



Risk factors of psychological distress during the COVID-19 pandemic: The roles of coping style and emotional regulation

Na Li^a, Lurong Fan^{b,c,*}, Yan Wang^{b,c}, Jing Wang^a, Yu Huang^a

^a Mental Health Education Center, Chengdu Normal University, Chengdu 611130, PR China

^b Business School, Sichuan University, No. 24, South Section 1, Yihuan Road, Chengdu, Sichuan 610064, PR China

^c Institute of Emergency Management and Reconstruction in Post-disaster, Sichuan University, Chengdu 610064, PR China

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ABSTRACT

Background: When COVID-19 emerged in China in late 2019, most citizens were home-quarantined to prevent the spread of the SARS-CoV-2 virus. Extended periods of isolation have detrimental effects on an individual's mental health. Therefore, the impact of the COVID-19 pandemic should include assessment of psychological distress and its known risk factors, including coping style and emotional regulation.

Methods: This cross-sectional study surveyed 6,027 Chinese university students recruited from May 25, 2020 to June 10, 2020. In addition to sociodemographic information, participant data were collected using online versions of the 10-item Kessler Psychological Distress Scale (K10), Simplified Coping Style Questionnaire (SCSQ), and Emotion Regulation Questionnaire (ERQ).

Results: The incidence of psychological distress was found to be 35.34%. Negative coping style and expressing panic about COVID-19 on social media were the most important predictors of psychological distress. In addition, being male, being a "left-behind child" or having a monthly household income lower than 5000 CNY or higher than 20,000 CNY were associated with higher psychological distress.

Conclusion: The psychological consequences of the COVID-19 pandemic could be serious. Psychological interventions that reduce nervousness and negative coping style need to be made available to home-quarantined university students, especially those who are male, are "left-behind", have a monthly household income lower than 5000 CNY or higher than 20,000 CNY, or express panic on social media.

1. Introduction

The novel coronavirus (SARS-CoV-2) causes coronavirus disease 2019 (COVID-19) pandemic (Tang et al., 2020a, 2020b). There was a rapid surge in the number of COVID-19 cases during March 2020, particularly in Iran, Italy, South Korea, and the United States (Elsous et al., 2020; Asokan et al., 2020). Previous studies have reported that psychological problems can occur during pandemics (Chen et al., 2006; Main et al., 2011; Salomon et al., 2021). In fact, the increasing and continuous threat of the pandemic led to a global atmosphere of psychological distress (PD), partially due to disrupted travel plans, social isolation, media information overload, and panic buying of necessity goods (Purtle, 2020; Pimenta et al., 2020; Bagus et al., 2021).

As the pandemic persists, the general population experiences different levels of PD, such as nervousness, fear of infection, anxiety, and depression (Duan and Zhu, 2020; Feinstein et al., 2020; Valenzano et al.,

2021). PD is strongly associated with psychological disorders, which can significantly reduce the quality of life and is a risk factor for physical health problems, such as arthritis, cardiovascular disease, and chronic obstructive pulmonary disease (McLachlan and Gale, 2018). Therefore, governments and public health authorities urgently need guidance and actionable information on effective public physical and psychological health interventions that can safeguard the general public. Recent mental health studies on COVID-19 have focused on health professionals or a particular age group, or have not analyzed the data in-depth to identify risk or protective factors for mental health.

Coping styles may have a strong effect on mental health in undergraduates (Anahita, 2008). Effective coping strategies might protect individuals from developing PD when they experience stressors, whereas inappropriate coping styles can lead to a perception of personal failure and distress (Gurvich et al., 2021). In a longitudinal study of undergraduates, maladaptive coping styles were associated with

* Corresponding author at: Business School, Sichuan University, No. 24, South Section 1, Yihuan Road, Chengdu, Sichuan 610064, PR China.

E-mail address: fanlurong@scu.edu.cn (L. Fan).

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increased PD following negative events (Cui et al., 2019). Problematic coping strategies, such as giving up in order to avoid a potential failure, may prevent a student from seeking help from family, friends, or professional services. Few studies have explored relationships between PD and different coping styles among Chinese undergraduates.

