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Relationship between stress response and depression in vocational medical school students in the COVID-19 epidemic: A moderated mediation model

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ARTICLE INFO

Keywords:

Vocational medical school students
Stress response
Meaning in life
Depression
Prosocial behavior

ABSTRACT

To investigate the relationship between stress response and depression in vocational medical school students at the initial stage of COVID-19 epidemic, and to explore the mediating role of meaning in life and the moderating role of prosocial behavior. The COVID-19 Stress Response Questionnaire, the Meaning in Life Questionnaire, the Prosocial Behavior Scale and the Depression Scale, were used to investigate 3526 vocational medical school students. The results showed that: (1) The relationship between stress response and depression in vocational medical school students was partially mediated by presence of meaning and search for meaning. Stress response has indirect effect on depression of vocational medical school students through meaning in life. (2) Prosocial behavior moderated the relationship between meaning in life and depression. Specifically, meaning in life has a more significant effect on depression for college students with higher levels of prosocial behavior.

1. Introduction

COVID-19 not only endangers people's health, but also has negative effect on mental health. Based on the psychological stress theory of Lazarus and Folkman (1986), individuals will produce a series of cognitive, emotional and physiological reactions to deal with the sudden crisis after experiencing a major stressful event. If the coping methods are ineffective, corresponding physiological dysfunction and psychological distress will appear (Xiong, Xu, Zhang, Zhu, & Su, 2021). Depression, as a common psychological problem, is also one of the emotional disorders that the public is susceptible to in a major crisis. A large number of studies have found that after experiencing sudden accidents, earthquakes and major epidemics, people related to these events are highly likely to have negative emotions such as sadness and depression, and the closer they are to the first-line disaster areas, the higher their depression index will be (Xiong et al., 2021; Q.Y. Yu, Wang, Wu, & Tian, 2021; Y.J. Yu, Yu, & Hu, 2022). Francis et al. (2019) collected information among 622 medical students at the Faculty of Medicine, University of Malaya, they have drew the conclusion that medical students are vulnerable to depression and anxiety due to the nature of academic life and the prevalence of anxiety and depressive symptoms were 4.7% and 17.4% among these medical students. Guo

et al. (2020) investigated 13,822 people in 31 provinces and autonomous regions of China and found that 18.6% of the public had different degrees of acute stress disorder, and people with acute stress disorder were significantly higher in depression than those without. Xiong et al. (2021) conducted a questionnaire survey of 533 clinical nurses, showing that nurses were affected by depression during acute stress events. Su et al. (2020) investigated the characteristics of the psychological stress response of the public at different time stages of the COVID-19 epidemic, and the results showed that the depressive symptoms of the public in SCL-90 were more prominent in each stage of the psychological stress response of the public at different stages of the COVID-19 epidemic. Based on the above theories and empirical studies, the first hypothesis was proposed that the stress response of vocational medical school students to the COVID-19 epidemic will lead to an increase in their depression level.

The integrated model of meaning making (Park, 2010) is used to explain the process of individuals responding to stressful events or adversities in life, that is, the process of meaning construction. Everyone has a directional system, that is, a general meaning system, including beliefs, goals, and subjective sense of meaning or purpose. It is a cognitive framework used to explain various life experiences and motivations of oneself. When encountering a situation that is inconsistent

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<https://doi.org/10.1016/j.actpsy.2022.103617>

Received 14 September 2021; Received in revised form 2 May 2022; Accepted 10 May 2022

