

Hope During the COVID-19 Epidemic Decreased Anxiety and Depression Symptoms Mediated by Perceived Stress: Coping Style Differences Among Patients with COVID-19*

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[Abstract] Objective: This study aimed to investigate whether perceived stress mediated the relationship between hope and anxiety/depression symptoms among patients with COVID-19 during the epidemic. In addition, the potential moderating effect of coping styles was examined. **Methods:** From February 26 to March 10, 2020, patients with COVID-19 were asked to complete a questionnaire online, which included demographic characteristics, as well as the SCL-90-Anxiety, SCL-90-Depression, Chinese Perceived Stress Scale (CPSS), Herth Hope Index (HHI), and Trait Coping Style Questionnaire (TCSQ). Hierarchical linear regression was performed to explore independent factors of anxiety/depression. A multi-group structural equation modeling with the collected data from patients in the Negative Coping style (NC) group and Positive Coping style (PC) group was used to test the hypothesized mechanism. **Results:** In total, 382 valid questionnaires of patients were obtained, including 96 from NC patients and 286 from PC patients. In the hierarchical linear regression, hope and perceived stress were independent risk factors for both anxiety and depression in the total sample and PC group. However, hope was not independently related to anxiety/depression in the NC group. As hypothesized, the hope of patients had significant and negative indirect effects on both anxiety and depression that were mediated by perceived stress. However, the direct effect from stress on anxiety and depression was stronger for NC patients than for PC patients. Besides, hope had significant direct effects on anxiety/depression in PC patients, but not in NC patients. **Conclusion:** During the COVID-19 epidemic, perceived stress could mediate the relationship between hope and anxiety/depression symptoms among COVID-19 patients, with coping style moderating this cultivation process.

Key words: COVID-19; hope; perceived stress; coping style; anxiety; depression

Coronavirus Disease 2019 (COVID-19) has caused a worldwide pandemic. Isolation from family members, family cluster, uncertainty over disease

status, increased number of critical cases and deaths may have created or worsened mental distress of COVID-19 patients during the peak of this pandemic^[1-3]. Even worse, the incidence of suicide in COVID-19 patients has been reported to be significant^[4].

Depression refers to an emotional disturbance marked by the cardinal symptoms of persistent and pervasive low mood and the loss of interest or pleasure in normal activities^[5]. Anxiety refers to irritability, agitation, hardly relaxing, and impatience, and it is characterized by subjective feelings of tension,

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apprehension, nervousness, and worry, as well as by stimulation of the autonomic nervous system^[6]. As reported by previous studies, individuals with other viral respiratory infectious diseases, severe acute respiratory syndrome (SARS), were at increased risk for persistent anxiety, depressive symptoms, and post traumatic stress disorder both in the acute phase of the illness and after discharge from the hospital^[7, 8]. In patients with respiratory diseases, experiencing psychological morbidities is associated with poorer health outcomes, including a higher risk of mortality, lower quality-of-life, poorer ability to manage physical symptoms, and reduced self-care behaviors^[9-13]. Therefore, depression and anxiety need to be evaluated in patients with COVID-19 in the peak period.

Hope is defined as a good or improved state of mind that has emotional tones, and is based on the ability to adjust during time of loss, uncertainty, and suffering^[14-16]. In clinical practice, restoring and maintaining hope is seen as an important function of the physician^[17]. Hope is probably the most important emotion state for patients with cancer or struggling with other diseases^[18, 19]. Past studies have revealed that lower hope can contribute to higher anxiety and depression symptoms in different populations^[20-23]. However, the impact and the importance of hope on anxiety and depression symptoms among patients with COVID-19 remained unknown.

Perceived stress represents the psychological perception of environmental change that exceeds individual coping resources and is a key component of the stress process, resulting in adverse physical outcomes^[24]. Previous studies have concluded that perceived stress appeared to be positively associated with psychopathological symptoms in patients with chronic illness, including anxiety and depression dimensions^[25, 26]. In contrast, several pieces of research have demonstrated the inverse association between perceived stress and hope^[27, 28]. Furthermore, some studies indicated that perceived stress can mediate the relationship between hope and other psychological disorders, such as fatigue, burnout, and post-traumatic stress disorder^[29-31]. However, the mediating role of perceived stress between hope and anxiety/depression symptoms among patients, especially during the pandemic of COVID-19, is unknown.