In addition to coping style, emotion regulation may also play an important role in PD among undergraduates, serving as a mediator between stress and psychological problems (Kashdan and Farmer, 2014). Effective emotion regulation was shown to help protect perfectionists from experiencing PD (Beblo et al., 2012). A useful instrument for assessing emotion regulation, particularly in the Chinese cultural context, is the Emotion Regulation Questionnaire (ERQ) (Gross, 1988). The ERQ has been widely applied in many PD studies (Aldao et al., 2014). This instrument comprises two subscales: cognitive reappraisal, which is an attempt to reframe a situation in a way that changes its meaning and emotional impact; and expressive suppression, which is an attempt to inhibit or reduce ongoing emotion-expressive behavior. Cognitive reappraisal has been shown to strengthen the experience of positive emotion, which may help prevent distress in the general population (Taylor and Heimberg, 2018). On the other hand, expressive suppression has been shown to heighten the felt intensity of negative emotion, which may significantly increase PD (Gross and Jazaieri, 2014). This discrepancy highlights the need for further analysis of how the two subtypes of emotion regulation are associated with PD in Chinese undergraduate students.

To evaluate mental health status during the initial outbreak and peak of the COVID-19 pandemic and to identify risk and protective factors of the resulting PD, we recruited university students upon their return from home quarantine. In this study, we explored the relationship of PD with coping style, emotion regulation, and COVID-19 exposure. We also assessed whether COVID-19 exposure, coping style, or emotion regulation predicted PD. We attempt to provide a reference to help identify students who have high levels of PD and enable early intervention.

2. Methods

2.1. Participants and procedure

This cross-sectional study was conducted using convenience sampling in one university in Chengdu between May 25, 2020 and June 10, 2020. Approximately 30 classes from each university year with between 40 and 70 students each were selected. In total, 8000 students from 120 classes across four university years were invited to participate in the survey. Of the 8000 students, 6079 completed the survey. However, 52 were eliminated because of illogical answers, such as all choices being one or zero. In the end, 6027 completed surveys were used for analysis, corresponding to a response rate of 75.3%. All surveys were de-identified, and all participants provided consent for their anonymized data to be analyzed and published for research purposes. All procedures complied with the ethical standards of the Research Ethics Committee of the Chengdu Normal University.

2.2. Measures

Sociodemographic data were collected from each participant, who self-reported sex, university year (1–4), their families' monthly household income, and whether they were "left behind" by parents who moved to a city for better work. PD, coping style, and emotional regulation were measured with the published scales described below.

2.2.1. Psychological distress (PD)

The 10-item Kessler Psychological Distress Scale (K10) was developed as a screening tool for PD in the general population, and we used it to assess non-specific PD in students. It is composed of items measuring psychological and physiological symptoms of anxiety and depression within the previous four weeks (Kessler et al., 2003). The items included

were: "Did you feel ... (1) tired out for no good reasons?", ... (2) nervous?", ... (3) so nervous that nothing could calm you down?", ... (4) hopeless?", ... (5) restless or fidgety?", ... (6) so restless that you could not sit still?", ... (7) depressed?", ... (8) that everything was an effort?", ... (9) so sad that nothing could cheer you up?" and ... (10) worthless?" Each item was scored on a five-point Likert scale (1 = none of the time, 2 = a little of the time, 3 = some of the time, 4 = most of the time, and 5 = all of the time). The total possible score of the K10 ranges from 10 (no distress) to 50 (severe distress). A participant with a total score of 10–19 is likely to be well, 20–24 is likely to have a mild disorder, 25–29 is likely to have a moderate disorder, and 30–50 is likely to have a severe disorder (Fuller-Thomson et al., 2020). Studies have shown that the K10 is psychometrically valid and appropriate for use in indigenous and general populations in Ghana (Anderson et al., 2013; Vasiliadis et al., 2015). A total score ≥ 25 indicates moderate to serious psychological distress (Fuller-Thomson et al., 2020).

2.2.2. Coping style

The Simplified Coping Style Questionnaire (SCSQ) is a 20-item self-report scale that measures individual coping style (Ye et al., 2017). The SCSQ is divided into two subscales: positive coping (12 items) and negative coping (8 items). Positive coping reflects the level of active coping style, such as "when facing problems, find several different solutions" or "look at the good side of things". In contrast, negative coping reflects the level of passive coping style, such as "when facing problems, escape troubles by drinking and smoking" or "imagine a miracle will come, and the problem will be solved". Each item is scored on a four-point Likert scale (0 = never, 1 = seldom, 2 = often, and 3 = always). The total possible score of the positive coping subscale ranges from 0 to 36, and the total possible score of the negative coping subscale ranges from 0 to 24. Higher scores on each subscale reflect higher levels of the indicated coping style. Cronbach's α for positive coping (0.89) and negative coping (0.78) demonstrate high reliability in Chinese population (Adbollahi and Carbring, 2017; Lin et al., 2020).

