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Factors associated with psychological stress in nurses in COVID-19-designated hospitals in the post-epidemic period in China: a cross-sectional study

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Abstract

Objective: The early days of the COVID-19 pandemic placed enormous pressure and subsequent stress on nurses, but at this stage of the year-long COVID-19 outbreak, the level of stress that nurses experience is unclear. Our study attempted to assess the factors influencing psychological stress in nurses during the post-epidemic period of COVID-19.

Design: Cross-sectional study.

Setting: COVID-19 designated hospitals.

Participants: 1,284 Chinese nurses.

Main outcome measures: Electronic questionnaires, including the Chinese version of the Perceived Stress Scale (CPSS) and Symptom Checklist-90 (SCL-90), were distributed for self-evaluation. Regression analysis was used to analyze the determinants of psychological stress among variables such as age, years of nursing experience, weekly working hours, anxiety symptoms, somatization symptoms, and compulsive symptoms.

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Results: A total of 1,284 respondents from COVID-19-designated hospitals in Guangdong Province were studied. The average CPSS score for all respondents was 22.91±7.12. A total of 38.5% of respondents scored ≥26 on the CPSS, indicating a significant degree of psychological stress. Nurses with high psychological stress had higher levels of anxiety symptoms (41.7% vs. 8.0%) , somatization symptoms (31.4% vs. 7.7%), and compulsion symptoms (62.3% vs. 27.0%) than nurses with low psychological stress. Stepwise multiple linear regression revealed that weekly working hours, years of nursing experience, anxiety symptoms, somatization symptoms, and compulsion symptoms had a linear relationship with the participants' psychological stress scores.

Conclusion: Nurses experienced significant physical and psychological risk while working in the post epidemic period. Our findings suggest that nurses still need support to protect their physical and mental health.

Keywords: COVID-19; pss14; scl-90; mental health; nurses

Strengths and limitations of this study

- One of the largest samples of nurses conducted so far in China in COVID-19-designated hospitals in the post-epidemic period
- The following tools used were used alongside the collection of demographic information: The Chinese version of Perceived Stress Scale (CPSS) and Symptom Checklist -90 (SCL-90).
- Convenience sample that may have missed participants not using social media.
- The study used self-reported questionnaires; therefore, data obtained were participants' subjective perceptions.
- It is not clear whether the observed mental health outcomes have irreversible adverse physical and mental effects on nurses.

INTRODUCTION

COVID-19 was first identified by Chinese scientists in December 2019[1]. In 2020, the World Health Organization (WHO) declared COVID-19 a pandemic[2]. As of February 1, 2021, 101,039 confirmed cases, 93,726 discharged patients, and 4,826 deaths have been reported in China (including Hong Kong, Macao, and Taiwan). There was one suspected case. A total of 967,415 close contacts were tracked, and 37,319 close contacts were still in medical observation[3]. According to the WHO, by February 28, 2020, more than 100 million people had been infected, and more than 2 million had died[4]. Due to the disease's highly contagious nature, the Chinese government set up designated hospitals to treat patients with symptoms of COVID-19 or those who had already been diagnosed. This situation may lead to great stress for nurses in designated hospitals. Because the virus is transmitted mainly through respiratory droplets or by contact[1], close environments, such as large gatherings and crowded places, can lead to clustered infections[5].

Previous studies have found that responding to the severe acute respiratory syndrome (SARS) pandemic took a heavy toll on health care workers and that nurses suffered much more than doctors. Depending on the nature of their work, nurses tend to work in close and long-term contact with patients[6]. Therefore, the psychological stress of nurses during the COVID-19 epidemic deserve more attention. In the early days of the COVID-19 outbreak, numerous reports described physical and psychological morbidity associated with COVID-19[7-10].

The experience of SARS and Middle East Respiratory Syndrome (MERS) suggests that many health care workers (HCWs) remain mentally ill long after an outbreak is over[11,12]. Therefore, we can expect considerable mass hysteria, such as stress, anxiety, and fear, over the duration of the COVID-19 pandemic. At present, although the COVID-19

epidemic has been well controlled in China, the virus has not been completely eliminated. New infections occur from time to time, which will inevitably impact nurses. It has been suggested that psychological fear is more dreadful than the disease itself[13]. However, nurses' mental health has been rarely documented over the course of the pandemic.

In the current pandemic, although the spread of COVID-19 has been effectively contained in China, nurses who worked in designated hospitals have been under high pressure to deliver care in highly stressful environments[14]. In addition, nurses working in COVID-19-designated hospitals (like many other health care workers) are vulnerable to the risk of infection and unknowingly putting family members and friends at higher risk. Fear of infection may result in reluctance to seek help from family members or friends and may reduce nurses' ability to show compassion in the workplace[15]. Therefore, the lack of long-term tracking of nurses' mental health status precludes the timely identification and treatment of mental health problems, which is not conducive to their career development. Our study examined nurses' mental health status and its influencing factors during a period of COVID-19 containment and normalization.

METHODS

Design and setting

In this study, we recruited nurses from designated hospitals in Guangdong Province. We conducted a cross-sectional study between January 23 and 31, 2021 using snowball sampling of nurses. This survey used the form of a questionnaire star, and QR scan codes to access the questionnaire were posted on WeChat to collect information from participants. At this questionnaire star link, nurses received guidance on how to complete and answer the questions. Participants accessed this survey using the questionnaire star link or QR scan code over a period of nine days. **Participants**

All nurses who were at least 18 years of age and worked in COVID-19-designated hospitals in Guangdong Province were eligible for participation and 1,345 nurses returned the questionnaire. IP addresses and other personal information were protected for privacy reasons. Respondents who failed to provide informed consent or took more

than 60 minutes to complete the questionnaire were excluded from further consideration, resulting in a total of 1,284 valid responses.

