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Mental health and personality implications among medical students during the outbreak of the COVID-19 pandemic

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Few studies have explored the correlations between personality traits and mental health during the outbreak period of the COVID-19 pandemic. Thus, we conducted a cross-sectional survey to assess the personality traits and mental health of 142 students at Wenzhou Medical University, using the Generalized Anxiety Disorder 7-Item Scale, the Patient Health Questionnaire-9, the Sleep Status Self-Rating Scale, and the NEO Five-Factor Inventory. The results indicate that 30.28% of the sample had symptoms of anxiety, 40.85% had symptoms of depression, and 13.38% had disordered sleep. Neuroticism was positively correlated with anxiety, depression, and disordered sleep; extraversion was negatively correlated with anxiety, depression, and disordered sleep; openness was negatively correlated with disordered sleep; and conscientiousness was negatively correlated with both depression and disordered sleep. The results demonstrate that personality traits were risk factors for psychological disorders among students during the COVID-19 outbreak. Our findings may help provide a guide for screening for those susceptible to psychological disorders.

Keywords
COVID-19; coronavirus; anxiety; depression; sleep disorder; personality traits; mental health; pandemic; medical students

Since the first reported case in December 2019, coronavirus disease 2019 (COVID-19) has infected people throughout China and in many other countries around the globe (Chan et al., 2020; Holshue et al., 2020; Shereen et al., 2020; Stoecklin et al., 2020). Because of the high infectivity and mortality rate of COVID-19, humans face both severe psychological and physiological threats from this disease (Chew et al., 2020; Zhou et al., 2020). Many studies have found that psychological disorders such as anxiety, depression, and insomnia have prevailed during the COVID-19 pandemic (Elmer et al., 2020; Fu et al., 2020; X. Liu et al., 2020). Gaining greater understanding of the mental health of the general population throughout this pandemic could help guide intervention measures for preventing susceptible individuals from developing psychological disorders.

Personality is the relatively stable pattern of behaviors, thoughts, and feelings that characterize individuals (Caspi et al., 2005; Funder, 2001). The most-used model to describe personality traits is the five-factor model (Big Five; McCrae & Costa, 1987), in which the personality is categorized into five dimensions: neuroticism (i.e., being emotionally unstable), extraversion (i.e., being energetic/active and sociable), openness (i.e., being openminded and creative), agreeableness (i.e., willingness to cooperate and having compassion) and conscientiousness (i.e., being responsible and organized; Widiger & Trull, 1997).

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According to their personality traits, people often exhibit different psychological and physiological responses to threats or pressure (Bibbey et al., 2013; Ruini et al., 2003). For example, one study conducted with a large Iranian sample found that the neuroticism was positively correlated with stress, anxiety, and depression (Alizadeh et al., 2018). In addition, in a sample of medical students, it was shown that extraversion was negatively correlated with the level of salivary immunoglobulin A, a marker of the stress response (Afrisham et al., 2016).

Among the personality traits of the Big Five model, it has usually been found that neuroticism and extraversion have opposite relationships with stressful responses. Many researchers have shown that people with a high level of neuroticism or a low level of extraversion are prone to being negatively affected by stress (Evans et al., 2016; Schneider et al., 2012; Uliaszek et al., 2010). In consideration of the high infectivity and mortality rate of COVID-19, people would probably have been susceptible to psychological stress when COVID-19 broke out, especially individuals with a high level of neuroticism. Individuals with a high level of extraversion might be prone to seek social–emotional support to alleviate the stress of the COVID-19 pandemic. Thus, we speculated that neuroticism would be positively correlated with psychological disorders and, in contrast, extraversion would be negatively correlated with psychological disorders during the outbreak of COVID-19.

Indeed, there have been some studies that support our speculation. For example, in a study conducted in the United States, Nikčević et al. (2021) found that residents' neuroticism was positively correlated with anxiety and depression, and extraversion was negatively correlated with anxiety and depression during the COVID-19 pandemic. Further, S. Liu et al. (2021) and Murphy and Moret-Tatay (2021) found that neuroticism was positively correlated with stress during the COVID-19 pandemic and that perceived threat mediated this effect. In addition, Prentice et al. (2020) found that extraversion was significantly related to positive emotion-focused coping.