Coping styles can be divided into positive coping and negative coping. Positive coping refers to taking a direct and rational approach to solve a problem, while negative coping refers to dealing with problems by avoidance, withdrawal, and wishful thinking^[32]. Researchers have found that positive coping was associated with decreased depressive mood, and negative coping was strongly related to increased depressive mood^[33, 34]. Another study conducted with cancer patients suggested that the greater the coping

capacity, the less the psychological suffering^[35]. Stress and coping theory is a framework for studying psychological stress^[24]. Positive coping styles are accustomed to effectively managing the emotional status resulting from a stressful situation, but negative coping styles often lead to less use of positive self-affirmations and less spiritual wellbeing^[36]. Besides, it has been proven that hope is positively related to the optimistic, self-reliant, and palliative coping styles and negatively related to the emotional and fatalistic coping styles in cancer patients^[37-39]. Aside from chronic illness, the pandemic of COVID-19 was an unprecedented global health emergency. The psychological stimulation of the illness was much more acute and greater than that of chronic illness, especially during the peak period. However, there is still a lack of evidence on how patients with different coping traits adjust mental status during the outbreak of COVID-19.

In sum, hope, perceived stress, and coping styles are all important factors that influence anxiety and depression symptoms in the general population. Therefore, it can be hypothesized that, among patients with COVID-19, perceived stress can mediate the relationship between hope and anxiety or depression symptoms. Furthermore, coping styles may moderate the relationship among these systems and also need to be explored.

1 MATERIALS AND METHODS

1.1 Participants and Study Design

From February 26 to March 10, 2020, local patients diagnosed with COVID-19 in Wuhan Union Hospital and Jiangnan Mobile Cabin Hospital in Wuhan were recruited to complete an anonymous online survey, regardless of hospitalization status. Patients who met the following inclusion criteria were eligible participants: 1) at least 18 years old when diagnosed with COVID-19; 2) able to read and understand the Chinese items of the questionnaire. Exclusion criteria were as follows: 1) patients with history of psychiatric illness such as depression, anxiety, or other psychiatric disorders before being diagnosed with COVID-19; 2) patients who had been diagnosed with any type of cancers before the diagnosis of COVID-19. A convenience sampling by an online self-reported questionnaire on the WeChat mini program (Tencent, Shenzhen, China; available at <https://wx.qq.com/>) was conducted. We sent the two-dimension code to doctors and nurses who directly contacted patients with COVID-19. The patients in hospitals, quarantine areas, or home quarantine could then scan the code and had access to the online questionnaire voluntarily. Participants were divided into two groups based on coping styles, and the relationship among mental disorders were investigated in two groups.

1.2 Measures

1.2.1 Demographic and Clinical Characteristics

Demographic characteristics obtained included age, gender, education level, and marital status. Education level was divided into primary school or below, middle school, high school, junior college, or above. Clinical characteristics included symptoms related to COVID-19, such as fever, shortness of breath, cough, excessive phlegm, fatigue, muscular soreness, diarrhea, nausea, and vomiting. "Family cluster" meant that there were multiple family members diagnosed with COVID-19.

1.2.2 Anxiety and Depression Syndromes

The Chinese Version of the Symptom Check-List-90 (SCL-90) was designed to screen a broad range of psychological problems^[40, 41]. The SCL-90 consists of 90 items, each rated on a 5-point Likert scale [from 1 (absence of the symptom) to 5 (maximum disturbance)], with higher scores indicating more severe symptoms. The items can be combined into 10 symptoms scales: somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, psychoticism, and unscaled items to assess other symptoms (e.g. poor appetite, sleeping). Subscale scores 2 and 3 are suggestive of mild and moderate-severe mental health issues, respectively. The anxiety and depression subscales of SCL-90 were included in this questionnaire to explore the specific symptoms. There were 10 and 13 items for the anxiety and depression sub-scales, respectively. The Cronbach alpha coefficients of the SCL-90-Anxiety and SCL-90-Depression scales were 0.905 and 0.921, respectively.