Available online 13 May 2022

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with the general meaning in real life, the individual will evaluate the situation and give it meaning. If the meaning given to the situation is inconsistent with the general meaning, the individual will feel uncomfortable, which will promote its construction of meaning. Individuals reduce the difference between general meaning and contextual meaning through meaning construction, thereby regaining the sense that the world is meaningful and their lives are valuable. If the process of meaning construction is successful and meaning is obtained, then the individual will adapt to this stressful situation or event (Zhang & Li, 2018). The stress reaction will have adverse effects on the individual's psychology, such as job withdrawal, depression, anxiety, etc. (Guo et al., 2020; Su et al., 2020; Xiong et al., 2021), according to the integrated model of meaning making (Park, 2010), the stress response will be related to the individual's meaning in life. As an effective protective factor, meaning in life can reduce psychological distress and promote mental health. People who lack meaning of life will experience more loneliness, anxiety and depression (Disabato, Kashdan, Short, & Jarden, 2017; Zhang et al., 2021; Germani, Delvecchio, Li, Lis, & Mazzeschi, 2021; Q.Y. Yu, Wang, Wu, & Tian, 2021; Y.J. Yu, Yu, & Hu, 2022; Zhang & Zhang, 2021). According to Frankl's theory of meaning therapy, the search for the meaning in life is the core motivation of human individuals. If the meaning in life is lacking, it will produce the feeling of emptiness and boredom. Having a high meaning in life or a good view of meaning in life will make the individual more positive, which has a positive influence on the improvement of individual depression, anxiety and post-traumatic growth (Zhang et al., 2021). Based on the above theoretical and empirical studies, the second hypothesis was proposed, meaning in life could play a mediating role in the relationship between stress response and depression of vocational medical school students.

Prosocial behavior is an important part of socialization in the adolescent development process, which not only benefits the target of the behavior, but also promotes the positive psychological adaptation of the individual himself (Weinstein & Ryan, 2010). Individuals with high prosocial behavior are more likely to exhibit normal social adaptation patterns, including peer acceptance, social self and general self. On the other hand, individuals with low prosocial behaviors are more likely to have more internalization problems and peer rejection, showing more maladaptation (Li, Zheng, & Liu, 2019). When individuals engage in more helping behaviors, they also have a higher sense of purpose and more positive emotions, and thus exhibit fewer depressive symptoms (Grant & Sonnentag, 2010; Li et al., 2019). Numerous studies have shown that higher prosocial behavior among adolescents is significantly associated with lower levels of depression (Eli et al., 2021; Li et al., 2019). The theory of resource conservation puts forward that individuals will try their best to acquire, protect and maintain their existing resources (such as individual resources and situational resources). Individuals with more initial resources have more investment capital and opportunities, so they are more able to acquire new resources, leading to a spiraling increase in resource returns (Duan, Yang, & Zhu, 2020; Hobfoll, 2011). When meaning in life of adolescents is strong, their levels of depression are lower (Zhang et al., 2021; Q.Y. Yu, Wang, Wu, & Tian, 2021; Y.J. Yu, Yu, & Hu, 2022), it can be inferred from the resource conservation theory that, in this case, individuals with strong life meaning will benefit more from prosocial behaviors. In other words, high levels of prosocial behavior enhanced the association between meaning in life and depression. In conclusion, the third hypothesis was proposed: Prosocial behavior played a moderating role in the relationship between the vocational medical school students' meaning in life and their depression.

2. Methods

2.1. Participants

In this study, vocational medical school students in central China were investigated at the initial stage of COVID-19 epidemic (February

16 to 22, 2020). This time period is during the winter vacation in China. The students have been off for about a month, and there are no teaching commence during this period. Participants are mainly faced with the pressure of the epidemic and are required to be closed at home and unable to go out. None of the participants or their family members had been infected with COVID-19 at the time of the investigation in this study. We conducted a questionnaire survey online through questionnaire star (a questionnaire survey system). All students of the vocational medical school agreed and participated in the survey. After eliminating questionnaires with incomplete answers and obvious patterns of options, 3526 valid questionnaires were finally obtained. Among them, 379 were male and 3147 were female. The mean age of the subjects was 17.03 ± 1.29 years.

2.2. Measurement

2.2.1. COVID-19 stress response questionnaire

The COVID-19 Stress Response Questionnaire was revised according to the SARS Stress Response Questionnaire compiled by Tong (2004). The 13-question questionnaire measures three items on a 4-point scale: perceptions of COVID-19: "I believe humans will beat COVID-19." Fears about COVID-19: "Worrying about 'COVID-19' is causing me insomnia (or dizziness, headaches)." Defensive psychological and behavioral responses to COVID-19: "I wash my hands to prevent COVID-19," etc. The higher the score, the stronger the individual's stress response to COVID-19. In this study, the Cronbach's α coefficient of the scale was 0.63.