Instrumentation

Demographic characteristics such as sex, gender, marital status, years of nursing experience, technical title, weekly working hours, and COVID-19 vaccination status were included. The two instruments used in this study were the Chinese version of the Perceived Stress Scale (CPSS) and the Symptom Checklist 90 (SCL-90). The Perceived Stress Scale (PSS) , also known as the Cohen PSS, is the most widely used psychological instrument for measuring the perception of stress[16]. In 2003, Yang et al.[17] translated the PSS into Chinese, and the Cronbach's alpha coefficient was 0.78 after adjustment. Referring to Hewitt[18] (1992), we divided the Chinese version of the PSS into two dimensions of "perceived distress" and "perceived coping ability" and conducted reliability and validity tests on nurses. The Cronbach's alpha coefficients of the total scale and the two dimensions were 0.837, 0.816, and 0.901, respectively. Scores on the CPSS range from 0 to 56, with scores greater than 26 indicating high psychological stress.

The SCL-90 is a psychosomatic screening scale proposed by Derogatis[19], and is widely used in China and elsewhere. In 1986, Chinese scholars applied the SCL-90 to the adult population and obtained the norm of each factor of the SCL-90. In 2017, a meta-analysis obtained the norm of the nurse population[20]. The SCL-90 is composed of 90 questions, and each item has five answer choices using five levels (between 1-5, none = 1, too much = 5). The symptom of interest was considered when the factor score was $\geqslant$2. In this survey, we chose the anxiety, somatization, and compulsion subscale scores for analysis. The Cronbach's alpha coefficients of the anxiety, somatization, and compulsion subscales were 0.921, 0.908, and 0.908, respectively.

Ethical issues

Ethical approval was obtained from the Ethics Committee of the Guangdong Provincial People's Hospital, Guangdong Academy of Medical Sciences (approval number: KY-Q-2021-023-01).

Statistical analysis

Data were entered into EXCEL and SPSS Statistics for Windows, Version 23.0 was used for statistical analysis. The counting data were described by frequency and composition ratios, and the measurement data were expressed as X±s. We divided anxiety, somatization, and compulsion factor scores that were ⩾2 into one group and <2 into the other group. PSS scores ⩾26 and <26 were divided into two groups, and the Chi-square X^2 was used for univariate analysis. Stepwise multiple linear regression analysis was used to evaluate the factors associated with psychological stress. The standard of significance was $P < 0.05$.

Patient and public involvement

No patient involved.

RESULTS

There were a total of 1,345 respondents from COVID-19-designated hospitals in Guangdong Province. We excluded respondents who disagreed with the survey (n = 22) and took too long to complete the questionnaire (n = 39), resulting in a final analytic sample of 1,284 respondents. The questionnaire completion time was 476.03±322.93 seconds. Respondents were primarily female (95.7%), over the age of 30 (56.95), married (70.2%), and had more than 10 years of work experience as a nurse (48%). Table 1 lists the mean scores on the CPSS by demographic characteristics.

The mean psychological stress measured by the CPSS was 22.91±7.12. In our study, 38.5% of respondents reported high psychological stress (n = 494), and 61.5% of respondents reported low psychological stress (n = 790). Table 2 list the scoring of psychological stress.

We divided the respondents into two groups: 1) one group of those who had a psychological stress score ≥26 and 2) another group of those who had a psychological stress score <26. We then conducted univariate analysis. The results showed that there was no significant difference in psychological stress by gender or COVID-19 vaccination status ($P > 0.05$). The results revealed a significant difference in age (x^2 = 14.912, p = 0.170), marital status (x^2 = 7.648, p = 0.022), years of work experience as a nurse (x^2 = 18.360, p = 0.001), technical title (x^2 = 15.659, p = 0.001), weekly working

hours (x^2 = 16.675, p < 0.001), anxiety symptoms (x^2 = 208.748, p < 0.001), somatization symptoms (x^2=121.546, p<0.001), and compulsion symptoms (x^2 = 157.842, p < 0.001). In addition, people who worked more than 40 hours a week reported higher levels of psychological stress than those who worked 35-40 hours a week (p < 0.001). Table 3 summarizes the results.

We defined psychological level as the dependent variable, and the significant variables from the univariate analysis in Table 3 as the independent variables. Our analysis showed that having less than 15 years of nursing service (β = -0.100, p < 0.001), working more than 40 hours a week (β = 0.087, p < 0.001), anxiety symptoms (β = 0.235, p < 0.001), somatization symptoms (β = 0.095, p = 0.002) and compulsion symptoms (β = 0.266, p < 0.001) were identified as risk factors for psychological stress (Table 4).

Table 1 Mean scores on the CPSS by demographic characteristics(N=1284).

Variables		N (%)	mean CPSS scores x ± s	95% *CI*	
				Lower Bound	Upper Bound
Gender	male	55(4.3%)	23.25±6.66	21.45	25.06
	female	1229(95.7%)	22.89±7.14	22.49	23.29
Age (year)	≤25	193(15.0%)	23.87±6.75	22.91	24.83
	26-30	359(28.0%)	23.47±7.21	22.72	24.22
	31-35	315(24.5%)	22.82±6.87	22.06	23.58
	36-40	188(14.6%)	22.53±7.13	21.50	23.55
	≥41	229(17.8%)	21.66±7.45	20.69	22.63
Marital status	Married	902(70.2%)	22.51±7.24	22.04	22.99
	Unmarried	371(28.9%)	23.86±6.68	23.18	24.55
	Others	11(0.9%)	23.36±8.32	17.77	28.95
Years of nursing experience (year)	≤5	344(26.8%)	23.49±6.72	22.77	24.20
	6-10	324(25.2%)	23.58±7.27	22.79	24.38
	11-15	258(20.1%)	22.17±7.28	22.17	23.95
	16-20	153(11.9%)	21.64±6.64	20.58	22.70
	≥21	205(16.0%)	21.64±7.42	20.62	22.67
Technical Title	Nurses	348(27.1%)	23.72±6.68	23.01	24.41
	Nurse Practitioners	570(44.4%)	22.97±7.34	22.37	23.58
	Nurse Supervisor	312(24.3%)	22.33±7.18	21.53	23.13