2.2.3. Emotional regulation strategies

The Emotion Regulation Questionnaire (ERQ, Aldao et al., 2010) is a 10-item self-report measure of two emotion regulation strategies: cognitive reappraisal (6 items) and expressive suppression (4 items). Sample items for the ERQ are "When I want to feel less negative emotion (such as sadness or anger), I change what I am thinking about" for the cognitive reappraisal dimension and "I control my emotions by not expressing them" for the expressive suppression dimension. Each item is rated on a seven-point Likert scale (1 = strongly disagree, 4 = neutral, and 7 = strongly agree). The total possible score for cognitive reappraisal ranges from 6 to 42, and the total possible score for expressive suppression ranges from 4 to 28. The Italian version of the ERQ has shown good reliability and validity (O'Mahen et al., 2015). The ERQ had an internal consistency of 0.78 and 0.80 for cognitive reappraisal and 0.72 and 0.78 for emotional suppression in samples that were or were not obese, respectively (Fucito et al., 2010).

2.3. Statistical analysis

Data were summarized with descriptive statistics. one-way analysis of variance (ANOVA) or t-tests was used to examine the associations between the categorical variables. Multiple linear regression was performed to identify predictors of PD. All statistical analysis was performed using SPSS 25.0 (IBM, Chicago, IL, USA). A p-value less than 0.01 was considered significant.

3. Results

Sociodemographic characteristics of the 6027 respondents are summarized in Table 1. The sample population was slightly more female than the general population, with 3518 (58.4%) female and 2509

Table 1
Sociodemographic characteristics of the study population.

Characteristic	N	%
Sex		
Male	2509	41.6%
Female	3518	58.4%
University year		
1st year	2029	33.67%
2nd year	1369	22.71%
3rd year	1731	28.72%
4th year	894	14.83%
Left-behind		
No	2559	42.46%
Yes	3468	57.54%
Household income (CNY/month)		
0–4999	3185	52.85%
5000–9999	2079	34.49%
10,000–14,999	521	8.64%
15,000–19,999	103	1.71%
≥20,000	139	2.31%
Time focused on COVID-19		
≤1 h	3917	65%
1–2 h	1859	30.8%
3–5 h	132	2.2%
≥5 h	119	2.0%
Expressed panic about COVID-19 on social media		
No	5487	91%
Yes	540	9%
Worry about myself infection with COVID-19		
Do not worry	1836	30.46%
A little worry	2388	39.62%
More worry	1343	22.28%
Very worried	460	7.63%
Worry about family infection with COVID-19		
Do not worry	1289	21.39%
A little worry	1498	24.85%
More worry	2076	34.44%
Very worried	1164	19.31%
Cohabitants are nervous about COVID-19		
Never	2477	41.1%
A few days	3221	53.4%
More than half the time	274	4.5%
Almost every day	55	0.9%
Someone was infected with COVID-19 in my community		
No	5625	93.33%
Yes	402	6.67%

(41.6%) male. Approximately half of the respondents (57.54%) were left behind in rural areas to be cared for by other family members while their parents sought work in a nearby city. The monthly household income of 52.85% of the respondents was lower than 5000 yuan (CNY; 1 CNY = 0.15 USD). We also surveyed students about their behavior and exposure to COVID-19 media coverage. Most students (65%) spent less than one hour each week focused on COVID-19, but 30.8% focused on COVID-19 for one to two hours. Only 9% expressed panic about COVID-19 on social media, and 94.5% of respondents indicated that their cohabitants worried about the disease less than half of the time. Student responses were more evenly distributed when students were asked about their level of worry about infection, either for themselves or for family members. Only 6.7% of respondents knew a member of their community who had been infected.

Mean scores of coping style subscales (positive coping and negative coping), emotion regulation subscales (cognitive reappraisal and expressive suppression), and PD are shown in Table 2. The percentage of respondents in each PD category was also reported, with 35.34% likely suffering from a moderate or severe mental disorder. Table 3 summarizes the interactions between the subscales and each sociodemographic characteristic from Table 1. Female students showed a significantly higher positive coping style than male students (22.76 vs 21.42, $p < 0.001$). Females also demonstrated significantly better emotion regulation than males, with higher cognitive reappraisal (31.26 vs 30.21, $p < 0.001$) and lower expressive suppression (15.42 vs 17.21, $p < 0.001$).

Table 2
Psychological evaluation of the study population.