2.2.2. Depression scale

Subjects were measured according to the Depression Scale (CES-D) developed by Radloff in 1977 (Radloff, 1977). The scale had a total of 20 items with a 0–3 scale, of which 4 items were scored in reverse. The sum of the scores of all items is the total score of the scale, and the higher the score was, the more serious the individual's depression was. In this study, the Cronbach's α coefficient of the scale was 0.87.

2.2.3. Meaning in life scale

According to the meaning in life scale developed by Steger, Frazier, Oishi, and Kaler (2006), and revised by Wang (2013), the study subjects were measured. The scale has a total of 10 questions, which is composed of two subscales of presence of meaning and search for meaning. Each scale contains 5 items and uses a 7-point score. The higher the score, the stronger the meaning in life. In this study, the Cronbach's α coefficient of the scale was 0.88, the internal consistency coefficient for presence of meaning was 0.84, and the internal consistency coefficient for search for meaning was 0.88.

2.2.4. Prosocial behavior scale

The subjects were measured according to the prosocial tendency scale developed by Carlo and Randall (2002) and revised by Kou, Hong, Tan, and Li (2007). The questionnaire has a total of 26 questions and adopts a five-point scoring method. The higher the score, the more prosocial behaviors an individual had. In this study, the Cronbach's α coefficient of the scale was 0.97.

3. Results

3.1. Control and test of common method deviation

The data in this study were mainly self-reported by participants, which may be subject to common methodology bias. In order to minimize the influence of common method deviation on the research results, the anonymous questionnaire survey, balance item order and other program control methods were adopted in the process of measurement. In addition, in order to further test the existence of common method bias, Harman single factor method was used in this study to test the common method bias. The characteristic roots of 11 factors were greater

than 1, among which the interpretation rate of the first factor was 25.03% (<40%). This indicates that the data common method deviation in this study is not serious (Podsakoff, MacKenzie, & Podsakoff, 2012).

3.2. Descriptive analyses and correlations

We reported the mean, standard deviation, and correlation coefficients of this study in Table 1. It can be seen from the data summarized in this table that stress response has a significant positive correlation with presence of meaning, search for meaning, depression and prosocial behavior. There was a significant negative correlation between presence of meaning and depression and a significant positive correlation between search for meaning and prosocial behavior. Search for meaning was negatively correlated with depression and positively correlated with prosocial behavior. There was a significant negative correlation between depression and prosocial behavior.

3.3. Relationship between stress response and depression: Mediating effect test

The PROCESS 3.4 was used to test the significance of the mediating effect with stress response as the independent variable, meaning in life (presence of meaning and search for meaning) as the mediating variable and depression as the dependent variable. Model 4 and Bootstrap methods were used to test the significance of the mediating effect (95% confidence interval with sample size of 5000). Firstly, the mediating effect of presence of meaning on stress response and depression of vocational medical school students was tested. The results were shown in Table 2. Stress response had a significant positive prediction significance ($\beta = 0.13, t = 7.95, P < 0.001$), and having a significant negative prediction of depression ($\beta = -0.37, t = -23.59, P < 0.001$). At the same time, stress response was still significantly positive in predicting depression ($\beta = 0.13, t = 5.25, P < 0.001$), suggesting that presence of meaning played a partial mediating role in the relationship between stress response and depression in vocational medical school students. Secondly, the mediating effect of search for meaning on stress response and depression in vocational medical school students was examined. The results were shown in Table 3. Stress response significantly positively predicted search for meaning ($\beta = 0.19, t = 11.66, P < 0.001$), while search for meaning significantly negatively predicted depression ($\beta = -0.14, t = -8.06, P < 0.001$). Stress response was still a significant positive predictor of depression ($\beta = 0.10, t = 6.07, P < 0.001$), suggesting that search for meaning played a partial mediating role between stress response and depression in vocational medical school students. For further verification, the 95% confidence interval of the mediating effect was estimated by sampling 5000 samples. The data showed that the 95% confidence interval of the bootstrap of the indirect effect of search for meaning on the stress response was [0.16, 0.23], and the upper and lower limits did not contain the value of 0. The results showed that search for meaning had a significant mediating effect on the

Table 1
Descriptive statistics and correlations among variables.

