig. 2B, controlling for sex and education. Neuroticism significantly predicted gentleness constitution ( $B = -0.520$ ,  $P < 0.001$ ), damp heat constitution ( $B = 0.556$ ,  $P < 0.001$ ), and the Pittsburgh Sleep Quality Index (PSQI;  $B = 0.035$ ,  $P < 0.001$ ). As a goodness-of-fit measure, measures demonstrated that our mediation-only model explains 43.2 % of the variance of PSQI, 21.5 % of the variance of gentleness constitution, and 14.8 % of the variance of damp heat constitution. Sedentary time marginally moderated the direct pathway from neuroticism to the PSQI ( $B = -0.025$ , 95 % CI [-0.046, -0.004]) in the nursing interns. The simple slope analysis suggested that when nursing interns' had less sedentary time, the effect of neuroticism on the PSQI was more pronounced (Fig. 3B). These findings suggest that neuroticism has a greater predictive power for the PSQI in nursing interns with less sedentary time than in those with more sedentary time. Sedentary time marginally moderated the pathway from neuroticism to the damp heat constitution ( $B = 0.175$ , 95 % CI [0.021, 0.329]) in the nursing interns. Fig. 3A illustrates that an increase in sedentary time exacerbates the impact of neuroticism on damp heat constitution.

The moderated mediation model suggested that the direct effect of neuroticism on the PSQI varied at different levels of sedentary behaviour. A statistically significant correlation between the PSQI and neuroticism was observed in individuals with a low or moderate level of sedentary behaviour. However, this correlation was not significant when the level of sedentary behaviour was high (Table 5). Meanwhile, the indirect effect of damp heat constitution was significant at a low level ( $B = 0.008$ , 95 % CI [0.003, 0.015]), moderate level ( $B = 0.011$ , 95 % CI [0.004, 0.018]), and high level ( $B = 0.014$ , 95 % CI [0.005, 0.023]) of sedentary behaviour. This finding suggests that sedentary time moderates the indirect effect of neuroticism on the PSQI through damp heat constitution.

## 4. Discussion

There is increasing concern regarding poor sleep quality among nursing interns. This study found that 78.6 % of nursing interns experienced sleep problems, a rate consistent with that reported in previous studies [8]. In addition, this study identified education, sex, and sedentary time as the primary factors affecting sleep quality; this finding is consistent with those of previous studies [51,52].

Consistent with the findings of previous studies, we observed that nursing interns with a higher level of neuroticism generally reported lower sleep quality [53,54]. One reason for this may be because individuals with a higher level of neuroticism experience

**Table 2**  
Pearson correlations, mean, and standard deviations of the main study variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.PSQI														
2.Gentleness constitution	-0.607**													
3.Yang deficiency constitution	0.308**	-0.617**												
4.Yin deficiency constitution	0.361**	-0.420**	0.329**											
5.Qi deficiency constitution	0.484**	-0.738**	0.620**	0.520**										
6.Phlegm dampness constitution	0.408**	-0.521**	0.427**	0.567**	0.649**									
7.Damp-heat constitution	0.378**	-0.425**	0.357**	0.491**	0.522**	0.729**								
8.Blood stasis constitution	0.385**	-0.512**	0.464**	0.488**	0.604**	0.601**	0.573**							
9.Qi depression constitution	0.503**	-0.695**	0.434**	0.480**	0.697**	0.619**	0.574**	0.634**						
10.Special diathesis constitution	0.305**	-0.426**	0.436**	0.433**	0.475**	0.484**	0.448**	0.550**	0.538**					
11.psychoticism	-0.02	-0.07	-0.016	-0.052	-0.027	-0.053	-0.078	-0.024	0.01	0.094*				
12.extra-version	-0.049	0.217**	-0.003	-0.072	-0.170**	-0.093*	-0.042	-0.079*	-0.146**	-0.038	-0.285**			
13.neuroticism	0.410**	-0.439**	0.247**	0.298**	0.421**	0.375**	0.354**	0.236**	0.572**	0.293**	-0.157**	0.096*		
14.lie	-0.162**	0.206**	-0.133**	-0.177**	-0.223**	-0.300**	-0.289**	-0.238**	-0.297**	-0.158**	0.193**	-0.136**	-0.522**	
M	7.18	59.42	29.8	34.52	37.42	34.26	36.1	30	34.2	22.79	52.19	46.9	53.12	51
SD	3.38	14.99	19.76	17.28	18.79	19.71	20.01	17.45	19.87	18.05	10.54	12.25	12.53	10.05

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001.