	Associate Senior and above	54(4.2%)	20.41±6.38	18.67	22.15
Weekly working hours	<35	51(4.0%)	22.65±8.27	20.32	24.97
	35-40	549(42.8%)	22.02±6.78	21.45	22.59
	>40	684(53.3%)	23.64±7.21	23.10	24.19
Vaccination with COVID-19	Yes	317(24.7%)	22.88±6.72	22.14	23.63
	No	967(75.3%)	22.92±7.25	22.46	23.38
Anxiety symptoms	Yes (≥2)	269(21.0%)	29.06±5.73	28.37	29.75
	No (<2)	1015(79.0%)	21.28±6.53	20.88	21.68
somatization symptoms	Yes (≥2)	216(16.8%)	28.69±6.30	27.84	29.54
	No (<2)	1068(83.2%)	21.74±6.69	21.34	22.14
compulsion symptoms	Yes (≥2)	521(40.6%)	26.79±6.05	26.27	27.31
	No (<2)	763(59.4%)	20.26±6.56	19.80	20.73

Table 2 Scoring of psychological stress.

Variables	N (%)	X ± s	95% *CI*	
			Lower Bound	Upper Bound
Psychological stress	1284(100%)	22.91±7.12	22.52	23.30
High (≥26)	494(38.5%)	29.76±3.84	29.42	30.10
Low (<26)	790(61.5%)	18.63±5.04	18.28	18.98
Perceived Distress	1284(100%)	11.60±4.32	11.36	11.83
Perceived coping	1284(100%)	11.31±4.98	11.04	11.59

Table 3 Univariate analyses of the factors associated with psychological stress(N=1284).

Variables		PSS score≥26 (n=494)	PSS score<26 (n=790)	x^2	*p*
Gender	male	26(5.3%)	29(3.7%)	1.879	.170
	female	468(94.7%)	761(96.3%)		
Age (year)	≤25	90(18.2%)	103(13.0%)	14.912	.005*
	26-30	148(30.0%)	211(26.7%)		
	31-35	123(24.9%)	192(24.3%)		
	36-40	64(13.0%)	124(15.7%)		
	≥41	69(14.0%)	160(20.3%)		
Marital status	Married	325(65.8%)	577(73.0%)	7.648	.022*
	Single	164(33.2%)	207(26.2%)		
	Others	5(1.0%)	6(.8%)		
Years of nursing	≤5	145(29.4%)	199(25.2%)	18.360	.001*

experience(year)	6-10	141(28.5%)	183(23.2%)		
	11-15	103(20.9%)	155(19.6%)		
	16-20	44(8.9%)	109(13.8%)		
	≥21	61(12.3%)	144(18.2%)		
Technical Title	Nurses	151(30.6%)	197(24.9%)		
	Nurse Practitioners	229(46.4%)	341(43.2%)		
	Nurse Supervisor	103(20.9%)	209(26.5%)	15.659	.001*
	Associate Senior and above	11(2.2%)	43(5.4%)		
Weekly working hours	<35	22(4.5%)	29(3.7%)		
	35-40	176(35.6%)	373(47.2%)	16.675	.000*
	>40	296(59.9%)	388(49.1%)		
Vaccination with COVID-19	Yes	121(24.5%)	196(24.8%)	0.016	.898
	No	373(75.5%)	594(75.2%)		
Anxiety symptoms	Yes (≥2)	206(41.7%)	63(8.0%)	208.748	.000*
	No (<2)	288(58.3%)	727(92.0%)		
somatization symptoms	Yes (≥2)	155(31.4%)	61(7.7%)	121.546	.000*
	No (<2)	339(68.6%)	729(92.3%)		
compulsion symptoms	Yes (≥2)	308(62.3%)	213(27.0%)	157.842	.000*
	No (<2)	186(27.7%)	577(73%)		

*P<0.05. PSS, perceived stress scale.

Table 4 Multivariate liner regression analysis of psychological stress.

Variables	*B*	*SE*	*β*	*p*	95% *CI*	
					Lower Bound	Upper Bound
compulsion symptoms	3.859	0.428	0.266	0.000	3.019	4.699
Anxiety symptoms	4.102	0.574	0.235	0.000	2.975	5.229
Years of nursing experience	-0.509	0.122	-0.100	0.000	-0.748	-0.270
Weekly working hours	1.075	0.295	0.087	0.000	0.496	1.653
somatization symptoms	1.812	0.597	0.095	0.002	0.640	2.983

R^2 = 0.278, adjust R^2 = 0.275, F = 98.510, p < 0.001.

DISCUSSION

In the study, we found some mental health problems among nurses during the normalization of COVID-19 prevention and control. First, although the whole sample showed that nurses were experiencing relatively normal levels of psychological stress, 38.5% of nurses had a high level of stress, which is a significant portion that cannot be

ignored. Second, the ability to perceive stress in the high psychological stress group was higher than that in the low psychological stress group, and this difference was statistically significant. Finally, the results of this study also indicate that anxiety, somatization, and obsessive-compulsive symptoms can aggravate nurses' psychological stress.

Our study revealed that the median level of psychological stress among nurses was 23. Other studies found higher levels of psychological stress among students and other health workers in the early stages of the COVID-19 outbreak[21 22]. We found that 98.5% of nurses were taught about infectious diseases. Psychological effects of COVID-19 were more common among health care workers without medical training than among those with medical training[23]. Over time, adaptive responses to stress and the positive effects of infection control training may be protective[24]. Scholars investigated the psychological status of HCWs during SARS and found that 39.3% of the general population had elevated psychological stress levels[25], while approximately 38.5% of the nurses in our study showed high psychological stress. This reduction may be related to experience in the fight against COVID-19 today and the timely and effective response to the epidemic, and its prevention and control in Guangdong[26].