1.2.3 Perceived Stress

The Chinese Perceived Stress Scale (CPSS) was translated and introduced from the Perceived Stress Scale by Yang and Huang for assessing the individual perceived stress among the general population of China^[42, 43]. This scale has 14 items rated on a 5-point Likert scale from 1 (not at all) to 5 (always). A higher score indicates a higher level of perceived stress. The ideal CPSS threshold score for stress among the general population is 25/26, with total scores ≥ 26 and ≤ 25 used to indicate high and low stress, respectively^[43]. In this study, Cronbach's alpha for the total scale was 0.765.

1.2.4 Hope

The Herth Hope Index (HHI), translated and introduced by Zhao Haiping, is divided into temporality and future (T), positive readiness and expectancy (P), and interconnectedness (I)^[44, 45]. It is a questionnaire that includes 12 items, with each item rated on a 4-point Likert scale (1=strongly disagree; 4=strongly agree). Here, 12–23 was defined as low level, 24–35 as middle level, and 36–48 as high level. In this study, Cronbach's alpha for the total scale was 0.892.

1.2.5 Coping Style

We selected the Trait Coping Style Questionnaire (TCSQ) to measure the coping style of participants as a positive coping style (PC) or

negative coping style (NC). There are 10 items for each dimension, with each item scores from 1 (absolutely no) to 5 (absolutely yes). The Chinese version of TCSQ was proven to be valid and reliable in the Chinese population, with Cronbach's alpha for each coping style dimension at 0.790 and 0.776, respectively^[46, 47]. Individuals are more likely to use one coping style if the score is higher than that of another coping style^[47, 48]. According to the higher scores of these two dimensions, we divided participants into two groups, the NC and PC group. In this study, the Cronbach alpha coefficients of the positive and negative coping dimension were 0.835 and 0.849, respectively.

1.3 Data Analysis

Descriptive statistics for variables are presented as the mean, standard deviation (SD), number (N), and percentage (%), as appropriate. The primary study analyses were conducted using continuous scores for hope, perceived stress, depression, and anxiety.

We used IBM SPSS Statistic 24 and AMOS 24 (IBM, USA) to run the analyses. A Mann-Whitney U-test and Chi-square test were used to test the change in demographic and clinical characteristics, depressive symptoms, anxiety symptoms, hope, and perceived stress between the NC and PC groups. The variables did not conform to a normal distribution according to the Shapiro-Wilk test, and therefore a Spearman correlation analysis was used to measure bivariate associations among hope, perceived stress, anxiety symptoms, and depression symptoms. Hierarchical multiple regression analyses were performed to explore the independent variables associated with anxiety and depression symptoms. There were three blocks of independent variables. In block 1, all demographic and clinical variables were entered as control variables, hope was added in block 2, and perceived stress was added in block 3.

Multi-group structural equation modeling (SEM) was used for testing the hypothesized model to determine whether the hypothesized paths among hope, perceived stress, anxiety symptoms were moderated by coping style^[49]. Demographic and clinical variables were considered as covariates. We constructed two multi-group structural equation models for anxiety and depression symptoms separately. AMOS used a procedure known as the full information maximum likelihood in the presence of missing data.

We tested an unconstrained structural model and a series of constrained models to determine whether the hypothesized relationships among the study variables were moderated by coping style. The goodness-of-fit was evaluated using the comparative fit index (CFI, values > 0.90 indicate good fit) and the root mean square error of approximation (RMSEA, values < 0.08 indicate acceptable fit). For our final model, we released constraints as we did not gain improvement

in the goodness-of-fit in models with constraints. The path coefficients were compared between the groups for statistically significant differences. Finally, we conducted a bias-corrected bootstrap analysis with a 95% confidence interval (CI) and 2000 bootstrap samples to determine the significance of the direct, indirect, and total effects.

1.4 Ethics Statement

The Medical Ethics Committee for Union Hospital, Tongji Medical College, Huazhong University of Science and Technology revised and approved the research and study procedures described in this study. All the patients provided their permission to participate after being verbally informed of the research purpose. Participants were completely voluntary and anonymous. We protected the privacy of personal data processing and maintained the confidentiality of individual records and accounts.