Score	N	%	Mean	Standard Deviation
Positive coping style Range = [0–36]			22.20	6.355
Negative coping style Range = [0–24]			9.43	4.420
Cognitive reappraisal Range = [6–42]			30.82	5.69
Expressive suppression Range = [4–28]			16.16	4.679
Psychological distress (PD) Range = [10–50]			21.37	8.238
10–19	2594	43.04%		
20–24	1303	21.62%		
25–29	759	12.59%		
30–50	1371	22.75%		

Unsurprisingly, male students had a higher average PD score than female students (22.17 vs 20.81, $p < 0.001$). There were no significant differences in any psychological metric across the four university years. Compared with students that lived with their parents, the left-behind students had a significantly lower positive coping style score (21.86 vs 22.67, $p < 0.001$) and cognitive reappraisal score (30.65 vs 31.06, $p = 0.005 < 0.01$). They also showed higher PD scores than students that were not left behind (21.93 vs 20.62, $p < 0.001$). There were significant differences in PD scores among various household incomes ($p < 0.001$). Students whose family monthly income was lower than 5000 CNY or higher than 20,000 CNY had a higher average PD score.

The length of time focused on COVID-19 was positively associated with positive coping style scores ($p < 0.001$); however, it was not found to be associated with PD scores ($p = 0.044$). Compared with students who did not report expressing panic about COVID-19 on social media, those who did had a higher negative coping style score (10.72 vs 9.31, $p < 0.001$), lower cognitive reappraisal (30.01 vs 30.9, $p = 0.001$), and higher PD scores (25.81 vs 20.94, $p < 0.001$). People who reported more worry about themselves or family being infected had higher PD scores (24.37 vs 22.08 vs 20.90 vs 20.72, 23.45 vs 21.52 vs 20.39 vs 20.39, $p < 0.001$). In addition, students who had more nervous cohabitants also had higher negative coping style scores (23.35 vs 22.16 vs 21.55 vs 21.18, $p < 0.001$), lower cognitive reappraisal scores (28.38 vs 30.02 vs 30.64 vs 31.2, $p < 0.001$), and higher PD scores (27.55 vs 25.02 vs 22.15 vs 19.82, $p < 0.001$). Respondents who knew someone infected with COVID-19 in their community had higher PD scores (23.01 vs 21.26, $p < 0.001$).

Table 4 presents results from multiple linear regression analysis to identify predictors for PD. The regression model indicated that negative coping style was the most significant predictor for PD, followed by expressive suppression, cognitive reappraisal, positive coping style, expressing panic about COVID-19 on social media, cohabitants being nervous about COVID-19, worry about family contracting COVID-19, and being left behind. In contrast, sex, household income, worry about oneself contracting COVID-19, or knowing someone with COVID-19 in the community did not predict PD.

4. Discussion

We conducted a survey of 6027 Chinese university students to explore sociodemographic variables and certain psychological metrics as potential risk factors of PD after the COVID-19 outbreak. We observed that male sex, being left behind, and a monthly household income lower than 5000 CNY or higher than 20,000 CNY were associated with higher PD in our sample. However, of these, only being left behind was predictive of PD. Among pandemic-specific variables, expressing panic about COVID-19 on social media was the most important predictor of PD. The second most important predictor of PD was having cohabitants who were nervous about COVID-19. In addition to these factors,

Table 3
Comparative analysis of psychological measures with sociodemographic characteristics.

