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ORIGINAL RESEARCH

Social Support Mediates the Relationship Between Coping Styles and the Mental Health of Medical Students

Peilin Dai[1,2,*], Guoguo Yi[3,4,*], Dandan Qian[5,*], Zhe Wu[2], Min Fu[6], Hui Peng[1]

[1]School of Nursing, Hunan University of Medicine, Huaihua, Hunan, People's Republic of China; [2]The Second School of Clinical Medicine, Southern Medical University, Guangzhou, People's Republic of China; [3]Department of Ophthalmology, The Sixth Affiliated Hospital, Sun Yat-sen University, Guangzhou, People's Republic of China; [4]Biomedical Innovation Center, The Sixth Affiliated Hospital, Sun Yat-sen University, Guangzhou, People's Republic of China; [5]Department of Clinical Skills Training Center, Zhujiang Hospital, Southern Medical University, Guangzhou, People's Republic of China; [6]Department of Ophthalmology, Zhujiang Hospital of Southern Medical University, Guangzhou, People's Republic of China

*These authors contributed equally to this work

Correspondence: Min Fu, Department of Ophthalmology, Zhujiang Hospital of Southern Medical University, No. 253, Industrial Avenue Middle, Haizhu, Guangzhou, People's Republic of China, Tel +86 18665621066, Email min_fu1212@163.com; Hui Peng, School of Nursing, Hunan University of Medicine, No. 492, Jinxi South Road, Huaihua, Hunan, People's Republic of China, Email pengh533@163.com

Purpose: This study aimed to explore the impact that coping styles and social support have on the mental health of medical students by constructing a corresponding structural situation model that reveals the complex relationship between these three factors. In doing so, it seeks to help medication students better manage mental health problems.

Patients and Methods: The online study was conducted between March 6, 2021 and May 6, 2021. A total of 318 participants from multiple medical schools were involved. The general information questionnaire, simple coping style questionnaire (SCSQ), perceived social support scale (PSSS) and symptom checklist 90 (SCL-90) were used to collect relevant information from the subjects by snowball sampling. An independent *t*-test, ANOVA, Pearson correlation coefficient analysis, and intermediary effect analysis were all used to analyze the relevant data and construct the structural equation model.

Results: There was a significant difference in SCL-90 between medical students and national college students (1.78±0.70, $P < 0.001$), and the positive rate of mental health status was as high as 40.3%. Sleep quality, regular diet, and positive coping style were positively correlated with mental health ($P < 0.01$), while negative coping styles and total scores of coping style as well as family, friends, and other sources of social support and total scores of social support were negatively correlated with mental health problems ($P < 0.01$). Positive and negative coping styles have an impact on mental health through the mediating effect of between social support and coping styles, as well as in the direct pathway.

Conclusion: The mental health status of medical students was significantly poor. Medical schools should thus pay close attention to the mental health status of students and encourage them to develop healthy living habits, optimize coping styles, and establish stable sources of social support to improve their psychological wellbeing.

Keywords: mediating effect, structural equation model, questionnaire investigation, psychological wellbeing

Introduction

Medical students are a distinct group that experience intense academic pressure and burnout due to the fact that their enrollment in professional courses and high-intensity practice make it difficult to balance their work, education, and personal lives.[1,2] They face a variety of financial, social, and psychological challenges that can impact their mental health. For instance, medical students undergo a long training cycle and carry heavy economic burdens.[3] They also have to contend with a widely-held social belief that doctors are the ones who shoulder the responsibility of saving lives and must grapple with the ethical and psychological pressure of facing death. Moreover, within the context of social networking, doctors feel the weight of public opinion like never before, and increasingly sophisticated medical

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technology has created stricter requirements for medical students. All of these factors jointly contribute to a tendency among medical students to strive for unrealistic perfectionism.[4–7] Perfectionism is strongly positively correlated with mental health problems, and intense medical specialty and fierce employment competition pose career planning challenges to medical students.[8–10] A tense doctor-patient relationship that often plays out in medical environments also contributes to the sense of uncertainty that medical students experience when considering their future work.[11,12] A large number of studies that have taken place around the world show that medical students have more serious mental health problems than their peers and the general population;[13–22] however, compared with a large number of studies on medical students' mental health problems, research that investigates the coping styles and social support networks of medical students is limited. Exploring how coping styles and social support affect the mental health of medical students could help identify specific solutions that are likely to improve the situation and cultivate a new generation of doctors with strong levels of physical and mental health.[23,24]