Our study identified weekly working hours, and symptoms of anxiety, somatization, and compulsiveness as potential risk factors for psychological stress in nurses, whereas years of nursing experience was protective against the development of psychological stress. Nurses who worked more than 40 hours a week reported significantly higher levels of psychological stress than those who worked less than 40 hours a week. This result may be related to extended work hours leading to nursing errors, such as patient identification errors, communication errors, and patient complaints[27]. At the same time, longer work hours may result in more severe conflicts between work-life balance for female workers[28]. Years of nursing experience being a protective factor may be attributed to greater capabilities to cope with emergencies and improved psychological quality.

A certain level of psychological stress can lead to psychological disorders, such as anxiety and somatization symptoms. Conversely, anxiety and somatization symptoms

can also cause psychological stress to rise[29]. In the high psychological stress group, we found that 41.7% and 31.4% of nurses suffered from anxiety and somatization, respectively. Huang et al. reported that the percentages of anxiety and somatization were 33.02% and 7.59%, respectively, in the Chinese population[30], which are lower than that of the nurses in our study. This result may be attributed to the fact that nurses are more likely to be exposed to COVID-19 than those in the general population. However, Li et al. reported that the frequencies of symptoms of anxiety and somatization symptoms were 45.4% and 12.0%, respectively[31]. In our survey, 26.1% of nurses received psychological counseling, which may have led to a slight decrease in anxiety symptoms. However, spending increasingly more time working in high-pressure environment may cause nurses to develop headaches and other somatic symptoms. Compulsive symptoms were reported in 62.3% of nurses, which contrasts with an online survey of 927 Chinese medical workers conducated between February 19 and March 6, 2020 which showed a prevalence of compulsive symptoms of only 5.3%[10]. The reason for this large discrepancy may be that 85.1% of the latter medical staff were not at risk of exposure to COVID-19 patients in the hospital.

Our findings have important clinical implications for alleviating high levels of psychological stress in nurses. Reasonable work schedules and proper education on infection control can relieve nurses experiencing high psychological stress.

Limitations

We acknowledge that our study has some limitations. First, although we had a large sample size and attempted to capture all nurses working at designated hospitals, male nurses population in designated hospitals in Guangdong Province were underrepresented. Second, self-report questionnaires were used in this study, and the data obtained were participants' perceptions, which are highly subjective. Third, this study can only highlight the status quo of psychological stress, anxiety, compulsion, and somatization of nurses during the investigation period and cannot determine whether there are irreversible adverse physical and mental effects on nurses. Finally, the study was conducted online using convenience sampling, which may have missed some participants.

Despite the above limitations, our study provided valuable information on the psychological impact of the COVID-19 pandemic on nurses in China. People's mental conditions will change with time and the environment, as will their psychological stress. Therefore, coping strategies across periods may differ, and the effectiveness of these strategies needs further study. Further research will need to expand our findings with additional surveys in other provinces in China.

CONCLUSION

This survey found that 38.5% of nurses still suffered high psychological stress, and there was a significant association between anxiety symptoms, somatization symptoms, compulsion symptoms, with psychological stress. Considering the current situation, we suggest using an online platform to provide psychological support for nurses. For nurses with severe psychiatric symptoms or even somatic symptoms, we recommend individualized psychological support and interventions after ruling out infection. The COVID-19 pandemic is a public health challenge that puts health systems in a highly vulnerable position[21]. Nurses are an important part of the health care system. Therefore, we must ensure the physical and mental health of nurses to help them meet the future challenges in their future careers.

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Contributor Minrou, Zhang was involved in the conception of the study, data collection, analysis, and writing of the main manuscript. Huigen, Huang, the corresponding author, was involved in conception, data collection, analysis, and critical revision of the manuscript. Hanxi, Chen was involved in conception. Yafang, Deng was involved in the data analysis. All authors approved the final manuscript.

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STROBE Statement—Checklist of items that should be included in reports of cross-sectional studies

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Factors associated with poor mental health outcomes in nurses in COVID-19-designated hospitals in the post-epidemic period in Guangdong Province: a cross-sectional study

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Factors associated with poor mental health outcomes in nurses in COVID-19-designated hospitals in the post-epidemic period in Guangdong Province: a cross-sectional study

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Abstract

Objective: The early days of the COVID-19 pandemic placed enormous pressure and subsequent negative psychological problems on nurses, but at this stage of the year-long COVID-19 outbreak, the level of stress and negative emotions that nurses experience is unclear. Our study attempted to assess the factors influencing mental health status in nurses during the post-epidemic period of COVID-19.

Design: Cross-sectional study.

Setting: COVID-19 designated hospitals.

Participants: 1,284 Chinese nurses.

Main outcome measures: Electronic questionnaires, including the Chinese version of the Perceived Stress Scale (CPSS) and Symptom Checklist-90 (SCL-90), were distributed for self-evaluation. Regression analysis was used to analyze the associated factors of psychological stress among variables such as age, years of nursing experience, weekly working hours, anxiety symptoms, somatization symptoms, and compulsive symptoms.

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Results: A total of 1,284 respondents from COVID-19-designated hospitals in Guangdong Province were studied. The average CPSS score for all respondents was 22.91±7.12. A total of 38.5% of respondents scored ≥26 on the CPSS, indicating a significant degree of psychological stress. Nurses with high psychological stress had higher levels of anxiety symptoms (41.7% vs. 8.0%), somatization symptoms (31.4% vs. 7.7%), and compulsion symptoms (62.3% vs. 27.0%) than nurses with low psychological stress. Stepwise multiple linear regression revealed that weekly working hours, years of nursing experience, anxiety symptoms, somatization symptoms, and compulsion symptoms had a linear relationship with the participants' psychological stress scores.