**Table 3**  
Multiple stepwise regression analyses of the influencing factors on the scores of the PSQI among 630 nursing interns.

independent variable	B	SE	t	P	95%CI
Gentleness	-0.131	0.010	-12.940	<0.001	-0.151~-0.112
Neuroticism	0.028	0.010	2.977	0.003	0.010-0.047
Sedentary time	0.450	0.140	3.221	0.001	0.176-0.725
Damp-heat	0.017	0.006	2.741	0.006	0.005-0.029
Yang deficiency	-0.022	0.007	-3.280	0.001	-0.036~-0.009
Education	-0.710	0.266	-2.673	0.008	-1.231~-0.188
Extra-version	0.024	0.009	2.629	0.009	0.006-0.041
Yin-deficiency	0.015	0.007	2.182	0.029	0.002-0.029
Sex	-0.626	0.291	-2.149	0.032	-1.198~-0.054

Independent variable assignment: nine constitutions of the Constitution in Chinese Medicine Questionnaire (CCMQ) scores (input with original values); four personality type scores in the Eysenck Personality Questionnaire Short Form Scale China (EPQ-RSC) (input with original values); sedentary time (less than 3 h = 1, 3-6 h = 2, more than 6 h = 3); education (junior college or below = 0, bachelor's degree or above = 1); sex (male = 0, female = 1).

**Table 4**  
Regression results of test mediation effects.

variable	Gentleness constitution			Damp heat constitution			PSQI		
	B	SE	t	B	SE	t	B	SE	t
Neuroticism	-0.527***	0.042	-12.400	0.568***	0.059	9.569	0.039***	0.009	4.127
Gentleness constitution							-0.113***	0.008	-13.879
Damp heat constitution							0.021***	0.006	3.516
Sex	0.351	1.495	0.235	0.626	2.088	0.300	-0.662*	0.290	-2.281
Education	-4.851***	1.374	-3.529	4.730*	1.920	2.464	-0.788**	0.270	-2.920
sample size	630			630			630		
R <sup>2</sup>	0.208			0.134			0.417		
F	54.976***			32.293***			89.286***		

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001.

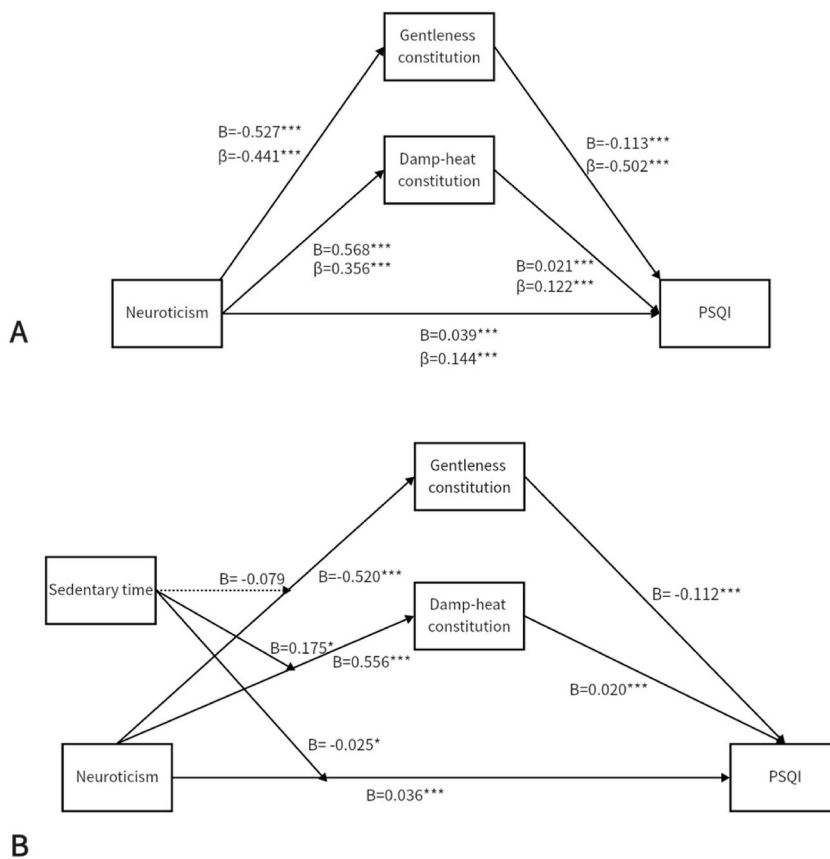
difficulty in regulating their emotions effectively, leading to an increased level of anxiety [19], [55-57]. This constant anxiety may interfere with their ability to fall and stay asleep. In addition, neuroticism is associated with poorer assessments of physical and mental health [58,59]. Individuals with a high level of neuroticism are prone to experiencing negative emotions, which can affect their sleep patterns [60]. Those with high neuroticism scores tend to report more problems than others in general. However, personality traits are often difficult to change [61]. In summary, our study provides a strong rationale for identifying individuals at risk for health issues, such as sleep problems or poor health, based on their personality traits.