Coping style refers to specific behavioral and psychological efforts to master, tolerate, reduce, or minimize stress events. Previous studies have shown that positive coping styles can improve outcomes by generating positive emotions and behaviors, while negative coping styles may cause mental health problems.[25] Nevertheless, some studies have found that negative coping styles are beneficial in that they can relieve psychological stress and allow individuals to temporarily cope with adverse environments.[26] Many studies indicate that coping style has a significant impact on mental health status and produces direct or intermediary effects,[27,28] which means that targeting this factor may be an effective means of intervening in the mental health status of medical students. Social support refers to all types of spiritual and material support that individuals obtain through social relations. Strong social support can help people resist setbacks from work, study, and life, relieve pressure,[29] and enhance their self-confidence when facing challenges or difficulties. Many studies have shown that social support positively impacts mental health.[30,31] Medical students often confront strenuous work and course tasks, and they usually do not have enough free time to relax. They require strong social support that can provide them with spiritual motivation, encourage them to maintain a balanced psychological state, and ultimately allow them to realize the continuity of their work and study. Therefore, our study puts forward the following assumptions:

Hypothesis 1: Coping style and social support can significantly predict the mental health status of medical students.

According to previous study, coping style and social support contribute to an individual's level of resilience to mental health problems.[32] Assessment support can change an individual's perception of threats and impact their coping abilities when they are experiencing psychological pain caused by stress.[33] Generally speaking, emotional factors, such as the belief in social support, can predict behavior more effectively than cognitive factors.[34,35] A study from Pakistan[36] demonstrated that ineffective coping mechanisms and a lack of social support can lead to poor academic performance among medical students. For medical students who work in insular academic environments, perceived stress and low levels of social support are more common than they are in general populations.[37] Medical students require more support than students of other majors,[38] and social support can influence the way that they deal with difficulties and setbacks. According to existing research, social support can affect the relationship between health literacy and depression through mediating effects.[39–41] For instance, Dunn et al[42] proposed that both negative and positive inputs, including psychosocial support, would affect a student's personal coping ability.[43] Although we speculate that social support can affect the relationship between coping style and mental health, the exact role that it plays in this dynamic remains a mystery. Therefore, we also put forward the following assumption:

Hypothesis 2: Coping style affects the mental health status of medical students through the intermediary of social support.

Therefore, this online study establishes and verifies the model based on the above two hypotheses, aiming to explain the internal correlation and causal relationship between coping style, social support and mental health of medical students.

Materials and Methods

In this study, the general information questionnaire, simple coping style questionnaire (SCSQ), perceived social support scale (PSSS), and symptom checklist 90 (SCL-90) were used to analyze medical students. The purpose of this research was to better understand the coping style, social support, mental health status, and related influencing factors of this group and reveal their internal relationship through a structural equation model (SEM) to provide theoretical reference for the prevention and intervention of the mental health problems of medical students. After a manual screening and discarding the questionnaires of the abnormal value with high consistency of options and too short answer time (<5min), 318 valid questionnaires were retained. The effective rate of the questionnaire was 96.36%. In the course of receiving the data, the consent of the subjects is obtained, and the personal data and results are kept confidential.

Participants and Procedures

In this survey, the participants were medical students who were attending different medical colleges and universities dominated by Southern Medical University and Sun Yat-sen University and Nanchang University Medical School in China. The inclusion criteria was that students who were included in this study needed to be majoring in medicine and had to have been born after January 1, 2000. The exclusion criteria was that participants who selected the same choices to all of the questions in the questionnaire were excluded, as were participants who were suspended or dropped out of school. Considering that the survey period took place during the COVID-19 epidemic, all the questionnaires in this study were completed using a professional online questionnaire software called Questionnaire Star by snowball sampling. Advertisements in the form of linkage, QR codes and text messages were given in social platforms like WeChat and Tencent to invite medical students to participate in the study about mental health. The questionnaire consisted of two screens, with 135 questions in total. It took 6 minutes on average to complete the questionnaire, and people were given 1 to 2 yuan RMB for their participation at random. We prevented reduplicate participation by IP control. During the period from March 6, 2021 to May 6, 2021, 330 complete questionnaires were collected through the online platform after 360 questionnaires were started. Due to the mandatory completion before submission, all collected questionnaires had no missing values.

Materials

General Information Questionnaire

The demographic information and basic living conditions of the subjects were investigated using self-made items that inquired about gender, age, whether they were an only child, whether their parents were alive, whether they were single, whether they had never been in love, how often they stay up late, their sleep quality, and whether they ate regularly and exercised (Supplementary Table 1). Staying up late was artificially defined as falling asleep after 12:00 am or staying up all night. The frequency of staying up late was divided into five different levels: almost every day, 3–5 times a week, 1–2 times a week, 1–3 times a month, and almost never. Sleep quality was scored on a four-point Likert scale (1 = excellent; 4 = insomnia), adapted from subjective sleep quality assessment in the Pittsburgh Sleep Quality Index. The design of exercise items referred to the method mentioned above.