Conclusion: Nurses experienced significant physical and psychological risk while working in the post epidemic period. Our findings suggest that nurses still need support to protect their physical and mental health.

Keywords: COVID-19; pss14; scl-90; mental health; nurses

Strengths and limitations of this study

- One of the largest samples of nurses conducted so far in China in COVID-19-designated hospitals in the post-epidemic period
- The following tools used were used alongside the collection of demographic information: The Chinese version of Perceived Stress Scale (CPSS) and Symptom Checklist -90 (SCL-90).
- Convenience sample that may have missed participants not using social media.
- The study used self-reported questionnaires; therefore, data obtained were participants' subjective perceptions.
- It is not clear whether the observed mental health outcomes have irreversible adverse physical and mental effects on nurses.

INTRODUCTION

The COVID-19 epidemic has not only caused a big impact on economic and social development, but also brought great trauma to the whole society's mentality. After strenuous efforts, China's epidemic prevention and control situation is now developing positively, and has entered a "post-epidemic period" that integrates epidemic prevention and control with socio-economic development[1 2]. The post-epidemic period refers to the stage when the COVID-19 epidemic is effectively controlled, the epidemic prevention and control has changed from a surprise to a normal one, and the economic development of the entire society and people's daily life are gradually returning to a normal state[3].

As of February 1, 2021, 101,039 confirmed cases, 93,726 discharged patients, and 4,826 deaths have been reported in China. There was one suspected case. A total of 967,415 close contacts were tracked, and 37,319 close contacts were still in medical observation[4]. According to the WHO, by February 28, 2020, more than 100 million people had been infected, and more than 2 million had died[5]. Due to the disease's highly contagious nature, the Chinese government set up designated hospitals to treat patients with symptoms of COVID-19 or those who had already been diagnosed, among which 30 hospitals in Guangdong Province have been designated as designated hospitals for COVID-19 treatment[6]. Depending on the nature of their work, nurses tend to work in close and long-term contact with patients[7]. This situation may lead to psychological problems for nurses in designated hospitals. Because the virus is transmitted mainly through respiratory droplets or by contact[8], close environments, such as large gatherings and crowded places, can lead to clustered infections[9].

In the early days of the COVID-19 outbreak, nurses risked their lives to contact patients every day. They were at high risk of infection, had a heavy workload, and suffer from

psychological stress, anxiety and other negative psychological distress[10 11], the mental health of nurses during the COVID-19 epidemic deserve more attention. As a result, during this period, numerous reports described physical and psychological morbidity associated with COVID-19[12-15].

The experience of severe acute respiratory syndrome (SARS) and Middle East Respiratory Syndrome (MERS) suggests that many health care workers (HCWs) remain mentally ill long after an outbreak is over, and that nurses suffer more than doctors[16 17]. Therefore, we can expect considerable collective mental health issues, such as stress, anxiety, and fear, over the duration of the COVID-19 pandemic. At present, although the COVID-19 epidemic has been well controlled in China, the virus has not been completely eliminated. New infections occur from time to time, which will inevitably impact nurses. It has been suggested that psychological fear is more dreadful than the disease itself[18]. However, nurses' mental health has been rarely documented over the course of the pandemic with a few exceptions.

In the current pandemic, although the spread of COVID-19 has been effectively contained in China, nurses who worked in designated hospitals have been under high pressure to deliver care in highly stressful environments[19]. For example, hospital administrators may restrict the movement of nurses once a COVID-19 patient is found in one place, and nurses often need to travel to different areas to support nucleic acid collection. In addition, nurses working in COVID-19-designated hospitals (like many other health care workers) are vulnerable to the risk of infection and unknowingly putting family members and friends at higher risk. Fear of infection may result in reluctance to seek help from family members or friends and may reduce nurses' ability to show compassion in the workplace[20], to the detriment of the nursing profession in the long term.

Thus, our study examined nurses' mental health status and its influencing factors during a period of COVID-19 containment and normalization.

METHODS

Design and setting

In this study, we recruited nurses from designated hospitals in Guangdong Province through the nursing branch of Guangdong Health Economics Association. We conducted a cross-sectional study between January 23 and 31, 2021 using snowball and convenience sampling of nurses. This survey used Ranxing Technology "SurveyStar" (www.wjx.cn), and QR scan codes to access the questionnaire were posted on WeChat to collect information from participants. At this questionnaire star link, nurses received guidance on how to complete and answer the questions. Before entering the questionnaire, there is an informed consent form to be filled in. Choose "yes", continue to complete the questionnaire. Choose "No", then you will not enter the filling in the questionnaire. Participants accessed this survey using the questionnaire star link or QR scan code over a period of nine days.

Participants

The sample size was estimated based on WHO recommendations on the minimum sample size required for epidemiological studies[21 22]. The confidence interval was 95%, the standard deviation was 0.5, the margin of error was 0.5. Finally, with addition of a 10% contingency for non-response, the minimum sample size was 423. Guangdong Province has 30 provincial-level designated hospitals[6]. All nurses who were at least 18 years of age and worked in COVID-19-designated hospitals in Guangdong Province were eligible for participation and 1,345 nurses returned the questionnaire. IP addresses and other personal information were protected for privacy reasons. Respondents who failed to provide informed consent or took more than 60 minutes to complete the questionnaire were excluded from further consideration, resulting in a total of 1,284 valid responses.