However, there are also some studies in which the findings did not support our speculation. For example, in a study conducted in Canada, S. Liu et al. (2021) found that higher neuroticism and extraversion were associated with higher levels of stress during the COVID-19 pandemic. In addition, in a study conducted in Korea, Han et al. (2021) found no significant correlation between neuroticism and anxiety, and in their study in Japan, Qian and Yahara (2020) found no significant correlation between extraversion and psychological disorders (stress, anxiety, and depression). However, similar studies have not yet been conducted in China. Thus, our aim in this study was to replicate these findings in the Chinese context, and to expand the scope of the research by also examining sleep problems and other demographic factors correlated with anxiety, depression, and sleep disorder.

In our cross-sectional study we examined the correlation between personality traits and psychological disorders (anxiety, depression, and disordered sleep) in a group of Chinese students during the outbreak of the COVID-19 pandemic. Here, we focused on the two personality traits of the Big Five model that are generally considered most relevant to stressful responses: neuroticism and extraversion (Hayes & Joseph, 2003), and formed the following hypotheses:
Hypothesis 1: Neuroticism will be positively correlated with psychological disorders.
Hypothesis 2: Extraversion will be negatively correlated with psychological disorders.

Method

Participants

This was a cross-sectional study conducted among students in Grades One to Four at Wenzhou Medical University (a detailed description of the sample is shown in Table 1). The exclusion criteria were as follows: (a) having suffered from a mental disorder before the COVID-19 pandemic, (b) currently taking medication for a mental disorder, and (c) not fully filling out the survey or submitted a survey with logical errors. Overall, 142 students submitted valid forms.

Table 1. *Mental Health of the Respondents During the Outbreak of the COVID-19 Pandemic in China*