Simple Coping Style Questionnaire

The Chinese version of the Simplified Coping Style Questionnaire (SCSQ) was used to evaluate the coping style tendency of subjects. Coping style is the cognitive and behavioral style that individuals adopt while under pressure or facing psychological distress. The scale was adapted from the foreign coping style scale and is considered to align with the characteristics of the local population. It shows high reliability and validity in other studies and constructs a two-dimensional model that includes positive and negative coping styles.[44] The questionnaire contains 20 items. The combination of positive coping dimensions (items 1–12) and negative coping dimensions (items 13–20) reflect the characteristics of different coping styles and their relationship with mental health.[45] This scale adopts multi-level scoring, and after each coping style item, there are four options: never, occasionally, sometimes, and often (the corresponding scores are 0, 1, 2, and 3). The subjects chose the corresponding options based on their own situation. The results were the respective average scores of positive and negative coping dimensions. The standard score is obtained by Z conversion

between positive coping style and negative coping style; that is, the standard score Z = (actual score – sample average score) / sample standard deviation. The final result was as follows: coping tendency score = positive coping standard score – negative coping standard score. If the score of coping tendency is more than 0, the higher the score, the greater the possibility that the participants possessed positive coping styles. However, if the score is less than 0, the lower the score, the greater the likelihood that they are more inclined to negative coping styles. Due to its convenience and practicability, the scale has been widely used and is proven to have good reliability and validity.[44,46–48] The Simple Coping Style Questionnaire showed high internal consistency (the Cronbach's α = 0.807) in the study, The Kaiser–Meyer–Olkin Measure of Sampling Adequacy (KMO) was 0.816, with the significance of Bartlett's test of sphericity <0.001. A total of 5 factors were obtained by rotation, with each factor including 3 to 5 items, and the factor load was between 0.527 and 0.899, larger than the acceptable value of 0.35.

Perceived Social Support Scale

Perceived Social Support scale (PSSS) is a social support scale used to reflect individual self-feeling. It is used to measure the various social support sources that individuals perceive, such as the level of support that they receive from family, friends, and others, and can reflect the total degree of social support that an individual experiences.[49] Social support refers to psychological and material support or encouragement from family or friends while under stress. The support of social relations can affect the way that individuals understand their surroundings, play an essential role in formal and informal support networks,[50] and reflect the closeness and quality of a person's relationship with society. This domestic scale was revised in 1999 based on the perceived social support scale that Zimet complied in 1987.[51] PSSS includes 12 self-assessment items. Each item adopts the seven-level scoring method of Likert scale 1–7 and is divided into seven levels: extremely disagree, strongly disagree, slightly disagree, neutral, slightly agree, very agree, and strongly agree. It also consists of three subscales: family support (items 3, 4, 8 and 11), friend support (items 6, 7, 9 and 12), and other sources of support (including teachers, classmates, and relatives). The total score of the scale is calculated by adding all the item scores. The higher the score, the higher an individual's degree of social support. When the total score is between 12 and 36, it indicates a low support state. If the total score is between 37 and 60, it implies an intermediate support state, and a total score between 61 and 84 is considered to reflect a high support state. Similarly, because it is a simple scale suitable for domestic populations, PSSS is also widely used in various specific populations and shows excellent effects.[52–54] The Cronbach's α coefficient for PSSS was 0.952 in this study. The KMO was 0.936, with the significance of Bartlett's test of sphericity <0.001, indicating that factor analysis suitable, and the factor load was between 0.657 and 0.879. The two factors had 4 and 8 items respectively.

Symptom Checklist-90

Symptom Checklist-90 (SCL-90) is one of the most famous mental health test scales in the world and contains 90 items that reflect on a subject's somatization, obsessive-compulsive symptoms, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoia, psychosis, and other dimensions of their wellbeing, such as sleep and diet. The score of each item is 1–5, and the total score is the sum of the scores of all 90 items. The score of each dimension = (the sum of scores of subscales of this dimension) / (the number of items of this dimension). If the dimension score exceeds 2 points, it indicates that the dimension is positive. The number of positive items refers to the total number of items with a score greater than 1. SCL-90 positive means that the total score is more than 160, the number of positive items is over 43, or the score of any dimension is larger than 2. Positive results indicate that the subjects might have mental health problems in a certain dimension. The scale is widely used by researchers around the world[55–57] because it can accurately reflect the multi-dimensional mental health status of subjects. The Cronbach's α coefficient for SCL-90 was 0.987. The KMO was 0.970, with the significance of Bartlett's test of sphericity <0.001.