2 RESULTS

2.1 Demographic and Clinical Characteristics and the Prevalence of Mental Distress

In total, 404 questionnaires were collected, 22 of which were filled in incompletely and were excluded from the analysis. Finally, 382 participants were included in this study, resulting in a valid recovery rate of 94.55%. Demographic and clinical characteristics of participants are shown in table 1. There were 96 (25.13%) participants with negative coping styles and 286 (74.87%) with positive coping styles. The distribution of negative/positive coping styles exhibited no statistical significance in terms of gender, age, marital status, education level, symptoms, and family cluster. However, the proportion of participants with negative coping style was larger in participants still in hospital (28.51%) than in participants discharged from hospital (18.80%) ($P=0.037$). Most participants had high hope (77.49%) and low perceived stress (60.21%). A total of 57 (14.9%) and 61 (16.0%) participants had mild anxiety or depression symptoms, while 25 (6.54%) and 21 (5.50%) participants had moderate-severe anxiety or depression symptoms, respectively. However, participants with a negative coping style had a lower level of hope, higher level of perceived stress, and more severe anxiety/depression symptoms ($P<0.001$).

2.2 Relationship of Hope, Stress, Anxiety or Depression Symptoms with Coping Styles

According to the results of the hierarchical linear regression (table 2, model A for total participants, model B for the NC group, and model C for the PC group), hope and perceived stress were both independent risk factors for depression and anxiety symptoms in the total participants and the PC group, but hope was not a significant factor in the NC group. Moreover, the coefficient of hope in step 3 of the regression

declined from step 2 in each model when putting perceived stress in regression step 3 (for example, a coefficient of -0.446 in step 2 dropped to -0.269 in step 3 in the total participants). Further analysis (table 3) showed a significant positive correlation between perceived stress and depression/anxiety symptoms, but a significant negative correlation between hope and depression/anxiety symptoms, both in NC participants ($P<0.05$) and PC participants ($P<0.05$).

2.3 Moderated Mediation Analysis

The multi-group structure models without equality constraints fit the data well, with a Chi-square= 179.316 , $df=102$, $P<0.001$, CFI= 0.914 , RMSEA= 0.045 for model 1 (anxiety model) and a Chi-square= 177.882 , $df=102$, $P<0.001$, CFI= 0.918 , RMSEA= 0.044 for model 2 (depression model). The scaled Chi-squared difference test comparing this baseline model against the equal measurement weights model produced a nonsignificant result (Model 1: $\Delta\chi^2=1.154$, $P=0.562$; Model 2: $\Delta\chi^2=1.236$, $P=0.539$), suggesting that factor loadings were equivalent across coping groups. The factor loadings and path coefficient of the measurement model are presented in figs. 1 and 2.

For the constrained model posing equal weights on the paths among three variables in model 1 and model 2 across the coping groups, the model comparison results indicated that assuming the model to be unconstrained was correct, and that the equal-weight model was significantly different from the unconstrained model, with $\Delta\chi^2=85.798$, $P<0.001$ for model 1 and $\Delta\chi^2=88.386$, $P<0.001$ for model 2. The fitness of the model of equal weight also decreased from the unconstrained model both in the anxiety and depression model. Therefore, coping styles moderated the relationships presented in the conceptual model both in the anxiety and depression model.

In the final model, there were two direct paths in the hypothesized model that were significantly different from the two groups in model 1 and model 2 (figs. 1 and 2; table 4). In the PC group, hope had a significant, negative direct effect on anxiety symptoms (model 1: $r=-0.237$, $P<0.01$) or depression symptoms (model 2: $r=-0.313$, $P<0.01$), but the relationship was nonsignificant for the negative coping group (model 1: $r=-0.238$; model 2: $r=-0.235$). Besides, the examination of the standardized regression weights indicated that the positive relationship between perceived stress and anxiety symptoms ($P<0.05$) or depression symptoms ($P<0.05$) was stronger for the negative coping group than for the positive coping groups. There was no significant difference in the direct path from hope to perceived stress across coping style both in model 1 and model 2.