	Positive coping style	F	p-value	Negative coping style	F	p-value	Cognitive reappraisal	F	p-value	Expressive suppression	F	p-value	Psychological distress (PD)	F	p-value
Gender		65.097	<0.001		2.043	0.153		50.193	<0.001		223.12	<0.001		40.202	<0.001
Man	21.42 (6.823)			9.53 (4.713)			30.21 (6.285)			17.21 (4.666)			22.17 (8.720)		
Woman	22.76 (5.938)			9.37 (4.198)			31.26 (5.182)			15.42 (4.543)			20.81 (7.828)		
University Year		0.92	0.43		0.328	0.805		1.966	0.117		2.185	0.088		2.3	0.075
1st year	22.33 (6.30)			9.50 (4.471)			31.06 (5.65)			16.37 (4.734)			21.30 (8.118)		
2nd year	22.13 (6.61)			9.40 (4.327)			30.66 (5.982)			16.11 (4.618)			20.97 (8.401)		
3rd year	22.03 (6.30)			9.40 (4.327)			30.78 (5.503)			16.06 (4.717)			21.73 (8.38)		
4th year	22.34 (6.19)			9.34 (4.207)			30.62 (5.67)			15.97 (4.56)			21.47 (7.957)		
Left-behind		24.15	<0.001		0.201	0.645		7.718	0.005		0.594	0.441		37.549	<0.001
No	22.67 (6.54)			9.46 (4.622)			31.06 (5.878)			16.22 (4.817)			20.62 (8.328)		
Yes	21.86 (6.193)			9.41 (4.265)			30.65 (5.542)			16.12 (4.575)			21.93 (8.128)		
Household Income (CNY/month)		2.60	0.035		0.782	0.536		2.561	0.037		2.143	0.073		5.094	<0.001
0–4999	22.06 (6.365)			9.41 (4.413)			30.64 (5.563)			16.27 (4.604)			21.81 (8.403)		
5000–9999	22.18 (6.071)			9.40 (4.28)			30.90 (5.605)			15.94 (4.6)			20.94 (7.908)		
10,000–14,999	22.68 (6.828)			9.63 (4.74)			31.29 (5.992)			16.3 (5.055)			20.71 (8.453)		
15,000–19,999	22.76 (7.186)			9.39 (4.542)			31.32 (7.438)			16.02 (5.251)			20.27 (7.832)		
≥20,000	23.42 (7.538)			9.94 (5.253)			31.57 (6.963)			16.63 (5.491)			21.06 (8.246)		
Time focused on COVID-19		17.149	<0.001		.679	.565		5.029	0.002		4.358	0.005		2.708	.044
≤1 h	21.79 (6.422)			9.41 (4.366)			30.63 (5.721)			16.08 (4.07)			21.39 (8.329)		
1–2 h	23.01 (6.049)			9.44 (4.514)			31.18 (5.654)			16.21 (4.667)			21.15 (7.922)		
3–5 h	23.36 (6.482)			9.85 (4.432)			31.7 (4.672)			17.17 (4.251)			22.97 (8.495)		
≥5 h	21.92 (7.306)			9.78 (4.703)			30.72 (5.972)			17.16 (5.371)			22.39 (9.530)		
Expressed panic about COVID-19 on social media		2.094	.148		50.615	<0.001		11.97	0.001		2.644	0.104		177.534	<0.001
No	22.24 (6.364)			9.31 (4.412)			30.9 (5.68)			16.13 (4.676)			20.94 (8.124)		
Yes	21.82 (6.254)			10.72 (4.298)			30.01 (5.741)			16.48 (4.702)			25.81 (8.081)		
Worry about myself infection with COVID-19		2.299	.075		9.341	<0.001		2.743	0.042		10.086	<0.001		30.529	<0.001
Do not worry	22.43 (7.037)			9.30 (4.854)			31.12 (6.246)			16.41 (5.026)			20.72 (8.811)		
A little worry	22.03 (5.990)			9.21 (4.071)			30.76 (5.348)			15.83 (4.445)			20.90 (7.737)		
More worry	22.05 (5.810)			9.76 (4.278)			30.61 (5.313)			16.15 (4.499)			22.08 (7.650)		
Very worry	22.62 (6.808)			10.17 (4.624)			30.55 (6.108)			16.94 (4.799)			24.37 (9.207)		
Worry about family infection with COVID-19		2.306	.075		7.683	<0.001		2.449	0.062		13.077	<0.001		38.676	<0.001

(continued on next page)

Table 3 (continued)

	Positive coping style	F	p-value	Negative coping style	F	p-value	Cognitive reappraisal	F	p-value	Expressive suppression	F	p-value	Psychological distress (PD)	F	p-value
Do not worry	22.47 (7.249)			9.32 (5.000)			31.19 (6.408)			16.43 (5.118)			20.39 (8.890)		
A little worry	22.22 (6.094)			9.07 (4.123)			30.78 (5.385)			15.74 (4.432)			20.39 (7.915)		
More worry	21.93 (5.871)			9.54 (4.193)			30.73 (5.351)			15.97 (4.493)			21.52 (7.656)		
Very worry	22.36 (6.444)			9.85 (4.460)			30.63 (5.805)			16.76 (4.731)			23.45 (8.500)		
Cohabitants are nervous about COVID-19		1.948	.120		12.441	<0.001		10.018	<.0001		1.860	<0.134		69.359	<0.001
Never	22.35 (6.911)			9.08 (4.699)			31.2 (6.01)			16.11 (4.905)			19.82 (8.489)		
A few days	22.16 (5.877)			9.61 (4.210)			30.64 (5.371)			16.14 (4.509)			22.15 (7.767)		
More than half the time	21.55 (6.144)			10.25 (3.803)			30.02 (5.884)			16.67 (4.533)			25.02 (7.896)		
Almost every day	21.18 (7.888)			10.93 (4.879)			28.38 (6.643)			17.05 (4.588)			27.55 (10.203)		
Someone was infected with COVID-19 in the community		1.776	.183		2.042	.153		1.675	0.196		0.784	0.376		17.011	<0.001
No	22.23 (6.374)			9.41 (4.437)			30.85 (5.69)			16.15 (4.696)			21.26 (8.235)		
Yes	21.79 (6.066)			9.74 (4.163)			30.47 (5.697)			16.36 (4.43)			23.01 (8.119)		

Note: All data are reported as mean (standard deviation) unless otherwise noted.