Data Analysis

We used Amos 26.0, SPSS 26.0, and PROCESS 3.2 macro (IBM Crop) to examine and sort through the questionnaire data, conduct variable transformation and data analysis, and construct the structural equation model. The measurement data was represented by mean and standard deviation or median and interquartile range, and the counting data was

represented by frequency and composition ratio (%). Pearson correlation analysis was used for bivariate normal distribution data whose independent variable was continuous, and Spearman correlation analysis was used for non-bivariate normal distribution data. According to the central limit theorem,[58] when the sample size is large, *t*-test can be used even if the data does not meet the normal distribution. Thus, an independent sample *t*-test was applied to compare the data of this study with the national norm. ANOVA and mediation effect analysis were conducted between other variables in the questionnaire and the total score of SCL-90. After selecting appropriate variables, the feasibility of factor analysis was verified by KMO and Bartlett's test of sphericity. The reliability and validity of the data were also tested using Cronbach's α coefficient and multifactor confirmatory factor analysis (CFA). Finally, the SEM that can clearly show the internal correlation among the factors was constructed by Amos. $P < 0.05$ indicated that the difference was statistically significant.

Results

Descriptive Statistics and Sample Characteristics

This study investigated 318 medical students. The sample included 94 males (29.56%) and 224 females (70.44%) who were 17 to 21 years of age (mean = 19.88 years, SD = 1.01). Eighty-seven (27.36%) of participants had no siblings, 239 participants were single, 168 participants had never been in love, and 9 participants unfortunately suffered the death of their parents. With respect to living habits, only 20 participants said that they hardly stayed up late (staying up late was defined as falling asleep after 12:00 pm or staying up all night to study), while 112 participants (35.22%) said they stayed up almost every night and 56 people (17.61%) said that their sleep quality was poor, of which 9 had insomnia. Fifty-nine subjects admitted that they had an irregular diet, and 69 of the participants admitted that they hardly exercised. Through one-way ANOVA, significant statistical differences in sleep quality and diet were discovered. Table 1 shows the descriptive statistics of the sample.

There were 189 students' SCL scores lower than 160, indicating that only 59.43% medical students were in a good mental health. Only 9 students (2.83%) in our study held low social support, and 39.62% students held middle social support. The students with high social support occupied 57.55%, similar to the proportion of students with good mental health. The proportion of negative coping style is 25.47%, and the one of positive coping style is 74.53%. Moreover, comparing the SCL-90 score of medical students obtained in this study with the national college student norm (Supplementary Table 2) revealed significant differences between medical students and other college students in the dimension of paranoia and the total score of SCL-90 ($P < 0.001$). The score of our subjects in the dimension of paranoia (1.66±0.73) was obviously lower than the national college student norm (1.84±0.63, $t = -4.420$). By contrast, the total score of SCL-90 of medical students (1.78±0.70) was apparently higher than the norm (1.63±0.51, $t = 3.762$). This study mainly determined the sample size based on mental health status. As the sample size of the national survey is 2685, our preset allocation ratio was 8:1. With an α of 0.05, 2-tailed testing, power of 0.80, and the effect size of d=0.5 in preset independent sample *t*-test, we estimated that 320 participants needed to be recruited by G*Power (3.1.9.7 for Windows XP, Vista.). Within the acceptable error range, the final actual sample size is 318.

Table 1 The Descriptive Statistics of SCL-90, PSSS, and SCSQ

Variables	Categories	Numbers (N=318)	Proportions
SCL-90	SCL-90 ≥160	129	40.57%
	SCL-90<160	189	59.43%
PSSS	Low social support(12–36)	9	2.83%
	Middle social support(37–60)	126	39.62%
	High social support(61–84)	183	57.55%
SCSQ	Negative coping style	81	25.47%
	Positive coping style	237	74.53%

Abbreviations: SCL-90, Symptom Checklist-90 Score; PSSS, perceived social support scale; SCSQ, simple coping style questionnaire.

Correlation Analysis

Table 2 shows the mean, standard deviation, and binary correlation between the main variables. There was no significant correlation between the dimensions of social support (family support, friend support, and other sources of support) and negative coping styles; however, there was a significant correlation between the other main variables. SCL-90 score mainly reflects mental health status. In our analysis, there was a significant negative correlation between positive coping styles, an individual's mental health status, and the three dimensions of social support and mental health status. There is a positive correlation between other relevant variables.

Verification of Mediation Effect

In order to verify the mediation effect, this study applied Baron's multiple linear regression to verify the mediation model.[59] This study constructed three models to verify the mediating role of social support between coping style and mental health status. Similar to the previous study with Chinese college students with disabilities,[60] model 1 also showed that coping style had a significant predictive effect on mental health ($\beta = -0.470$, $P < 0.001$). And model 2 demonstrated that coping style had a significant predictive effect on social support ($\beta = 0.434$, $P < 0.001$). Moreover, when social support and coping style were included in the regression model as predictors (model 3) just like the programme of a multicenter survey,[61] the prediction effect of the model on mental health was still significant. Then, model 4 was established through SPSS-PROCESS macro, which was an intermediary model based on a bootstrap method. The result indicated that 95% CI did not contain 0 [95% CI = (−2.174, −1.002)], which meant that coping style was related to mental health status but did not indirectly affect mental health status through social support. Table 3 illustrates the details.