Instrumentation

After literature research and discussion by the research team, we believe that gender, age, marital status, years of nursing experience, technical title, weekly working hours, andCOVID-19 vaccination status may have an impact on the psychological status of nurses in the post-epidemic period. Therefore, we selected these contents as the social demographic data of nurses. The two instruments used in this study were the Chinese

version of the Perceived Stress Scale (CPSS) and the Symptom Checklist 90 (SCL-90). The Perceived Stress Scale (PSS), also known as the Cohen PSS, is the most widely used psychological instrument for measuring the perception of stress[23]. In 2003, Yang et al.[24] translated the PSS into Chinese, and the Cronbach's alpha coefficient was 0.78 after adjustment. Referring to Hewitt[25] (1992), we divided the Chinese version of the PSS into two dimensions of "perceived distress" and "perceived coping ability" and conducted reliability and validity tests on nurses. The Cronbach's alpha coefficients of the total scale and the two dimensions were 0.837, 0.816, and 0.901, respectively. Scores on the CPSS range from 0 to 56, and the higher the score, the greater the psychological stress. The health risk stress standard for Chinese was 26[24]. Therefore, we defined a CPSS score higher than 26 as high psychological stress.

The SCL-90 is a psychosomatic screening scale proposed by Derogatis[26], and is widely used in China and elsewhere. In 1986, Chinese scholars applied the SCL-90 to the adult population and obtained the norm of each factor of the SCL-90. In 2017, a meta-analysis obtained the norm of the nurse population[27]. The SCL-90 is composed of 90 questions, and each item has five answer choices using five levels (between 1-5, none = 1, too much = 5). The symptom of interest was considered when the factor score was ⩾2. In this survey, we chose the anxiety, somatization, and compulsion subscale scores for analysis. The Cronbach's alpha coefficients of the anxiety, somatization, and compulsion subscales were 0.921, 0.908, and 0.908, respectively.

Ethical issues

Ethical approval was obtained from the Ethics Committee of the Guangdong Provincial People's Hospital, Guangdong Academy of Medical Sciences (approval number: KY-Q-2021-023-01).

Statistical analysis

Data were entered into EXCEL and SPSS Statistics for Window, Version 23.0 was used for statistical analysis. The counting data were described by frequency and composition ratios, and the measurement data were expressed as X±s. We divided anxiety, somatization, and compulsion factor scores that were ⩾2 into one group and <2 into the other group. Psychological stress score ⩾26 and <26 were divided into two groups. Independent sample T

test was used to compare the two groups and the Chi-square X^2 was used for univariate analysis. Stepwise multiple linear regression analysis was used to evaluate the factors associated with psychological stress. The standard of significance was $P < 0.05$.

Patient and public involvement

No patient involved.

RESULTS

There was a total of 1,345 respondents from COVID-19-designated hospitals in Guangdong Province. We excluded respondents who disagreed with the survey (n = 22) and took too long to complete the questionnaire (n = 39), resulting in a final analytic sample of 1,284 respondents, yielding a 95.5% response rate. The questionnaire completion time was 476.03±322.93 seconds. Respondents were primarily female (95.7%), over the age of 30 (56.9%), married (70.2%), and had more than 10 years of work experience as a nurse (48%). Table 1 list the psychological stress scores of nurses in COVID-19 desginated hospitals with different demographic characterstics.

The mean score of psychological stress measured by the CPSS was 22.91±7.12. In our study, 38.5% of respondents reported high psychological stress (n = 494), and 61.5% of respondents reported low psychological stress (n = 790). Table 2 list the scoring of the psychological stress.

We divided the respondents into two groups: 1) one group is those with psychological stress scores ⩾26 and 2) another group is those with psychological stress scores score <26. First, we compared the scores of each dimension between the two groups, as shown in Table 3. We then conducted univariate analysis. The results showed that there was no significant difference in psychological stress by gender or COVID-19 vaccination status ($P > 0.05$). The results revealed a significant difference in age (x^2 = 14.912, p = 0.170), marital status (x^2 = 7.648, p = 0.022), years of work experience as a nurse (x^2 = 18.360, p = 0.001), technical title (x^2 = 15.659, p = 0.001), weekly working hours (x^2 = 16.675, p < 0.001), anxiety symptoms (x^2 = 208.748, p < 0.001), somatization symptoms (x^2=121.546, p<0.001), and compulsion symptoms (x^2 = 157.842, p < 0.001). In addition, people who worked more than 40 hours a week

reported higher levels of psychological stress than those who worked 35-40 hours a week ($p < 0.001$). Table 4 summarizes the results.

We defined the total psychological stress scores as the dependent variable, and the significant variables from the univariate analysis in Table 4 as the independent variables. Our analysis showed that having less than 15 years of nursing service (β = -0.100, $p < 0.001$), working more than 40 hours a week (β = 0.087, $p < 0.001$), anxiety symptoms (β = 0.235, $p < 0.001$), somatization symptoms (β = 0.095, p = 0.002) and compulsion symptoms (β = 0.266, $p < 0.001$) were identified as risk factors for psychological stress (Table 5).

Table 1 Psychological stress scores of nurses in COVID-19 desginated hospitals with different demographic characterstics(N=1284).

Variables		N (%)	Psychological stress scores $\bar{x} \pm s$	95% *CI*	
				Lower Bound	Upper Bound
Gender	male	55(4.3%)	23.25±6.66	21.45	25.06
	female	1229(95.7%)	22.89±7.14	22.49	23.29
Age (year)	≤25	193(15.0%)	23.87±6.75	22.91	24.83
	26-30	359(28.0%)	23.47±7.21	22.72	24.22
	31-35	315(24.5%)	22.82±6.87	22.06	23.58
	36-40	188(14.6%)	22.53±7.13	21.50	23.55
	≥41	229(17.8%)	21.66±7.45	20.69	22.63
Marital status	Married	902(70.2%)	22.51±7.24	22.04	22.99
	Unmarried	371(28.9%)	23.86±6.68	23.18	24.55
	Others	11(0.9%)	23.36±8.32	17.77	28.95
Years of nursing experience (year)	≤5	344(26.8%)	23.49±6.72	22.77	24.20
	6-10	324(25.2%)	23.58±7.27	22.79	24.38
	11-15	258(20.1%)	22.17±7.28	22.17	23.95
	16-20	153(11.9%)	21.64±6.64	20.58	22.70
	≥21	205(16.0%)	21.64±7.42	20.62	22.67
Technical Title	Nurses	348(27.1%)	23.72±6.68	23.01	24.41
	Nurse Practitioners	570(44.4%)	22.97±7.34	22.37	23.58
	Nurse Supervisor	312(24.3%)	22.33±7.18	21.53	23.13
	Associate Senior and above	54(4.2%)	20.41±6.38	18.67	22.15
Weekly working	<35	51(4.0%)	22.65±8.27	20.32	24.97
	35-40	549(42.8%)	22.02±6.78	21.45	22.59