Variable		Anxiety				Depression				Disordered sleep			
	Total (N = 142) N (%)	Yes (n = 43) n (%)	No (n = 99) n (%)	χ^2	p	Yes (n = 58) n (%)	No (n = 84) n (%)	χ^2	p	Yes (n = 19) n (%)	No (n = 123) n (%)	χ^2	p
Gender				15.00	< .001			3.90	< .05			0.00	.96
Male	68 (47.89)	10 (14.71)	58 (85.29)			22 (32.35)	46 (67.65)			9 (13.24)	59 (86.76)		
Female	74 (52.11)	33 (44.59)	41 (55.41)			36 (48.65)	38 (51.35)			10 (13.51)	64 (86.49)		
Grade				12.95	< .01			1.21	.75			3.78	.29
Freshman	27 (19.01)	8 (29.63)	19 (70.37)			11 (40.74)	16 (59.26)			1 (3.70)	26 (96.30)		
Sophomore	33 (23.24)	3 (9.09)	30 (90.91)			11 (33.33)	22 (66.67)			6 (18.18)	27 (81.82)		
Junior	37 (26.06)	18 (48.65)	19 (51.35)			17 (45.95)	20 (54.05)			6 (16.22)	31 (83.78)		
Senior	45 (31.69)	14 (31.11)	31 (68.89)			19 (42.22)	26 (57.78)			6 (13.33)	39 (86.67)		
Religious				0.95	.33			1.82	.18			2.29	.13
Yes	5 (3.52)	3 (60.00)	2 (40.00)			4 (80.00)	1 (20.00)			2 (40.00)	3 (60.00)		
No	137 (96.48)	40 (29.20)	97 (70.80)			54 (39.42)	83 (60.58)			17 (12.41)	120 (87.59)		
Being a single child				0.09	.77			2.27	.13			0.03	.86
Yes	72 (50.70)	21 (29.17)	51 (70.83)			25 (34.72)	47 (65.28)			10 (13.89)	62 (86.11)		
No	70 (49.30)	22 (31.43)	48 (68.57)			33 (47.14)	37 (52.86)			9 (12.86)	61 (87.14)		
Preparing for postgraduate entrance examination				0.13	.72			0.02	.90			0.13	.72
Yes	40 (28.17)	13 (32.50)	27 (67.50)			16 (40.00)	24 (60.00)			6 (15.00)	34 (85.00)		
No	102 (71.83)	30 (29.41)	72 (70.59)			42 (41.18)	60 (58.82)			13 (12.75)	89 (87.25)		
Electronic entertainment time per day				0.57	.75			0.14	.93			1.97	.37
< 3 hours	21 (14.79)	7 (33.33)	14 (66.67)			9 (42.86)	12 (57.14)			1 (4.76)	20 (95.24)		
3–5 hours	39 (27.46)	10 (25.64)	29 (74.36)			15 (38.46)	24 (61.54)			6 (15.38)	33 (84.62)		
> 5 hours	82 (57.75)	26 (31.71)	56 (68.29)			34 (41.46)	48 (58.54)			12 (14.63)	70 (85.37)		
Marital status of parents				5.93	< .05			6.70	< .01			16.20	< .001
Married	136 (95.77)	38 (27.94)	98 (72.06)			52 (38.24)	84 (61.76)			14 (10.29)	122 (89.71)		
Divorced	6 (4.23)	5 (83.33)	1 (16.67)			6(100.00)	0 (0.00)			5 (83.33)	1 (16.67)		
Annual family income (CNY)				5.75	.22			1.39	.85			7.14	.13
< 100,000	37 (26.06)	10 (27.03)	27 (72.97)			16 (43.24)	21 (56.76)			5 (13.51)	32 (86.49)		
100,000–200,000	54 (38.03)	14 (25.93)	40 (74.07)			19 (35.19)	35 (64.81)			4 (7.41)	50 (92.59)		
200,000–400,000	39 (27.46)	12 (30.77)	27 (69.23)			18 (46.15)	21 (53.85)			7 (17.95)	32 (82.05)		
400,000–800,000	9 (6.34)	6 (66.67)	3 (33.33)			4 (44.44)	5 (55.56)			1 (11.11)	8 (88.89)		
> 800,000	3 (2.11)	1 (33.33)	2 (66.67)			1 (33.33)	2 (66.67)			2 (66.67)	1 (33.33)		
COVID-19 infection risk of city of residence				9.25	< .01			8.10	< .05			1.56	.46
Low	14 (9.86)	4 (28.57)	10 (71.43)			2 (14.29)	12 (85.71)			2 (14.29)	12 (85.71)		
Medium	78 (54.93)	16 (20.51)	62 (79.49)			29 (37.18)	49 (62.82)			8 (10.26)	70 (89.74)		
High	50 (35.21)	23 (46.00)	27 (54.00)			27 (54.00)	23 (46.00)			9 (18.00)	41 (82.00)		
Strictness of home quarantine				0.97	.62			3.71	.16			1.84	.40
Loose	11 (7.75)	2 (18.18)	9 (81.82)			7 (63.64)	4 (36.36)			3 (27.27)	8 (72.73)		
General	27 (19.01)	9 (33.33)	18 (66.67)			13 (48.15)	14 (51.85)			4 (14.81)	23 (85.19)		
Strict	104 (73.24)	32 (30.77)	72 (69.23)			38 (36.54)	66 (63.46)			12 (11.54)	92 (88.46)		
Amount of attention paid to the COVID-19 pandemic				4.65	.10			2.70	.26			3.03	.22
Little	4 (2.82)	0 (0.00)	4 (100.00)			2 (50.00)	2 (50.00)			0 (0.00)	4 (100.00)		
General	39 (27.46)	9 (23.08)	30 (76.92)			20 (51.28)	19 (48.72)			3 (7.69)	36 (92.31)		
Much	99 (69.72)	34 (34.34)	65 (65.66)			36 (36.36)	63 (63.64)			16 (16.16)	83 (83.84)		
Change in family income during COVID-19				3.29	.19			2.01	.37			0.06	.97
Worse off	77 (54.22)	24 (31.17)	53 (68.83)			34 (44.16)	43 (55.84)			10 (12.99)	67 (87.01)		
No change	49 (34.51)	17 (34.69)	32 (65.31)			20 (40.82)	29 (59.18)			7 (14.29)	42 (85.71)		
Better off	16 (11.27)	2 (12.50)	14 (87.50)			4 (25.00)	12 (75.00)			2 (12.50)	14 (87.50)		

Procedure

The study was conducted in March 2020. Students were asked to think about their mental health during the last month and respond to a series of measures were administered in the following order:

Demographic Questionnaire

Respondents provided (a) their grade, gender, religious orientation, postgraduate entrance examination preparation status, and daily hours spent using electronic entertainment products; (b) the marital status of their parents and their family's income; (c) the COVID-19 infection risk in their place of residence and home quarantine strictness (see Table 1). We assumed that individuals spending more time playing electronic products would be less likely to develop psychological disorders during the COVID-19 pandemic outbreak.