This study is the first to investigate the influence of TCM constitution on the association between neuroticism and sleep quality among nursing interns in China. The main finding of this study was that gentleness and damp heat constitution mediated the relationship between neuroticism and sleep quality. Individuals with a higher level of neuroticism tend to have a higher damp heat constitution and a lower gentleness constitution and thus experience poorer sleep quality. Damp heat is a type of biased constitution, reflecting a physiological state of poor health. From the perspective of TCM, the body may exhibit problems before the onset of a disease, which can be defined as a state of suboptimal health [62]. A high level of neuroticism can disrupt the harmony of TCM constitution. Over time, this imbalance can progress and ultimately manifest as insomnia [63]. Thus, the TCM constitution mediates the relationship between neuroticism and sleep quality in practicing nursing interns. According to TCM principles, an individual's physical state can be regulated and improved to minimise their problems and thereby enhance sleep quality [64]. Earlier conditioning is correlated with more favourable results. Considering the presence of damp heat constitution in research results, previous studies have summarised three main intervention methods [65]. Prescription interventions, acupuncture, and health management can effectively regulate damp heat constitution [66,67]. These strategies emphasise basic directions. First, nursing interns' awareness of TCM constitution and sleep quality should be raised through online or face-to-face teaching. In addition, hospitals should help nursing students' regulate biased constitutions.

Previous studies have not adequately focused on the sedentary behaviour of nursing interns. This study revealed that 26.7 % of nursing interns engaged in sedentary behaviour for more than 6 h. Furthermore, sedentary behaviour was found to impact sleep quality among nursing interns; this finding is consistent with that of a previous study [68]. In addition, this study showed that sedentary behaviour moderated the relationship between neuroticism and sleep quality. Specifically, the effect of personality traits on sleep quality decreased as sedentary time increased. This finding implies that reducing sedentary behaviour can be an effective strategy for improving sleep quality, particularly in individuals with a low level of neuroticism [69,70]. Therefore, it is important to recognise personality traits early and implement preventive measures accordingly.

The present study indicated that sedentary behaviour increases the effect of neuroticism on damp heat constitution. Individuals with longer sedentary times and a higher level of neuroticism are more likely to experience imbalances in their TCM constitution. Because neuroticism is challenging to alter, we can focus on improving Individuals' TCM constitution by reducing sedentary





**Fig. 2.** Path results from neuroticism to the PSQI (A) simple mediation model and (B) moderated mediation model.

behaviour, thereby reducing health-related problems. Moreover, sedentary behaviour is easier to measure and assess objectively than are neuroticism and TCM constitution. Thus, some countries have implemented sedentary behaviour intervention programmes in communities and educational institutions [71]. These interventions include sit-stand desks, computerised prompts, and walking strategies [72]. It is crucial to prioritise the development of interventions for sedentary behaviours among nursing interns to address this issue. By reducing sedentary time, we can help this group improve their TCM constitution and thus enhance their psychological state and sleep quality.