3 DISCUSSION

Overall, 22.51% of participants exhibited low or

Table 1 Demographic, clinical and psychological characteristics of participants

Variables	Total (n=382)	NC group (n=96)	PC group (n=286)	P-value
Demographic and clinical characteristics				
Age (years, mean±SD)	43.66±12.01	44.10±12.29	43.52±12.29	0.689
Gender				0.237
Male	163 ^a	36	127	
Female	219	60	159	
Marital status				0.917
Married	313	79	234	
Single/widowed/divorced	69	17	52	
Education level				0.425
Primary school or below	12	3	9	
Middle school	49	17	32	
High school	73	18	55	
Junior college or above	248	58	190	
Hospitalized or not				0.037
No	133	25	108	
Yes	249	71	178	
Number of symptoms				0.566
0	42	7	35	
1–5	220	58	162	
6–10	100	25	75	
11–15	20	6	14	
Family cluster				0.148
Yes	113	34	79	
No	269	62	207	
HHI				
Low hope	2	2	0	<0.001
Middle hope	84	48	36	
High hope	296	46	250	
Hope scores (mean±SD)	38.96±5.21	35.30±5.50	40.19±4.49	<0.001
CPSS				
Low perceived stress	230	25	205	<0.001
High perceived stress	152	71	81	
Perceived stress scores (mean±SD)	23.27±7.35	29.10±6.72	21.32±6.47	<0.001
SCL-90-Anxiety				
Mild anxiety symptoms	57	33	24	<0.001
Moderate-severe anxiety disorder	25	17	8	
No potential anxiety disorder	357	79	278	
Anxiety scores (mean±SD)	1.63±0.67	2.16±0.80	1.46±0.51	<0.001
SCL-90-Depression				
Mild depression disorder	61	37	24	<0.001
Moderate-severe depression disorder	21	14	7	
No potential depression disorder	361	82	279	
Depression scores (mean±SD)	1.62±0.64	2.14±0.75	1.45±0.49	<0.001

^aValues are number of participants (n). NC: negative coping style; PC: positive coping style; HHI: Herth Hope Index; CPSS: Chinese Perceived Stress Scale

middle hope, 39.79% high perceived stress, and 5.50% and 6.54% moderate-severe depression and anxiety disorder, respectively. Hope and perceived stress were both independent factors of anxiety/depression symptoms of participants in the PC group. However, in the NC group, only perceived stress was independently related to anxiety/depression symptoms. According to the multi-group structural equation model, hope had a direct effect on anxiety/depression symptoms in the PC group but not in the NC group. However, the indirect

effects mediated by perceived stress between hope and anxiety/depression symptoms were both significant in the PC and NC groups.

We found that most of the participants exhibited a high level of hope, which was an important protective factor for both anxiety and depression of patients with COVID-19. Different from previous results in patients with chronic and malignant disease, we first explored the hope level among patients with infectious disease and proved its relationship with anxiety/depression

Table 2 Hierarchical linear regression for exploring the associated variables of anxiety and depression symptoms