Next, we used the previously mentioned sleep quality—which could significantly affect mental health status according to previous studies[62,63] —as the mediator between coping style and mental health status and established a model for verification.[64] Model 1 is the same as the model mentioned above and is used to predict SCL-90 score through SCSQ. Model 5 showed that sleep status had a notable impact on coping style ($\beta = -0.246$, $P < 0.001$). Zhang et al Indicated that coping style played a partial intermediary role in the relationship between sleep quality and depression symptoms of nursing students.[65] After incorporating sleep status and coping style into the regression model as predictive variables (model 6), our result revealed that the prediction effect of the model on mental health status was still satisfactory. Coping style and social

Table 2 Descriptive Statistics and Correlations Among the Main Variables

Variables	Mean	SD	PCS	NCS	FASS	FRSS	OSS
PCS	2.01	0.45	1.000				
NCS	1.35	0.51	0.153**	1.000			
FASS	20.61	4.79	0.379***	−0.053	1.000		
FRSS	20.98	4.34	0.530***	0.015	0.674***	1.000	
OSS	20.93	4.41	0.529***	0.001	0.692***	0.845***	1.000
SCL-90	160.00	63.07	−0.289***	0.325***	−0.280***	−0.266***	−0.296***

Notes: **$p<0.01$; ***$p<0.001$.
Abbreviations: SD, standard deviation; PCS, positive coping style; NCS, negative coping style; FASS, family social support; FRSS, friend social support; OSS, other social support; SCL-90, Symptom Checklist-90 Score.

Table 3 Analysis of Mediating Effect of Social Support Between Coping Style and Mental Health

Categories	Effect Value	Boot SD	LLCI	ULCI
Total effect	−27.925	3.638	−32.047	−17.667
Direct effect	−24.569	3.252	−30.967	−18.170
Mediating effect	−3.356	1.750	−6.636	0.360

Abbreviations: Boot SD, boot standard deviation; LLCI, boot confidence interval lower limit; ULCI, boot confidence interval upper limit.

Table 4 Model Parameters Among Sleep Quality and the Main Variables

Variables		SCSQ	Sleep Quality	PSSS	R^2	F
Model1(SCL-90)	β	−0.470			0.221	89.543***
	t	−9.463***				
Model5(SCSQ)	β		−0.246		0.061	20.397***
	t		−4.516***			
Model6(SCL-90)	β	−0.413	−0.230		0.270	58.372***
	t	−8.323***	−4.628***			
Model8(SCL-90)	β			−0.310	0.096	33.494***
	t			−5.787***		
Model9(PSSS)	β		−0.157		0.025	7.984***
	t		−2.826**			
Model10(SCL-90)	β		0.290	−0.264	0.178	34.089***
	t		5.609***	−5.104***		

Notes: **p<0.01; ***p<0.001.
Abbreviations: SCL-90, Symptom Checklist-90 Score; SCSQ, simple coping style questionnaire; PSSS, perceived social support scale.

support are important mediating and regulating factors in the process of individual psychological stress, which have an important impact on individual mental health.[66,67] Therefore, we applied the same method used to build model 4 to establish mediation model 7. The result indicated that coping style was not only directly related to mental health status but also indirectly affected mental health status through sleep status. After replacing coping style with social support, model 8–10 were established in the same way (as shown in Table 4). Similar to previous research results,[68,69] our research also showed the beneficial roles of social support for mental health, and displayed that higher levels of social support are related to lower levels of mental health.

The final results illustrated that sleep quality had a similar mediating effect between social support and mental health. Figure 1 displays the specific relationship network. Sleep quality had partial mediating effects between coping style and mental health and between social support and mental health, and the relative effects were 12.04% and 14.71%, respectively. Table 5 describes the details of the mediating effects of sleep quality.