## 5. Limitations

This study has several limitations. First, inferences regarding causation could not be made solely based on the cross-sectional design. Furthermore, the study's relevance is limited due to the absence of multi-centre research and the survey being restricted to the central southern regions of China. Furthermore, participants' sedentary time and physical activity were assessed through self-report methodologies, which may not be entirely accurate.

## 6. Conclusion

Our study not only extends the literature on the association between personality traits and sleep quality, especially in nursing interns, but also enhances our understanding of the negative relationship between neuroticism and sleep quality. This study demonstrated that the relationship between personality traits and sleep quality was partially explained by TCM constitution, providing a valuable reference for the early prevention of insomnia. Improving an individual's TCM constitution may be a promising strategy to reduce the risk of insomnia in individuals with a higher level of neuroticism. Finally, this study indicated that sedentary behaviour moderated the relationship between neuroticism and sleep and between neuroticism and TCM constitution. Thus, to improve the quality of sleep among nursing interns, we should focus on reducing sedentary behaviour.

## CRedit authorship contribution statement

**Liang Wang:** Writing – original draft, Data curation. **Zhuoer Huang:** Writing – review & editing. **Qin Zhao:** Data curation. **Lei**



**Table 5**

The moderated mediation effect of sedentary time on the relation between neuroticism and PSQI via gentleness and damp heat constitution.

variable	B	SE	t	LLCI	ULCI
Outcome variable: Gentleness constitution					
Neuroticism (A)	-0.520***	0.043	-12.166	-0.631	-0.436
Sedentary time (B)	-1.329	0.729	-1.823	-2.761	0.102
A * B	-0.079	0.056	-1.404	-0.189	0.031
Model summary: $R^2 = 21.5\%$					
Outcome variable: Damp-heat constitution					
Neuroticism (A)	0.556***	0.060	9.353	0.439	0.673
Sedentary time (B)	2.401*	1.014	2.367	0.409	4.392
A * B	0.175*	0.078	2.239	0.021	0.329
Model summary: $R^2 = 14.8\%$					
Outcome variable: PSQI					
Neuroticism (A)	0.035***	0.009	3.803	0.017	0.054
Sedentary time (B)	0.455**	0.141	3.230	0.178	0.732
A * B	-0.025*	0.011	-2.314	-0.046	-0.004
Gentleness constitution	-0.113***	0.008	-13.943	-0.129	-0.097
Damp-heat constitution	0.020***	0.006	3.474	0.009	0.032
Conditional indirect effects of Neuroticism on PSQI					
Indirect effect: Neuroticism- > Damp-heat constitution- > PSQI					
Low level of sedentary time	0.008*	0.003	-	0.003	0.015
Moderate sedentary time	0.011*	0.004	-	0.004	0.018
High level of sedentary time	0.014*	0.005	-	0.005	0.023
Index of moderated mediation	0.004*	0.002	-	0.000	0.008
Conditional direct effects of Neuroticism on PSQI					
Low level of sedentary time	0.054***	0.012	4.542	0.031	0.077
Moderate sedentary time	0.035***	0.009	3.803	0.017	0.054
High level of sedentary time	0.017	0.013	1.337	-0.008	0.042
Model summary: $R^2 = 43.2\%$					

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

**Dong:** Data curation. **Hongyu Zhao:** Formal analysis. **Xiao Zhu:** Formal analysis. **Lina Gong:** Conceptualization. **Jia Liu:** Conceptualization.

### Ethical considerations

The current cross-sectional study received approval from the ethical committee of the third xiangya hospital (2023-S252). The purpose of this study was informed to participants by the researchers. Prior to commencing the online survey, it was necessary for participants to provide their consent. Participation in the survey was voluntary, without any payment, and fully confidential as no personal information was gathered. Participants were informed that they had the option to withdraw from the study at any point without facing any negative consequences.