Variables	Anxiety symptoms (β)			Depression symptoms (β)		
	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3
Model A-Total ($n=382$)						
Gender	-0.108*	-0.102*	-0.059	-0.121*	-0.114*	-0.070
Age	-0.043	-0.045	0.010	0.010	0.007	0.065
Education	-0.066	-0.084	-0.061	-0.076	-0.096*	-0.072
Married	0.040	0.017	0.005	0.059	0.034	0.022
Hospitalized	0.064	0.011	-0.007	0.088	0.030	0.012
Symptoms	0.136*	0.128**	0.120**	0.095	0.086	0.078
Family cluster	0.015	0.020	-0.008	0.008	0.014	-0.015
Hope		-0.446***	-0.269***		-0.485***	-0.305***
Perceived stress			0.326***			0.334***
R^2	0.037	0.231	0.301	0.041	0.272	0.345
Adjusted R^2	0.018	0.216	0.284	0.023	0.257	0.329
ΔR^2	0.037	0.195***	0.069***	0.041*	0.232***	0.073***
Model B-NC group ($n=96$)						
Gender	0.042	0.026	0.032	-0.064	-0.08	-0.073
Age	-0.095	-0.154	-0.020	-0.090	-0.152	-0.003
Education	-0.045	-0.137	-0.061	-0.050	-0.146	-0.062
Married	0.113	0.059	0.042	0.201	0.145	0.126
Hospitalized	-0.062	-0.091	-0.087	0.011	-0.019	-0.015
Symptoms	0.009	0.045	0.054	-0.118	-0.081	-0.071
Family cluster	0.020	0.025	-0.033	-0.033	-0.027	-0.091
Hope		-0.390***	-0.206		-0.406***	-0.202
Perceived stress			0.388**			0.430***
R^2	0.019	0.156	0.262	0.047	0.195	0.325
Adjusted R^2	-0.059	0.078	0.185	-0.029	0.121	0.255
ΔR^2	0.019*	0.137***	0.106**	0.047	0.148***	0.130***
Model C-PC group ($n=286$)						
Gender	-0.148*	-0.148**	-0.121*	-0.122*	-0.123*	-0.094
Age	-0.032	-0.017	0.006	0.048	0.067	0.092
Education	-0.071	-0.068	-0.064	-0.088	-0.085	-0.081
Married	0.029	0.021	0.010	0.018	0.008	-0.003
Hospitalized	0.040	0.018	0.009	0.054	0.027	0.019
Symptoms	0.174**	0.166**	0.165**	0.159**	0.149**	0.148**
Family cluster	-0.047	-0.029	-0.036	-0.035	-0.013	-0.021
Hope		-0.303***	-0.227***		-0.362***	-0.282***
Perceived stress			0.168**			0.177**
R^2	0.056	0.147	0.168	0.054	0.184	0.208
Adjusted R^2	0.032	0.122	0.141	0.031	0.161	0.182
ΔR^2	0.056*	0.091***	0.021**	0.054*	0.130***	0.023**

* $P<0.05$, ** $P<0.01$, *** $P<0.001$

in the peak period of pandemic^[50-53]. Studies have confirmed that individuals with a high level of hope can protect themselves against depression and anxiety, and they are less likely to experience depression and anxiety again^[50]. These patients also have a more realistic goal and melt away hopelessness that ruins their confidence, and are consequently more resistant to negative events. For many patients with COVID-19, the disease contained both controllable and uncontrollable aspects. In general, patients may focus on different aspects of this threat, which works in concert with different coping strategies. Moreover, it is important to point out that some studies have shown that hope

therapy is effective in the reduction of depression and anxiety^[53, 54]. By intervention of hope therapy, the sort of feelings magnifying the possibility of any pleasant event in the future could be stimulated in patients, who may then choose more accessible points in life. For some patients with COVID-19, hope therapy may be a potentially effective intervention to help prevent and fight against severe anxiety or depression symptoms.

A high level of perceived stress resulted in anxiety or depression symptoms among patients with COVID-19. Furthermore, perceived stress mediated a large proportion of the relationship between hope and both depression and anxiety. The concept of perceived

Table 3 Correlation among study variables

Variables	Perceived stress	Hope	Depression	Anxiety
Total (n=382)				
Perceived stress	1			
Hope	-0.559**	1		
Depression	0.460**	-0.451**	1	
Anxiety	0.482**	-0.431**	0.849**	1
NC group (n=96)				
Perceived stress	1			
Hope	-0.504**	1		
Depression	0.481**	-0.423***	1	
Anxiety	0.466**	-0.399**	0.843**	1
PC group (n=286)				
Perceived stress	1			
Hope	-0.433**	1		
Depression	0.297**	-0.311**	1	
Anxiety	0.322**	-0.292**	0.804**	1