Construction of Structural Equation Model

According to the regression analysis of model 1, 2, 3 and 8, there were significant correlations between (positive and negative) coping styles and mental health and between social support and mental health in regression analysis, similar to previous studies.[46,61,70] We constructed several SEMs between coping style, social support and mental health, but the attempts failed. Subsequently we further analyzed the internal structure of latent variables. Ultimately, we included PCS, NCS, social support and mental health into SEM. In line with the rule-of-thumb of 10 cases per variable, the number of

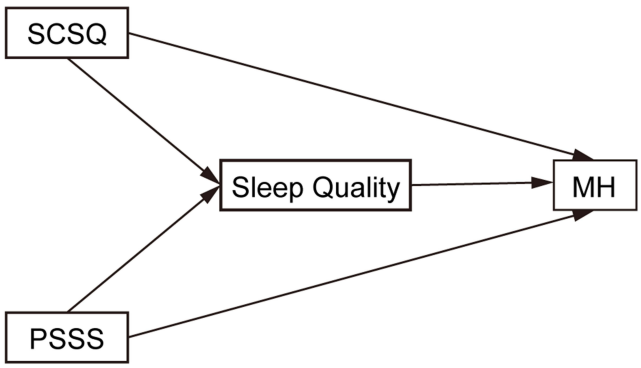

Figure 1 Theoretical framework for the mediating effect of sleep quality.
Abbreviations: SCSQ, simple coping style questionnaire; PSSS, perceived social support scale; MH, mental health.

Table 5 Decomposition Table of Mediating Effects of Sleep Quality

Effect Type	EV	Boot SD	LLCI	ULCI	REV
Mediating effect in coping styles					
TE	−27.925	3.052	−30.555	−18.675	
DE	−24.562	3.044	−30.479	−18.617	87.96%
ME	−3.363	1.317	−6.299	−1.182	12.04%
Mediating effect in social support					
TE	−1.591	0.312	−1.973	−0.745	
DE	−1.357	0.266	−1.880	−0.834	85.29%
ME	−0.234	0.103	−0.458	−0.057	14.71%

Abbreviations: TE, total effect; DE, direct effect; ME, mediating effect; EV, effect value; Boot SD, boot standard deviation; LLCI, boot confidence interval lower limit; ULCI, boot confidence interval upper limit; REV, relative effect value.

participants was deemed sufficient for SEM. Subsequent analysis revealed that taking the two dimensions of positive coping and negative coping as potential variables alone could realize the construction of the structural equation model. After analysis, the KMO value was 0.900, and Bartlett's test of sphericity significance was < 0.001, which indicated that the data was suitable for factor analysis. Concurrently, considering the limitation of the number of items of sleep quality and other variables (not enough to build SEM), they were not included in the SEM. We used SEM to verify the model shown in Figures 2 and 3. The path coefficient of the link between positive copying style and negative copying style was not significant enough. At this point, we reviewed the model by changing the path. The factor loading of the items is demonstrated in Table 6.

After maximum likelihood estimation, multi factor CFA was performed, and the model performed excellently: GFI=0.932; AGFI=0.904; NFI=0.958; IFI=0.977; CFI=0.977; TLI=0.972; RMSEA = 0.059. Positive and negative coping style accounted for 25% of the variance of social support. Positive coping style, negative coping style, and social support accounted for 25% of the variance of mental health problems. Social support and positive coping style were significantly negatively correlated with mental health problems ($\gamma = -0.20$ and -0.15, $P < 0.01$ and < 0.05). There was a significant positive correlation between negative coping styles and mental health problems ($\gamma = 0.38$, $P<0.001$). Negative coping style was negatively associated with social support ($\gamma = -0.13$, $P < 0.05$), while positive coping style was positively connected with social support ($\gamma = 0.48$, $P < 0.001$).

Discussion

Mental health is an important factor that affects the careers of medical students. Many medical students cannot successfully complete their studies or interrupt their medical career because of mental health problems that emerged before they officially became doctors.[71] Therefore, mental health management and intervention of medical students plays

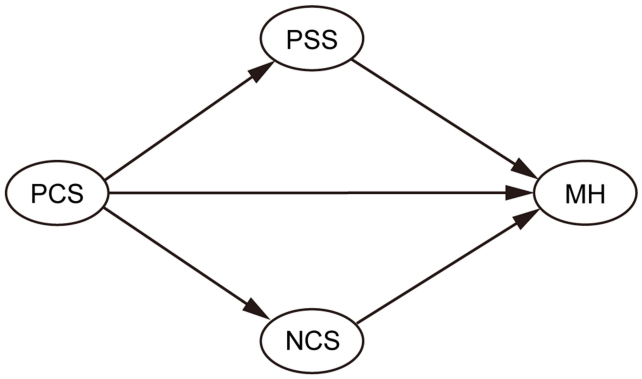

Figure 2 Envisaged structural equation model framework.
Abbreviations: PCS, positive coping style; PSS, perceived social support; NCS, negative coping style; MH, mental health.