Generalized Anxiety Disorder 7-Item Scale (GAD-7)

The GAD-7 is designed to assess anxiety symptoms (Spitzer et al., 2006). This scale comprises seven items (e.g., "I have trouble relaxing") rated on a 4-point Likert scale ranging from 0 = not at all to 3 = nearly every day. The total GAD-7 score is categorized as follows: ≤ 4 indicates no anxiety, 5–9 indicates mild anxiety,

10–14 indicates moderate anxiety, and 15–21 indicates severe anxiety. We considered a total score of less than 5 to indicate the absence of anxiety and a total score of 5 or more to indicate the presence of anxiety. The GAD-7 scale has established validity and reliability, and Cronbach's alpha coefficient was .88 in this study.

Patient Health Questionnaire-9 (PHQ-9)

The PHQ-9 is designed to assess depression symptoms (Kroenke et al., 2001). This scale has nine items (e.g., "I have little interest or pleasure in doing things") rated on a 4-point Likert scale ranging from 0 = *not at all* to 3 = *nearly every day*. The total PHQ-9 score is categorized as follows: ≤ 4 indicates no depression, 5–9 indicates mild depression, 10–14 indicates moderate depression, 15–19 indicates severe depression, and 20–27 indicates extremely severe depression. We regarded a total score of less than 5 to indicate the absence of depression and a total score of 5 or more to indicate the presence of depression. The PHQ-9 scale has established validity and reliability, and Cronbach's alpha coefficient was .87 in this study.

Sleep Status Self-Rating Scale (SRSS)

The SRSS is used to evaluate sleep disorders (J. M. Li et al., 2000). This scale has 10 items (e.g., "I have difficulty falling asleep") rated on a 5-point Likert scale from 1 = *not at all* to 5 = *nearly every day*. The higher the score, the poorer the sleep quality. The total SRSS score ranges from 10 (basically no sleep problems) to 50 (the most serious sleep problems). We regarded a total score < 23 to indicate no disordered sleep and a total score ≥ 23 to indicate poor-quality, disordered sleep. We selected the cutoff point of 23 in the SRSS according to a reference study by J. M. Li et al. (2000), in which the cutoff point for Chinese people with no disordered sleep was 22.14 ± 5.48. The SRSS scale has established validity and reliability, and Cronbach's alpha coefficient was .88 in this study.

Neuroticism Extraversion Openness Five-Factor Inventory (NEO-FFI)

The NEO-FFI consists of 60 items designed to assess personality traits (Costa & McCrae, 1992). This scale includes five 12-item subscales: neuroticism, extraversion, openness, agreeableness, and conscientiousness. Sample items are as follows: "Sometimes I feel completely worthless" (neuroticism), "I laugh easily" (extraversion), "I often try new and foreign foods" (openness), "I try to be courteous to everyone I meet" (agreeableness), and "I keep my belongings neat and clean" (conscientiousness). Items are rated on a 5-point Likert scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. The NEO-FFI scale has established validity and reliability, and Cronbach's alpha coefficients in this study were as follows: neuroticism = .82, extraversion = .82, openness = .67, agreeableness = .71, conscientiousness = .76.

Data Analysis

Data analysis was performed using SPSS software. Frequencies and percentages were used to describe the demographic variables. Chi-square tests were used to compare the differences in categorical variables. In addition, the variables were not normally distributed (Kolmogorov-Smirnov test: $p < .05$); thus, Spearman rank-order analysis was used to evaluate the correlations between the personality traits and anxiety, depression, or disordered sleep. The significance level for these analyses was set at .05. The probability values were Bonferroni corrected for multiple comparisons.