Table 4
Multiple linear regression to identify predictors of PD (n = 6027).

Variable	Unstandardized Coefficients		Standardized Coefficients Beta	t value	P-value
	B	Std. Error			
Sex	-0.286	0.193	-0.017	-1.482	0.138
Left-behind	0.796	0.188	0.048	4.235	<0.001
Household income	-0.242	0.105	-0.026	-2.300	0.021
Expressed panic about COVID-19 on social media	3.017	0.332	0.105	9.094	<0.001
Worry about myself infection with COVID-19	-0.088	0.152	-0.010	-0.579	0.563
Worry about family infection with COVID-19	0.429	0.134	0.054	3.211	0.001
Cohabitants are nervous about COVID-19	1.398	0.161	0.104	8.681	<0.001
Someone was infected with COVID-19 in my community	0.878	0.369	0.027	2.376	0.018
Positive coping style	-0.190	0.017	-0.146	-10.923	<0.001
Negative coping style	0.476	0.023	0.255	20.923	<0.001
Cognitive reappraisal	-0.309	0.019	-0.213	-16.155	<0.001
Expressive suppression	0.403	0.022	0.229	18.608	<0.001

worrying about oneself or one’s family contracting COVID-19 or knowing someone in the community with COVID-19 were associated with higher PD. All of our measured psychological metrics were more important predictors of PD than any sociodemographic metric. We also explored the interactions between sociodemographic characteristics and each psychological measure. Our findings are contextualized in the following sections.

4.1. The effects of sociodemographic factors on PD

About 35.34% of the students in our sample have moderate to serious psychological distress. Considering many previous reports about psychologic status during the COVID-19 pandemic were scored by K6 or K10, it is necessary to compare the PD prevalence results with these studies. The PD prevalence in this study was much lower than a sample of 993 adults from Eswatini using K6 (Shongwe and Huang, 2021) and a sample of 553 medical students from Jordan using K10 (Seetan et al., 2021), who had a PD rate of 47.1% and 50.3%, respectively. In Shongwe and Huang’s study, desperate need for food and concerns about the loss of business were associated with the increased of PD prevalence, which was different with our sample, who were protected by their families and did not need to deal with these problems. Medical students in Seetan et al.’s study faced higher exposure risk and were more vulnerable than the general population. The prevalence of our sample was also much lower than a sample of 11,333 Japanese using the K6 version of this scale (Yamamoto et al., 2020), who had a PD rate of 48.1%. Many participants in Yamamoto et al.’s study were healthcare workers or had a history of treatment for mental illness, which was risk factor for higher PD (Alqutub et al., 2021). The prevalence of PD in our study was comparable to a sample of 12,989 Welsh persons using the same screening scale (Gray et al., 2020), who had a PD rate of 36.9%. However, the PD prevalence of this study was much higher than a sample of 1293 British using K6 (Goodwin et al., 2021) and a sample of 3389 New Zealanders using K10 (Bell et al., 2021), who had a PD rate of 16.5% and 23.13%, respectively. In comparison to the 22.8% prevalence found in a sample of 1588 general Chinese people, the PD rate of our study was also greatly higher (Yu et al., 2020). Unlike these studies, many students in our

sample were left behind and faced poverty, and these were associated with the increased of PD prevalence (Racine et al., 2020).

In a word, the psychological distress of the population during the COVID-19 pandemic was not optimistic, and the screening scale (K6 or K10) does not significantly impact PD prevalence. Discrepancies of prevalence in the above-mentioned studies could be due to the age range (Horiuchi et al., 2020) and exposure risk (Seetan et al., 2021). For example, this study has interviewed young subjects in a small age range who had poor health risks related to COVID-19 infection (Bagus et al., 2021). Compared with children and old people, the pandemic-related psychological distress for young subjects was limited (Horiuchi et al., 2020; Gong et al., 2021). Then, the extent of the lockdown (Bell et al., 2021), pre-existing depressive disorders (Yamamoto et al., 2020), and food insecurity (Serafini et al., 2021) have been proved to significantly impact the PD prevalence. Furthermore, the stage of the pandemic (Goodwin et al., 2021), the data collection periods (Yu et al., 2020), and the country’s response to the pandemic (Shongwe and Huang, 2021) also could be important reasons for the different PD prevalence.