Variables	M	SD	1	2	3	4	5
1. COVID-19 stress response	2.18	0.29	-				
2. Presence of meaning	4.84	1.23	0.13**	-			
3. Search for meaning	4.94	1.31	0.19**	0.50**	-		
4. Depression	0.51	0.40	0.08**	-0.36**	-0.12**	-	
5. Prosocial behavior	3.56	0.68	0.20**	0.43**	0.45**	-0.19**	-

Note. N = 3526.
** p < 0.01.

Table 2

The mediating effect of presence of meaning on the relationship between stress response and depression.

Variables	Model1 (depression)		Model 2 (presence of meaning)		Model3 (depression)	
	β	t	β	t	β	t
Stress response	0.08	4.57***	0.13	7.95***	0.13	8.00***
Presence of meaning					-0.37	-23.59***
R ²	0.01		0.02		0.14	
F	20.85***		63.23***		290.34***	

Note. N = 3526.

*** p < 0.001.

relationship between stress response and depression. At the same time, the 95% confidence interval of the direct effect of stress response on depression was [0.06, 0.15], and the upper and lower limits of which do not contain 0 value, which indicated that search for meaning played a partial mediating role between stress response and depression of vocational medical school students.

3.4. The moderating effect of prosocial behavior on meaning in life and depression

To further explore whether vocational medical school students' prosocial behavior played a moderating role in the relationship between stress response, meaning in life and depression, Process3.4 was used in this study, with stress response as independent variable, meaning in life as mediating variable, depression as dependent variable, and prosocial behavior as moderating variable. Model 14 and Bootstrap methods (sample size 5000, 95% confidence interval) were used to test the moderating effect of prosocial behavior. The results showed that the moderating effect of prosocial behavior between presence of meaning and depression was significant (Bootstrap95% confidence interval [-0.050, -0.001]) (Table 4). However, the moderating effect of prosocial behavior between searching for meaning and depression was not significant (Bootstrap95% confidence interval [-0.040, 0.003]) (Table 5).

In order to further explain the specific moderating effect of prosocial behavior on the relationship between presence of meaning and depression, the subjects were divided into low group (Z = -1) and high group (Z = 1) according to the standard score of prosocial behavior, and the simple slope test was used to investigate the effect of presence of meaning at different levels of prosocial behavior on depression. The simple slope analysis is shown in Fig. 1. The results showed that for individuals with low prosocial behavior levels, presence of meaning had a significant effect on depression ($\beta_{\text{simple}} = -0.32, t = -14.52, p < 0.001$), while for individuals with high prosocial behavior levels, presence of meaning had a more significant effect on depression ($\beta_{\text{simple}} = -0.37, t = -17.65, p < 0.001$) (Fig. 2).

4. Discussion

We used an online questionnaire survey to reveal that the stress response would be linked to the depression of vocational medical school students through the mediating role of meaning in life. Based on the integrated model of meaning making (Park, 2010; Zhang & Li, 2018), everyone has an orientation system, the general meaning system, which is a cognitive framework used to explain their own various life experiences and motivations. If the process of meaning construction succeeds and gains meaning, then the individual will adapt to this stressful situation or event. Based on the expression of the integrated model of meaning making, stress response would affect the process of meaning construction of individuals, that is, the stress response will be related to the individual's meaning in life. In this online survey of vocational

Table 3
The mediating effect of search for meaning on the relationship between stress response and depression.

Variables	Model 1 (depression)		Model 2 (search for meaning)		Model 3 (depression)	
	β	t	β	t	β	t
Stress response	0.08	4.57***	0.19	11.66***	0.10	6.07***
Search for meaning					-0.14	-8.06***
R^2	0.01		0.04		0.02	
F	20.85***		135.97***		43.07***	

Note. $N = 3526$. *** $p < 0.001$.

Table 4
The moderating effect of prosocial behavior on the relationship between presence of meaning and depression.