P<0.01, *P<0.001. NC: negative coping style; PC: positive coping style

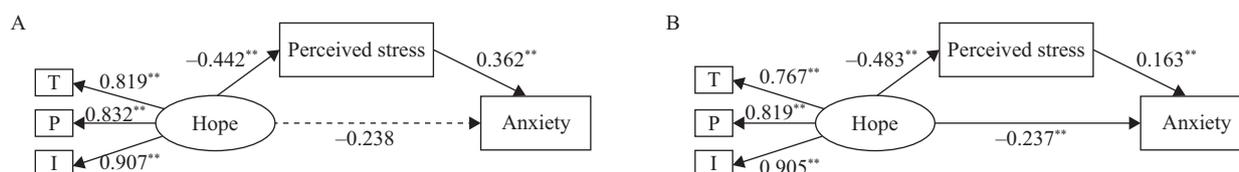


Fig. 1 The standardized parameter estimates of the hypothesized model of anxiety for negative coping style (NC) and positive coping style (PC) participants

A: In the NC group, hope had an indirect effect on anxiety symptoms mediated by perceived stress significantly, but the direct effect from hope to anxiety symptoms was not significant. B: In the PC group, hope had both significant direct and indirect effects on anxiety symptoms, and the indirect effect was mediated by perceived stress. **P<0.01

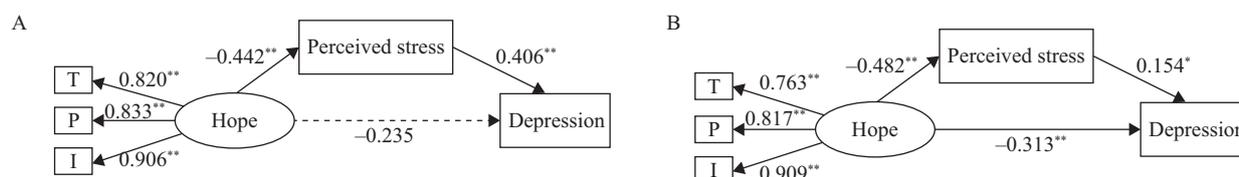


Fig. 2 The standardized parameter estimates of the hypothesized model of depression for negative coping style (NC) and positive coping style (PC) participants

A: In the NC group, hope had an indirect effect on depression symptoms mediated by perceived stress significantly, but the direct effect of hope on depression symptoms was not significant. B: In the PC group, hope had both significantly direct and indirect effects on depression symptoms, and the indirect effect was mediated by perceived stress. *P<0.05, **P<0.01

interventions should be implemented to relieve the patients' stress from COVID-19^[59]. For example, music therapy, defined as an interpersonal process in which the therapist uses music to help patients improve or maintain health, has been proven effective in the modulation of the stress.

In our study, we first investigated the moderate role of coping styles among relationships of hope, perceived stress, and anxiety/depression symptoms. We found that coping styles played a significant moderate role in the relationship among them in a moderated mediated model. Among patients in the PC group, hope could significantly influence the anxiety or depression symptoms, but the direct association

stress highlights how people feel about stress and not just stress itself. Hope may promote an adaptive way of thinking about stressful life experiences, can reduce the threat presented by stressors, and may also allow more efficient resolution of stressors^[55-57]. Therefore, a lower level of hope promoted patients to a higher perceived stress and thus resulted in a negative mental state. Despite the influence of hope, stress may be a modifiable risk factor that is involved in the unpredictable progress of COVID-19, for example, the sudden disruption of independence and autonomy from quarantine and worrying about the physical conditions of relatives with COVID-19. In our study, the origins and related factors of stress in patients were not investigated, but it has been reported that excessive days from illness onset to admission, as well as the health status of family members may contribute to the perceived stress of COVID-19 patients^[58]. According to patients' worry and needs, effective targeted mental

was not significant in the NC group according to the multi-group structural equation modeling. Consistent with the result of the hierarchical linear regression analysis in our study, hope may have a greater direct effect on anxiety or depression symptoms among patients in the PC group than those in the NC group. A previous study suggested that patients with higher hope may pursue efficient coping strategies designed to mitigate the influence that diseases have on their lives^[60]. But in our study, participants with positive coping style had higher hope, and thus the higher hope directly protected patients from anxiety and depression symptoms. Therefore, the hope level in PC patients should be given more attention.