We found that male students had higher average PD scores than female students. This significant sex difference is inconsistent with previous research results, which showed higher PD in females (Eisenberg et al., 2007; Zhang et al., 2018). This discrepancy may be caused by differences in coping styles and emotion regulation strategies employed during the COVID-19 pandemic. Previous studies have shown that populations with negative coping styles have higher levels of PD (Eaton et al., 2012). Similarly, a more positive coping style may promote emotional well-being (Wright et al., 2010). Our results showed that male students were more likely to use negative coping styles. In addition, cognitive reappraisal can offset the accumulation of negative emotions, perhaps reducing depression (Fredrickson and Joiner, 2002). Expression suppression, which masks an individual’s feelings and limits their external expressions of emotions, may negatively impact psychological adaptability (Hong et al., 2018). Our results showed that our male students used less cognitive reappraisal and more expressive suppression than female students, which may explain their higher PD.

Being left behind is a risk factor of PD, which is consistent with previous studies (Su et al., 2013). In China, many younger adults and couples migrate from rural areas or smaller cities to larger cities to find better-paying work, leaving their children behind to be cared for by relatives or community members. According to the ecological system theory of human development, the family has significant effects on adolescent development. Specifically, lack of financial and emotional support from parents leads to social anxiety (Ren and Li, 2020). Families play a major role in helping children cope with trauma, so parental absence during childhood may contribute to the development of somatic or panic symptoms (Tang et al., 2020a, 2020b). Without their parents to protect them, students who are left behind can feel hopeless and lonely, which increases their risk of PD (Jia and Tian, 2010). Further, the reduced parental support also increases the likelihood of problems such as low self-esteem (Amato, 1993), which is one of the most powerful clinical predictors of PD. It is also possible that being left behind may increase negative life events for children, which may have a cumulative effect on an individual’s mental health in adulthood (Li et al., 2020).

The students whose family monthly income is lower than 5000 CNY or higher than 20,000 CNY show higher PD, which is consistent with the findings reported in previous studies (Shafiee et al., 2021; McQuaid et al., 2020). For the students whose family monthly income is lower than 5000 CNY, it is more likely that they lacked care and support from their families, instead requiring they often deal with difficulties and pressure by themselves. They are also less likely to participate in group activities because of the additional expenditure, which reduces their avenues for making friends. Further, they are more likely to be sensitive and introverted, and therefore, less likely to express their emotions or needs. High income has been shown to be associated with elevated stress at work (Chamik et al., 2017). Therefore, the 2.31% of students whose family monthly income is higher than 20,000 CNY have parents who are

more anxious, which may increase their own stress. They may receive less emotional care from their parents because their parents are busier than the general people. In addition, their parents are considered highly successful, which may place extra pressure on them to be more hard-working. In fact, it is likely that above a certain level of stable income, individuals' emotional well-being is constrained by other factors in their temperament and life circumstances (Kahneman and Deaton, 2010).

Among COVID-19-related factors, expressing panic about COVID-19 on social media was the most important predictor of PD. During the COVID-19 pandemic, students use social media to continue their learning virtually, as well as to communicate with friends and to obtain more information about the pandemic. Thus, social media plays a major role in rapidly spreading panic about the COVID-19 pandemic among students (Radwan et al., 2020). The unavoidable media coverage and constant exposure to negative information relating to this pandemic, including an increase in cases and deaths, is likely to negatively affect respondents' mental health (Smith et al., 2020; Bagus et al., 2021). The second most important predictor of PD was the belief that cohabitants were nervous about COVID-19. A previous study showed that individuals might be consciously or unconsciously influenced by others' emotions (Hatfield et al., 1993). An individual can transmit his or her nervousness (Valenzano et al., 2021), which would likely happen often with cohabitants, given their proximity. Worries about family getting infected also increased the risk of PD in our sample (Fu et al., 2020). The severity and infectivity of the virus, the prospect of being quarantined alone, the many unknowns around how to manage and treat the disease, as well as the strict pandemic control measures were all factors that likely contribute to stress, and therefore, PD.