Variables	Model 1 (presence of meaning)		Model 2 (depression)	
	β	t	β	t
Stress response	0.13	7.95***	0.13	8.47***
Prosocial behavior			-0.07	-3.95***
Presence of meaning \times prosocial behavior			-0.03	-2.13*
Presence of meaning			-0.34	-19.73***
R^2	0.02		0.15	
F	63.23***		150.87***	

Note. $N = 3526$. Standardized values were used in the analysis of all variables. *** $p < 0.001$. * $p < 0.05$.

Table 5
The moderating effect of prosocial behavior on search for meaning and depression.

Variables	Model 1 (search for meaning)		Model 2 (depression)	
	β	t	β	t
Stress response	0.19	11.66***	0.12	7.34***
Prosocial behavior			-0.19	-10.37***
Search for meaning \times prosocial behavior			-0.02	-1.74
Search for meaning			-0.06	-3.06**
R^2	0.04		0.05	
F	135.97***		49.26***	

Note. $N = 3526$. *** $p < 0.001$. ** $p < 0.01$.

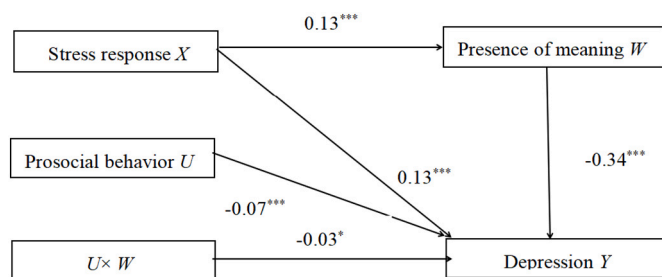


Fig. 1. Testing whether the mediating effect of presence of meaning was moderated by prosocial behavior.

medical school students, stress response affected the vocational medical school students' meaning in life (presence of meaning and search for meaning). This suggests that when the stress response of individuals under the influence of COVID-19, their meaning in life would be affected by the stress response. When paying attention to the effect of stress response, the status of individuals' meaning in life should be paid more

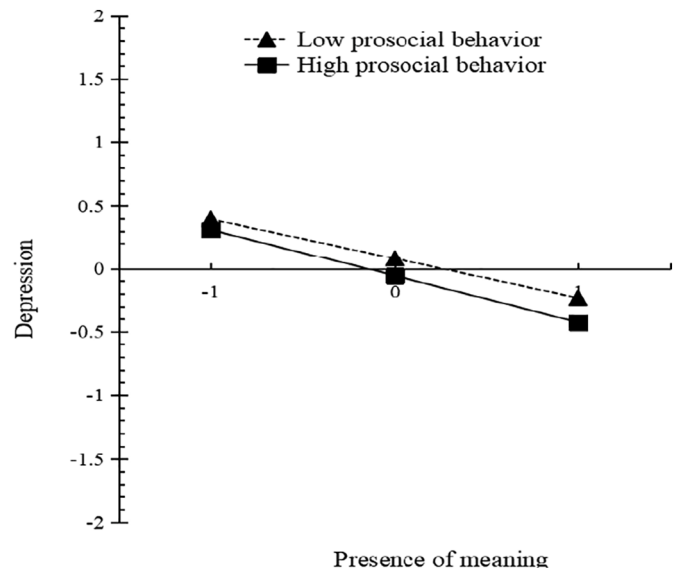


Fig. 2. Prosocial behavior moderates the presence of meaning and depression.

attention, so that individuals can better cope with the psychological damage of the COVID-19 outbreak. Liu, Li, and Xiao (2012) conducted a test on 316 medical students using the Purpose In Life (PIL) and Self-Rating Depression Scale (SDS). The evaluation of the results by Liu et al. (2012) showed that meaning in life of medical students was at a low level. The depressive mood status is at a moderate level and the 21.6% variation of depression in medical students can be explained by the meaning in life. Tang, Xiao, and Zhang (2019) investigated 1158 medical students in a medical university in Guangdong and found that 17.33% of them had obvious symptoms of depression, and there was a significant negative correlation between the meaning in life and depression. Our investigation on the relationship between the meaning in life and depression also came to the same conclusion (both presence of meaning and search for meaning can predict depression). The relationship between the meaning in life and depression has again verified Frankl's theory of meaning therapy, that is, having a strong meaning in life will make individuals more positive and is correlated with improving depression (Zhang et al., 2021). In short, in the early stages of COVID-19, the stress response of vocational medical school students can be correlated with their depression through their meaning in life.