### Data availability statement

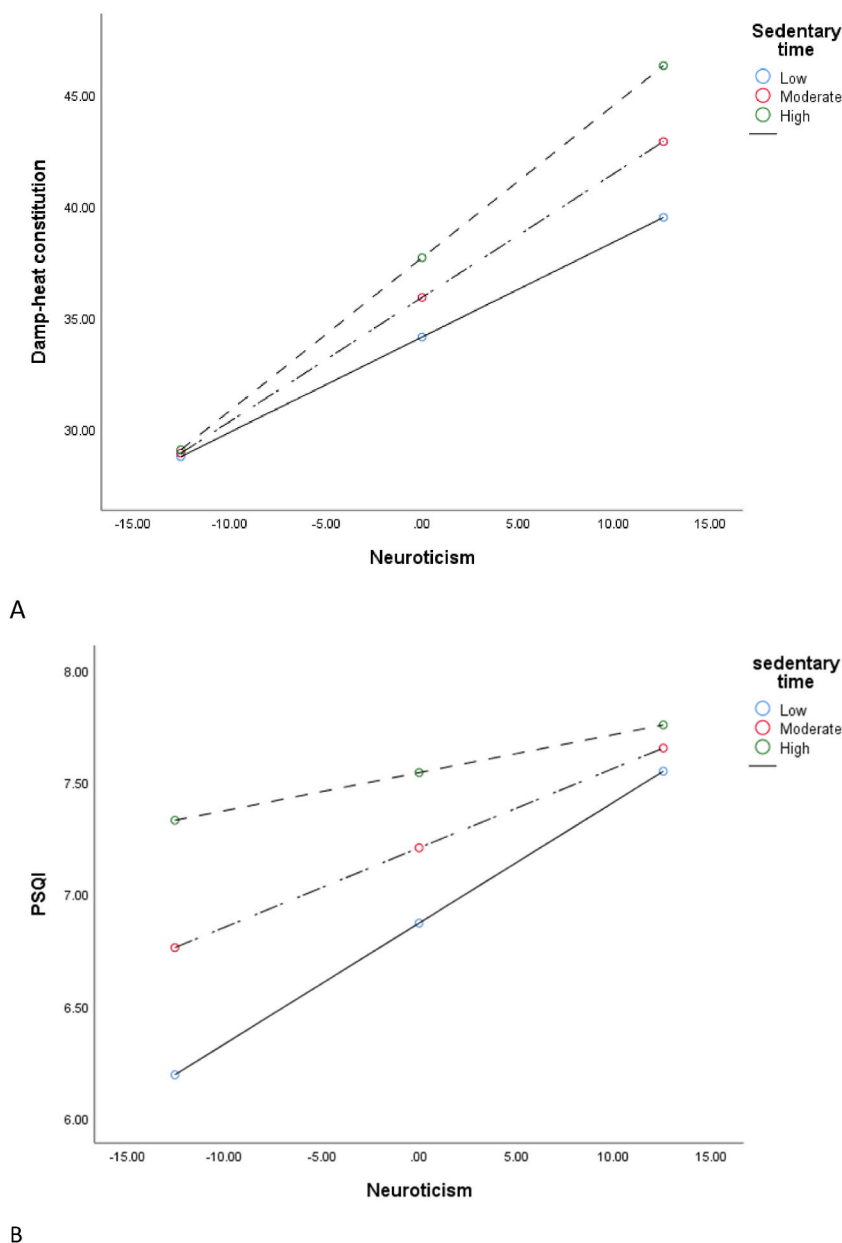
Data associated with this study have not been deposited into a publicly available repository. Data are not available due to the sensitivity of the written statements. The used data are confidential.

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### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.



**Fig. 3.** Conditional direct and indirect effects of neuroticism on damp heat constitution and PSQI, moderated by the level of sedentary time. (A) conditional indirect effect of neuroticism on damp heat constitution; (B) conditional direct effect of neuroticism on PSQI.

#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2024.e39040>.

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