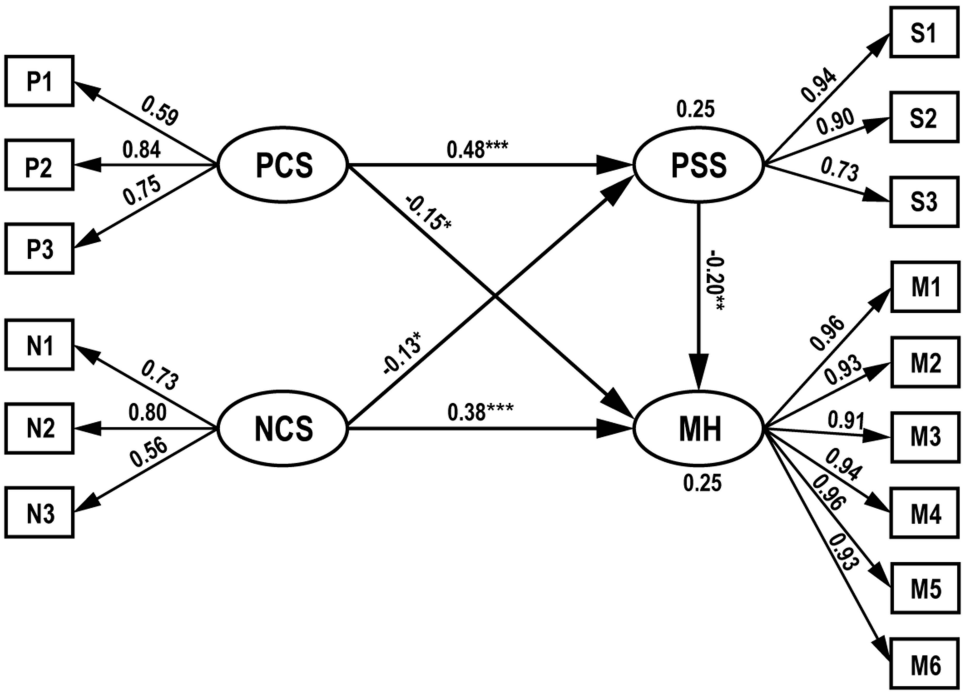

Figure 3 Final structural equation model framework.
Notes: *p<0.05; **p<0.01; ***p<0.001.
Abbreviations: PCS, positive coping style; PSS, perceived social support; NCS, negative coping style; MH, mental health.

an essential role in the cultivation of future doctors. Compared with the national norm for college students, the overall mental health status of medical students was worse, which was consistent with a large number of previous research findings. Though the dimension of paranoia was significantly better for medical students than the general college student population according to the SCL-90 scale, there was no significant difference in the other dimensions; however, from the perspective of the total score and average score of this scale, the situation was not optimistic. It is acknowledged that the threshold of SCL-90 scale to determine the positive mental health status is 160, and if the score exceeds 160, the subject

Table 6 The Related Parameters of the Final SEM Items

Latent Variables	Items	*p*-value	Factor Loading	CR
PSS	S1		0.936	0.895
	S2	<0.001	0.902	
	S3	<0.001	0.731	
NCS	N2		0.802	0.744
	N3	<0.001	0.562	
	N1	<0.001	0.730	
MH	M4		0.938	0.978
	M5	<0.001	0.964	
	M6	<0.001	0.927	
	M3	<0.001	0.909	
	M2	<0.001	0.932	
	M1	<0.001	0.955	
PCS	P1		0.590	0.774
	P2	<0.001	0.835	
	P3	<0.001	0.755	

Abbreviations: CR, construct reliability; PSS, perceived social support; NCS, negative coping style; MH, mental health; PCS, positive coping style.

can be considered to have mental health problems. The average value of the total score obtained in this study was exactly equal to 160, which means that there is an urgent need to improve the mental health of medical students.

Medical students generally have poor sleep quality, and there is a trend towards sleep deterioration that has emerged in recent years.[72,73] This study revealed that sleep quality can significantly predict the mental health status of medical students. It is worth mentioning that the effect is mutual, and mental health can also obviously predict an individual's quality of life, including sleep quality. There was a two-way predictive relationship between poor sleep quality and mental health problems. Methods to improve sleep quality, such as taking sleeping pills or other effective interventions, may promote mental health. Conversely, mental health treatment may also improve sleep quality.[74] In our study, sleep quality had partial mediating effects between coping style and mental health and between social support and mental health. In other words, coping style and social support can not only directly affect mental health but also have the ability to further affect mental health by impacting individual sleep quality, though our data showed that their relative effect values were not very high (12.04%, 14.71%). With respect to the relationship between sleep quality and mental health, previous studies have shown that an increase of glucocorticoid is linked to mental health problems. The operation of human endocrine system is affected by circadian rhythm. Poor sleep quality interferes with normal hormone secretion and regulation of the body, which affects the content of glucocorticoid in blood and impacts mental health.[75,76] This suggests that improving sleep quality could bolster the mental health of medical students and that ensuring they have adequate amounts of sleep is the first step towards helping this particular student group.