Results

Demographic Characteristics and Mental Health

We classified the city of residence of the respondents into three infection-risk levels according to the cumulative number of COVID-19 cases up until March 2020 (see Appendix). Detailed demographic information, including personal background, family background, and COVID-19-related information is

presented in Table 1. Among the 142 respondents, 43 (30.28%) had symptoms of anxiety, 58 (40.85%) had symptoms of depression, and 19 (13.38%) had disordered sleep.

The Relationship Between Demographic Variables and Mental Health

The percentage of respondents with a psychological disorder differed significantly by gender, grade, marital status of parents, and COVID-19 infection risk of city of residence (see Table 1, χ^2 test: $p < .05$). Women, compared to men, were more likely to suffer from anxiety (44.59% vs. 14.71%) and depression (48.65% vs. 32.35%). Juniors were more likely to suffer from anxiety (48.65%) compared to students in the other grades. Students whose parents were divorced showed greater anxiety (83.33%), more severe depression (100.00%), and more disordered sleep (83.33%) compared to those whose parents were married. Noticeably, a higher percentage of respondents living in a city with a high COVID-19 infection risk had symptoms of anxiety (46.00%) and depression (54.00%), compared with those living in a city with a lower infection risk.

The Relationship Between Personality Traits and Mental Health

As shown in Table 2, neuroticism was significantly and positively correlated with anxiety, depression, and disordered sleep; extraversion was significantly and negatively correlated with anxiety, depression, and disordered sleep; openness was significantly and negatively correlated with disordered sleep; and conscientiousness was significantly and negatively correlated with both depression and disordered sleep.

Table 2. *Correlations Between Mental Health and Personality Traits*

Personality traits	Anxiety	Depression	Disordered sleep
Neuroticism	.57***	.53***	.35***
Extraversion	−.22*	−.28**	−.29***
Openness	−.06	−.08	−.26**
Agreeableness	−.09	−.17	−.10
Conscientiousness	−.15	−.26**	−.27**

Note. Significance level was Bonferroni corrected.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Discussion

In this cross-sectional study we assessed the mental health and personality traits of students at Wenzhou Medical University in March 2020, during the outbreak of the COVID-19 pandemic. The results demonstrate that a high percentage of these students had psychological disorders. The figures are higher than those reported in previous similar studies conducted with Chinese students during the COVID-19 pandemic in which it was consistently reported that around 12% had symptoms of anxiety, 9% had symptoms of depression, and 3% were experiencing poor sleep quality (X. Li et al., 2020; Sun et al., 2020; Tang et al., 2020). This discrepancy is possibly owing to differences in sample characteristics, methods for psychological assessment, or severity of the COVID-19 pandemic in the respondents' respective cities of residence. However, in a recent review Xiong et al. (2020) reported that the prevalence of anxiety in the Chinese general population during the COVID-19 pandemic ranged from 6.33% to 50.9% and the prevalence of depression ranged from 14.6% to 48.3%. Generally, our findings are consistent with those of many previous studies demonstrating a negative correlation between the COVID-19 pandemic and the mental health of college students in China and other countries around the world (Dhar et al., 2020; Husky et al., 2020; Lyons et al., 2020; Marelli et al., 2020; Tang et al., 2020; Torun & Torun, 2020).

We found that gender, grade, marital status of parents, and COVID-19 infection risk of city of residence were risk factors for developing psychological disorders during the COVID-19 outbreak. These results are consistent with previous reports (Fu et al., 2020; X. Li et al., 2020; Wang et al., 2020; Zhu et al., 2020). These results imply that during the COVID-19 outbreak, the degree of threat of infection was the deciding factor in whether respondents experienced symptoms of psychological disorders. This speculation was supported by X. Li et al. (2020), who found that students' perceptions of the level of risk of COVID-19 infection were correlated with how much psychological stress they experienced during the COVID-19 outbreak. However, we found that home quarantine was not a risk factor. This was probably because of the respondents' perception of confinement measures during the COVID-19 outbreak as loose rather than strict (see Table 1). In comparison, some studies found that home quarantine was positively correlated with psychological disorders during the period of national lockdown (Elmer et al., 2020; Husky et al., 2020; Khan et al., 2020).