hours	>40	684(53.3%)	23.64±7.21	23.10	24.19
Vaccination with COVID-19	Yes	317(24.7%)	22.88±6.72	22.14	23.63
	No	967(75.3%)	22.92±7.25	22.46	23.38
Anxiety symptoms	Yes (≥2)	269(21.0%)	29.06±5.73	28.37	29.75
	No (<2)	1015(79.0%)	21.28±6.53	20.88	21.68
somatization symptoms	Yes (≥2)	216(16.8%)	28.69±6.30	27.84	29.54
	No (<2)	1068(83.2%)	21.74±6.69	21.34	22.14
compulsion symptoms	Yes (≥2)	521(40.6%)	26.79±6.05	26.27	27.31
	No (<2)	763(59.4%)	20.26±6.56	19.80	20.73

Table 2 Scoring of the psychological stress(N=1284).

Variables	N (%)	$\bar{x} \pm s$	95% *CI*	
			Lower Bound	Upper Bound
Psychological stress	1284(100%)	22.91±7.12	22.52	23.30
High (≥26)	494(38.5%)	29.76±3.84	29.42	30.10
Low (<26)	790(61.5%)	18.63±5.04	18.28	18.98
Perceived Distress	1284(100%)	11.60±4.32	11.36	11.83
Perceived coping	1284(100%)	11.31±4.98	11.04	11.59

Table 3 A comparison of scores across different dimensions between the two groups(N=1284).

Variables	psychological stress scores ≥26 $\bar{x} \pm s$	psychological stress scores <26 $\bar{x} \pm s$	*t*	*p*	*95%CI*	
					Lower bound	Upper bound
psychological stress	29.76±3.84	18.63±5.04	42.019	..000*	10.610	11649
perceived distress	14.29±4.41	9.91±3.28	19.017	..000*	3.929	4.833
perceived coping	15.47±3.89	8.72±3.65	31.440	..000*	6.327	7.169

*$P<0.05$.

Table 4 Univariate analyses of the factors associated with psychological stress(N=1284).

Variables		Psychological stress scores≥26 (n=494)	Psychological stress scores<26 (n=790)	x^2	*p*
Gender	male	26(5.3%)	29(3.7%)	1.879	.170
	female	468(94.7%)	761(96.3%)		

Age (year)	≤25	90(18.2%)	103(13.0%)	14.912	.005*
	26-30	148(30.0%)	211(26.7%)		
	31-35	123(24.9%)	192(24.3%)		
	36-40	64(13.0%)	124(15.7%)		
	≥41	69(14.0%)	160(20.3%)		
Marital status	Married	325(65.8%)	577(73.0%)	7.648	.022*
	Single	164(33.2%)	207(26.2%)		
	Others	5(1.0%)	6(.8%)		
Years of nursing experience(year)	≤5	145(29.4%)	199(25.2%)	18.360	.001*
	6-10	141(28.5%)	183(23.2%)		
	11-15	103(20.9%)	155(19.6%)		
	16-20	44(8.9%)	109(13.8%)		
	≥21	61(12.3%)	144(18.2%)		
Technical Title	Nurses	151(30.6%)	197(24.9%)	15.659	.001*
	Nurse Practitioners	229(46.4%)	341(43.2%)		
	Nurse Supervisor	103(20.9%)	209(26.5%)		
	Associate Senior and above	11(2.2%)	43(5.4%)		
Weekly working hours	<35	22(4.5%)	29(3.7%)	16.675	.000*
	35-40	176(35.6%)	373(47.2%)		
	>40	296(59.9%)	388(49.1%)		
Vaccination with COVID-19	Yes	121(24.5%)	196(24.8%)	0.016	.898
	No	373(75.5%)	594(75.2%)		
Anxiety symptoms	Yes (≥2)	206(41.7%)	63(8.0%)	208.748	.000*
	No (<2)	288(58.3%)	727(92.0%)		
somatization symptoms	Yes (≥2)	155(31.4%)	61(7.7%)	121.546	.000*
	No (<2)	339(68.6%)	729(92.3%)		
compulsion symptoms	Yes (≥2)	308(62.3%)	213(27.0%)	157.842	.000*
	No (<2)	186(27.7%)	577(73%)		

*P<0.05.

Table 5 Multivariate liner regression analysis of psychological stress(N=1284).

Variables	*B*	*SE*	*β*	*p*	95% *CI*	
					Lower Bound	Upper Bound
compulsion symptoms	3.859	0.428	0.266	0.000	3.019	4.699
Anxiety symptoms	4.102	0.574	0.235	0.000	2.975	5.229
Years of nursing experience	-0.509	0.122	-0.100	0.000	-0.748	-0.270
Weekly working hours	1.075	0.295	0.087	0.000	0.496	1.653
somatization symptoms	1.812	0.597	0.095	0.002	0.640	2.983

$R^2 = 0.278$, adjust $R^2 = 0.275$, $F = 98.510$, $p < 0.001$.