Unhealthy eating patterns are also common among medical students, despite the fact that they are knowledgeable about the harm these habits can have on their health. Resolving this particular situation seems more possible in recent years, however, due to a shift in the general public's attitudes towards eating and living habits.[77,78] An unhealthy diet can manifest as skipping meals, eating snacks instead of dinner, low intake of fruits and vegetables, and high intake of fast food or carbonated drinks. The research suggested that the eating habits of female medical students were worse than those of male students.[79] Although this study analyzed gender as an independent variable within mental health status, the results show that gender has no significant impact on mental health status. A study in Japan[80] showed that serum albumin content was linked to psychological distress, which means that unhealthy diet may affect the content of nutrients in the human body, thereby increasing the risk of mental health problems. A separate review[81] also extensively collected evidence that diet plays an important role in emotional and mental health and also found that diet can affect mental states by changing the content of nutrients in the body and altering hormone levels. For instance, excessive intake of sodium salt can increase the ratio of sodium to potassium, lead to progesterone secretion, change brain nerve activity, and result in emotional deterioration.[82,83] Hence, encouraging medical students to eat in the school canteen, balance their diet, and adjust their eating habits may be a solution worth pursuing to optimize their mental health.

Coping styles are divided into two dimensions: positive coping and negative coping. Individuals often deal with stress events and manage the corresponding emotional states through coping styles.[84] In the current study, the mental health status of medical students was significantly regulated by coping styles, especially negative coping styles, which can obviously increase the risk of mental health problems. Among college students, life stress is related to the increase of negative coping styles. Negative coping styles are often risk factors for mental health problems, such as suicidal ideation and depression.[85–87] Thus, a vicious circle can emerge between negative coping styles and adverse life stress events, ultimately worsening mental health. Positive coping style was a protective factor of mental health, which is consistent with previous research results.[88]

As predicted in hypothesis 2, we discovered that coping styles can indirectly affect the mental health of medical students through the intermediary effect of perceived social support. The intermediary effect of social support played a greater role in positive coping styles than in negative coping styles. The results suggested that positive coping styles can alleviate the pressure and negative emotions caused by adverse life events through high-level social support, which can reduce the risk of mental health problems. Medical students' perceptions of social support come from interpersonal relationships and a sense of belonging. Improving the humanistic atmosphere in their learning workplace is more likely to promote the positive development of their social support,[89] thereby reducing the probability of mental health problems. Social support was the protective factor of mental health in this study. Previous studies have illustrated that the lack of social support is often closely related to mental health problems, such as anxiety disorders, depression,[84,90] and

schizophrenia.[91] In addition, as other studies have demonstrated, social support not only contributes to the mental health of the general population but also plays a role in helping patients with respiratory diseases cope with dyspnea crisis.[92] Moreover, this study adopted the perceived social support scale that reflects the subjective perceived physical and mental support from others, which may differ from objective social support. We believe that perceived social support has a more accurate predictive effect on mental health than objective social support because mental health is closely related to personal subjective feelings logistically, but more research is needed to confirm this idea.

In this study, we creatively analyzed the relationship between the mental health and social support and coping styles of medical students, filling the gap of relevant researches, and putting forward targeted strategies to improve the current situation. There are also some limitations in our study: The number of samples is limited, which may affect the results and conclusions. The study is a cross-sectional study, and the sample is not nationally representative. For our study, the females occupied the majority of the sample (70.44%), and it mainly represented the mental health of women. Due to the excessive number of questions in the questionnaire, we did not fully include the authoritative sleep quality scale. Therefore, the sleep quality results we have evaluated are only indicative and further research is needed to confirm our conclusions about sleep quality. A potential deficiency of this study is that when the questionnaire was issued, the COVID-19 epidemic was still ongoing. By the time students filled out this questionnaire, they had returned to medical colleges or practice bases for normal study or practice; however, the impact of COVID-19 on medical students was not taken into account in the design of this study, though this unusual social environment would inevitably affect the mental health status of medical students to a certain extent. This aspect needs to be supplemented by follow-up research.

Conclusion

We found that mental health status was severe among medical students and that these poor results were linked to sleep quality and unhealthy diet. In addition, we discovered that sleep quality was the mediator between coping style and mental health and between social support and mental health. Positive and negative coping styles could significantly predict mental health status and also had an impact on mental health status through the mediating effect of social support. Our findings provided a valuable theoretical reference for improving the mental health of medical students. Future clinical practice could formulate intervention strategies based on these findings to improve the mental health of medical students and help cultivate future doctors with healthy psychological characteristics.

Human Ethnics Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of Zhujiang Hospital (protocol code 2021-KY-005-01 and date of approval February 10, 2021). Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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Disclosure

The authors report no conflicts of interest in this work.

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