Notably, we found that personality traits were also risk factors for experiencing psychological disorders during the COVID-19 outbreak. This is consistent with the findings of previous studies in which personality traits were assessed with the Big Five model (Nikčević et al., 2021; Osimo et al., 2021) or the Dark Tetrad model (Hardin et al., 2021). Moreover, other studies have reported that personality traits are strongly correlated with psychological and behavioral responses to the COVID-19 pandemic, such as concern, emotion, and precaution measures (Aschwanden et al., 2020; de Francisco Carvalho et al., 2020; Garbe et al., 2020; Somma et al., 2020). These results highlight the importance of personality traits in mediating psychological responses during the COVID-19 pandemic. According to the framework proposed by Bolger and Zuckerman (1995), personality affects both exposure and reactivity to stressful events, which could explain how personality affected mental health during the COVID-19 pandemic.

Limitations and Directions for Future Research

There are several limitations to this study that should be noted: First, this was a cross-sectional study; thus, we cannot draw causal inferences. Second, students at Wenzhou Medical University were the only group in the survey. The limited and small sample size may not represent the full student population in China. Third, we conducted this study using only self-report measures, which may be affected by subjective error. Finally, the demographic characteristics we examined are not comprehensive, and there may be other factors that have a close correlation with mental health. Nonetheless, our findings provide a valuable understanding of the demographic characteristics and personality traits that correlate with the mental health of medical students during the COVID-19 outbreak.

Conclusion

The COVID-19 pandemic has imposed a significant psychological threat for people around the globe. Individuals may show different psychological responses to the COVID-19 threat according to their demographic characteristics or personality traits. In this study we found that several demographic variables were risk factors for anxiety, depression, and disordered sleep among Chinese medical students during the COVID-19 outbreak. In addition, personality traits were closely correlated with psychological disorders. These findings may provide a guide for the screening of populations susceptible to psychological disorders, and for the provision of targeted psychological interventions during the COVID-19 pandemic.

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Appendix: Classification of COVID-19 Infection Risk According to the Cumulative Number of Cases in Each City in March 2020

City of residence	Number of COVID-19 cases	Infection risk	Respondent number
Dunhuang	0	Low risk	1
Jiayuguang	0	Low risk	1
Jinchang	1	Low risk	1
Lincang	1	Low risk	1
Tongliao	7	Low risk	1
Yan'an	8	Low risk	1
Mengzi	9	Low risk	1
Pingliang	9	Low risk	3
Qiandongnan	10	Low risk	1
Zhoushan	10	Low risk	3
Huzhou	12	Medium risk	3
Tianshui	12	Medium risk	1
Qujing	13	Medium risk	1
Quzhou	14	Medium risk	4
Lishui	17	Medium risk	3
Bijie	23	Medium risk	1
Zaozhuang	24	Medium risk	1
Shantou	25	Medium risk	1
Dalian	26	Medium risk	3
Kaifeng	26	Medium risk	1
Huainan	27	Medium risk	1
Luoyang	31	Medium risk	1
Zunyi	32	Medium risk	4
Guiyang	36	Medium risk	1
Luohe	36	Medium risk	1
Bangzhou	39	Medium risk	1
Shaoxing	42	Medium risk	12
Changchun	45	Medium risk	1
Jiaxing	46	Medium risk	7
Quanzhou	47	Medium risk	1
Anyang	53	Medium risk	2
Dongyang	56	Medium risk	1
Jinhua	56	Medium risk	13
Qingdao	61	Medium risk	1
Zhongshan	68	Medium risk	1
Zhuzhou	80	Medium risk	1
Shangqiu	91	Medium risk	1
Yongcheng	91	Medium risk	1
Foshan	94	Medium risk	2
Yichun	106	High risk	1
Tianjin	136	High risk	2
Taizhou	146	High risk	12
Cixi	157	High risk	1
Ningbo	157	High risk	12
Hangzhou	186	High risk	10
Xinyang	274	High risk	1
Shanghai	339	High risk	1
Guangzhou	440	High risk	1
Wenzhou	504	High risk	11
Chongqing	579	High risk	1
Beijing	580	High risk	3

Note. Low risk = 0–10 cases; medium risk = 11–100 cases; high risk = over 100 cases.