DISCUSSION

In the study, we found some mental health problems among nurses during the normalization of COVID-19 prevention and control. First, although the whole sample showed that nurses were experiencing relatively normal levels of psychological stress, 38.5% of nurses had a high level of stress, which is a significant portion that cannot be ignored. Second, the ability to perceive stress in the high psychological stress group was higher than that in the low psychological stress group, and this difference was statistically significant. Third, in the study, 21% of nurses reported anxiety, 16.8% of nurses reported somatization and 40.6% reported obsessive-compulsive symptoms. Finally, the results of this study also indicate that anxiety, somatization, and obsessive-compulsive symptoms can aggravate nurses' psychological stress.

Our study revealed that the median level of psychological stress among nurses was 23. Other studies found higher levels of psychological stress among students and other health workers in the early stages of the COVID-19 outbreak[28 29]. We found that 98.5% of nurses were taught about infectious diseases. Psychological effects of COVID-19 were more common among health care workers without medical training than among those with medical training[30]. Over time, adaptive responses to stress and the positive effects of infection control training may be protective[31]. Scholars investigated the psychological status of HCWs during SARS and found that 39.3% of the general population had elevated psychological stress levels[32], while approximately 38.5% of the nurses in our study showed high psychological stress. This reduction may be related to experience in the fight against COVID-19 today and the timely and effective response to the epidemic, and its prevention and control in Guangdong[33]. It could also be that the COVID-19 epidemic in Guangdong province was relatively stable during the study survey period.

Our study identified weekly working hours, and symptoms of anxiety, somatization, and compulsiveness as potential risk factors for psychological stress in nurses, whereas years of nursing experience was protective against the development of psychological

stress. Nurses who worked more than 40 hours a week reported significantly higher levels of psychological stress than those who worked less than 40 hours a week. This result may be related to extended work hours leading to nursing errors, such as patient identification errors, communication errors, and patient complaints[34]. At the same time, longer work hours may result in more severe conflicts between work-life balance for female workers[35]. In the post-epidemic period, when there are sporadic cases of COVID-19 infection, the longer the working hours, the higher the probability of nurses in designated hospitals being exposed to patients, the higher probability of being infected with the virus, and the greater their psychological stress. Years of nursing experience being a protective factor may be attributed to greater capabilities to cope with emergencies and improved psychological quality.

A certain level of psychological stress can lead to psychological disorders, such as anxiety and somatization symptoms. Conversely, anxiety and somatization symptoms can also cause psychological stress to rise[36]. In the high psychological stress group, we found that 41.7% and 31.4% of nurses suffered from anxiety and somatization, respectively. Huang et al. reported that the percentages of anxiety and somatization were 33.02% and 7.59%, respectively, in the Chinese population[37], which are lower than that of the nurses in our study. This result may be attributed to the fact that nurses are more likely to be exposed to COVID-19 than those in the general population. However, Li et al. reported that the frequencies of symptoms of anxiety and somatization symptoms were 45.4% and 12.0%, respectively[38]. In our survey, 26.1% of nurses received psychological counseling, which may have led to a slight decrease in anxiety symptoms. However, spending increasingly more time working in high-pressure environment may cause nurses to develop headaches and other somatic symptoms. Compulsive symptoms were reported in 62.3% of nurses, which contrasts with an online survey of 927 Chinese medical workers conducted between February 19 and March 6, 2020 which showed a prevalence of compulsive symptoms of only 5.3%[15]. The reason for this large discrepancy may be that 85.1% of the latter medical staff were not at risk of exposure to COVID-19 patients in the hospital.

Our findings have important clinical implications for alleviating high levels of

psychological stress in nurses. Reasonable work schedules and proper education on infection control can relieve nurses experiencing high psychological stress. Therefore, in the post-epidemic period, hospital managers can strengthen nurses' safety training including found COVID-19 patients with emergency drills and the right to wear protective clothing and wear goggles, the rational allocation of human resources, reduce the work intensity of nurses and other ways to reduce the occurrence of adverse psychological outcomes for nurses.

Limitations

We acknowledge that our study has some limitations. First, although we had a large sample size and attempted to capture all nurses working at designated hospitals, male nurse population in designated hospitals in Guangdong Province were underrepresented, and we did not take into account that nurses have different specialties in different departments. Second, self-report questionnaires were used in this study, and the data obtained were participants' perceptions, which are highly subjective. Third, this study can only highlight the status quo of psychological stress, anxiety, compulsion, and somatization of nurses during the investigation period and cannot determine whether there are irreversible adverse physical and mental effects on nurses. Finally, the study was conducted online using convenience sampling, which may have missed some participants.

Despite the above limitations, our study provided valuable information on the psychological impact of the COVID-19 pandemic on nurses in China. People's mental conditions will change with time and the environment, as will their psychological stress. Therefore, coping strategies across periods may differ, and the effectiveness of these strategies needs further study. Further research will need to expand our findings with additional surveys in other provinces in China.

CONCLUSION

This survey found that 38.5% of nurses still suffered high psychological stress, and there was a significant association between anxiety symptoms, somatization symptoms, compulsion symptoms, with psychological stress. Considering the current situation, we

suggest using an online platform to provide psychological support for nurses. For nurses with severe psychiatric symptoms or even somatic symptoms, we recommend individualized psychological support and interventions after ruling out infection. The COVID-19 pandemic is a public health challenge that puts health systems in a highly vulnerable position[28]. Nurses are an important part of the health care system. Therefore, we must ensure the physical and mental health of nurses to help them meet the future challenges in their future careers.

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Contributor Minrou, Zhang was involved in the conception of the study, data collection, analysis, and writing of the main manuscript. Huigen, Huang, the corresponding author, was involved in conception, data collection, analysis, and critical revision of the manuscript. Hanxi, Chen was involved in conception. Yafang, Deng was involved in the data analysis. All authors approved the final manuscript.

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STROBE Statement—Checklist of items that should be included in reports of cross-sectional studies