Table 4 Magnitude, statistical significance, and bootstrap test of the direct and indirect effects in NC (n=96) and PC (n=286) groups

Independent variable	Mediator variable	Dependent variable	Standardized coefficient (95% confidence interval)		Differences of coefficients	
			NC group	PC group	C.R. ^a	P-value
Model 1 ANXIETY						
Hope→		Anxiety	-0.238 (-0.528,0.067)	-0.237** (-0.371, -0.092)	/	/
Hope→	Perceived stress		-0.442** (-0.646, -0.207)	-0.483** (-0.575, -0.376)	0.976	0.329
	Perceived stress→	Anxiety	0.362** (0.120, 0.594)	0.163* (0.018, 0.304)	2.156	0.031
Hope→	Perceived stress→	Anxiety	-0.160* (-0.359, -0.049)	-0.076* (-0.154, -0.009)	/	/
<i>Total effect</i>						
	Hope →	Anxiety	-0.399** (-0.609, -0.170)	-0.313** (-0.413, -0.197)	/	/
Model 2 DEPRESSION						
Hope→		Depression	-0.235 (-0.511,0.066)	-0.313** (-0.453, -0.168)	/	/
Hope→	Perceived stress		-0.442** (-0.646, -0.211)	-0.482** (-0.575, -0.377)	0.969	0.332
	Perceived stress→	Depression	0.406** (0.154, 0.644)	0.154* (0.011, 0.305)	2.630	0.009
Hope→	Perceived stress→	Depression	-0.179** (-0.393, -0.060)	-0.075* (-0.154, -0.006)	/	/
<i>Total effect</i>						
	Hope →	Depression	-0.414** (-0.609, -0.170)	-0.388** (-0.413, -0.197)	/	/

*P<0.05, **P<0.01

^aC.R.: Critical ratios for differences between parameters; NC: negative coping style; PC: positive coping style

In contrast, perceived stress fully mediated the relationship between hope and anxiety/depression symptoms in the NC group, and perceived stress showed a stronger direct association with depression/anxiety symptoms among patients in the NC group than those in the PC group. Perceived stress is the degree to which a person perceives stressors as stressful, and coping is the progress in which the person uses cognitive and behavioral efforts to moderate the physical, emotional, and behavioral responses to perceived stress. However, evidence from past studies concerning the moderating effect of coping on mental symptoms has been inconsistent^[61-63]. Some researchers have failed to find that coping moderates the effect of stress on depression symptoms. The different results may be due to the concept that coping was defined as a situation-specific state rather than a trait in such studies^[62, 63]. In our study, we verified that coping style was a stable psychological structure and that certain coping strategies could be adopted to cope with the stress from the pandemic among patients with COVID-19. However, negative and ineffective coping strategies may be not appropriate to deal with similar challenges. Although negative coping strategies of some COVID-19 patients were stable and hard to improve in a short time, necessary interventions in two other topics, hope and stress, might protect patients from anxiety and depression disorders.

There are some limitations to the present study that should be discussed. First, this work was a cross-sectional study that did not allow causal interpretation. Future longitudinal studies or time-series designs are necessary for a potential causal ordering of the variables. Second, we used convenience sampling rather than stratified sampling, and we only recruited

voluntary patients with COVID-19 from hospitals of Wuhan, China. Therefore, caution should be taken when generalizing the findings of this work to other populations. Third, we used self-report instruments to measure our variables. Although the instruments we employed had good psychometric characteristics, future studies might consider structured interviews or other alternative methods of measuring psychiatric disorders. Besides these limitations, this work also exhibited various strengths in that it is a pioneer in showing various patterns of mental health for patients with COVID-19. Therefore, we believe that all of the included factors mentioned above can be effective targets for alleviating and diminishing anxiety and depression symptoms in patients with COVID-19. These findings could provide warranted evidence for further research.

Overall, our study revealed an underlying mechanism in that perceived stress mediated the effects of hope on anxiety/depression symptoms in COVID-19 patients both in the NC and PC groups. Among patients in the NC group, perceived stress had a stronger direct effect on anxiety/depression symptoms. By contrast, hope had a significant direct effect on anxiety/depression symptoms in the PC group, but not in the NC group.

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Conflict of Interest Statement

The authors declare no conflict of interest in this study.

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