Our survey also showed that pro-social behaviors moderated the relationship between the meaning in life and depression of vocational medical school students. Specifically, college students with higher levels of pro-social behavior, presence of meaning had a more significant effect on depression. However, what surprised us was that pro-social behaviors did not significantly moderate the relationship between search for meaning and depression of vocational medical school students. The existing theories support our research results, the resource conservation theory proposes that individuals will do their best to acquire, protect and maintain their existing resources, and make their resource income rise in a spiral by acquiring new resources (Duan et al., 2020; Hobfoll,

2011). When the meaning in life is strong, the individual's depression level is low (Zhang et al., 2021; Q.Y. Yu, Wang, Wu, & Tian, 2021; Y.J. Yu, Yu, & Hu, 2022), based on a survey of vocational medical school students at the beginning of the COVID-19 outbreak, combining with the resource conservation theory, we found that individuals with a high level of meaning in life benefited more from prosocial behavior, that is, prosocial behavior enhanced the association between meaning and depression among vocational medical school students. The non-significant moderating effect of prosocial behavior on search for meaning and depression among vocational medical school students may be attributed to the low degree of correlation between search for meaning and depression. For instance, Wang (2013) conducted a study on 1899 middle school students in China and showed that the correlation between presence of meaning and depression was (-0.344 , $P < 0.001$), while, the correlation between search for meaning and depression was (-0.021 , $P > 0.05$). Our survey in the group of vocational medical school students showed that the moderating effect of search for meaning was not significant, which suggested that search for meaning does not necessarily cause anxiety and depression, but may also be related to positive psychological variables (Liu & Gan, 2010). Subsequent research can verify the moderating effect of search for meaning in different groups of students, which will expand the scope of application of search for meaning in the field of mental health.

Our investigation of the stress response and depression of vocational medical school students in the early stage of the COVID-19 can provide relevant references for alleviating the mental health of vocational medical school students in the face of the impact of the COVID-19, and enhance meaning in life of vocational medical school students (both presence of meaning and search for meaning) is an important way to reduce the negative impact of the stress response of the COVID-19 on depression. At the same time, when there is a high sense of meaning in life, prosocial behaviors should be fully considered for the meaning in life and depression. Individuals who have a high sense of meaning in life and have good prosocial behaviors during the COVID-19 would be less affected by depression. Inevitably, our current investigation needs to be further verified and expanded in practice: (1) What we are investigating is the impact of stress response on vocational medical school students' depression in the early stage of the COVID-19. We can observe the impact of stress response on vocational medical school students' depression for a longer period of time (such as the period of normalization of the COVID-19). This can provide richer information for exploring the stress response and depression of vocational medical school students. (2) The subjects of our investigation were vocational medical school students in the central region. According to the actual situation, the source of the group can be appropriately expanded in order to enhance the generalization of the results. (3) In the investigation of the stress response and depression of vocational medical school students, we have included the individual factor of the meaning in life. Follow-up studies can incorporate social factors (such as social support) to further explore the effect of stress response on depression of vocational medical school students. However, the current study is a cross-sectional study, which is the limitation of this study. We will continue to conduct relevant research after the end of the epidemic, which has achieved the purpose of longitudinal research. In addition, although the subjects of this study are relatively large, they are all concentrated in the same school. Future research needs to further expand the scope of sample selection.

Funding

This study was supported by Project of Humanities and Social Sciences of Ministry of Education in China (Grants No. 20YJC190006), Science and Technology Plan Project of Wuhu City (Grants Nos. 2020ms3-20), Philosophy and Social Science Planning Project of Anhui Provincial (Grants Nos. AHSKQ2019D059; AHSKF2021D21), Outstanding Young Talent Support Program Project of Anhui Province

(Grants Nos. gxyq2020160), and University Science Research Project of Anhui Provincial Department of Education (Grants Nos. SK2020ZD33; SK2019A0224).

Declaration of competing interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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