4.2. The effects of coping style and emotion regulation on PD

We found that a negative coping style was the most important factor to predict PD in our sample, and that a positive coping style was associated with significantly lower risk of PD. In previous research, the population with negative coping styles showed higher levels of PD than people who use positive coping mechanisms (Wright et al., 2010). Negative coping styles usually make people doubt and deny themselves, which leads to increased anxiety and stress. Conversely, people who use positive coping styles prefer to believe that the problem will be solved in the end, which allows them to focus on finding the best method (Du et al., 2018). In other words, having a positive coping style improves one's probability of success (Wang et al., 2007). Students with positive coping styles find it easier to develop an appreciation of life, likely because that positivity stimulates self-growth (Guo et al., 2017). Further, those who have a positive coping style may depend more on themselves and depend less on their relationships with others, while a negative coping style promotes the opposite (Wang et al., 2013).

As for emotion regulation, cognitive reappraisal was inversely correlated with PD, and expressive suppression was positively correlated with PD in our sample. Previous research indicated that more frequent cognitive reappraisal is significantly associated with higher levels of life satisfaction, self-esteem, optimism, and environmental mastery, while expressive suppression has long-term negative effects on life satisfaction, self-esteem, and well-being (Brewer et al., 2016; Haga et al., 2009). Peers of individuals who perform cognitive reappraisal more frequently report closer connection and greater self-liking (Gross and John, 2003). Conversely, individuals who use expressive suppression more frequently report receiving less social and emotional support from their peers, and their peers report feeling less close to them. In addition, individuals who perform cognitive reappraisal more frequently may feel more confident in their ability to regulate their emotions and, subsequently, more in control of their lives (Taylor and Heimberg, 2018). Expressive suppression, which heightens the felt intensity of negative emotion and dampens the experience of positive emotion, may negatively impact mental health in the long term (Hong et al., 2018). Thus, it is not

surprising that students who perform cognitive reappraisal more frequently are more likely to have a higher mental health status, and those who use expressive suppression are at increased risk of mental illness.

5. Limitations

Although the present study has introduced unique contributions to the field with regard to the relationships among coping style, emotion regulation, and PD in the university after the COVID-19 outbreak, some limitations should be noted. First, since this is the first time that relationships among coping style, emotion regulation, and PD have been assessed, replication will be necessary to confirm our findings. Second, only coping style and emotion regulation strategies were examined in the present study. Subsequent studies should involve more psychological measures, such as emotional intelligence, social support, and the Fear of COVID scale. Third, the study population was limited to Chinese university students at one school. Samples involving people of all occupational groups and nationalities should be recruited in further studies. Fourth, the study has interviewed young subjects in a small age range. In fact, the benefit of the severe countermeasures to COVID-19 seems minimal in this age range compared to the old subjects, so our opinion was influenced by this situation. Further researches focused on this bias among larger age ranges would be important. This was a cross-sectional study, so future work could also include longitudinal assessment of PD in a specific population throughout the COVID-19 pandemic.

6. Conclusion

In this study after the COVID-19 outbreak, we found that Chinese university students who were male, were left behind, or had a monthly household income lower than 5000 CNY or higher than 20,000 CNY had higher PD scores. We identified that expressing panic about COVID-19 on social media was the most important pandemic-related factor to predict PD in this population. Negative coping style and expressive suppression were two of the most important factors overall to predict PD. The results of this study could assist healthcare professionals in identifying university students at elevated risk of mental health problems so that they can be targeted for appropriate interventions. Specifically, universities should focus more attention on students who are left behind, worry about family members being infected by SARS-CoV-2, live with others who are often nervous about COVID-19, express panic about COVID-19 on social media, utilize negative coping strategies, frequently suppress their emotions, or do not reframe situations. Extra attention should also be given to students who are male, have a monthly household income lower than 5000 CNY or higher than 20,000 CNY, worry about becoming infected with SARS-CoV-2, or know someone infected with COVID-19. Some of these factors are more easily ascertained than others, and together they can help identify students more likely to be affected by PD since the COVID-19 outbreak. Long-term psychological services should be provided for all students, and special efforts should be made to reach out to these especially vulnerable populations.

Authorship and copyright

All authors confirm that the submitted manuscript is an original contribution not previously published, that it is not under consideration for publication elsewhere, and that, if accepted, it will not be published elsewhere in similar form, in any language, without the consent of Elsevier B.V. We also confirm that all authors contributed significantly to the study.

CRedit authorship contribution statement

Na Li: Conceptualization, Data curation, Writing – review & editing.

Lurong Fan: Conceptualization, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Yan Wang:** Formal analysis, Writing – review & editing. **Jing Wang:** Data curation, Writing – review & editing. **Yu Huang:** Data curation, Writing – review & editing.

Declaration of Competing Interest

The authors have no conflicts of interest to declare.

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