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A cross-sectional survey on COVID-19 phobia and its influencing factors among undergraduate nursing students

Yunting Luo^{1,2*}, Jisong Li³, Xu Qiao^{2,4} and Mingyue Zheng⁵

Abstract

Background The COVID-19 pandemic has significantly impacted the psychological well-being of undergraduate nursing students in China. It is vital to have an understanding of their COVID-19 phobia and its predictors, especially during transitions in public health policy.

Objective This study aims to evaluate the situation and factors contributing to COVID-19 phobia among nursing students in Southwestern China.

Methods A cross-sectional study was conducted in December 2022 among nursing undergraduates in southwestern China. A convenience sample of 317 undergraduate nursing students from all grades at a medical university in Chengdu was assessed using the COVID-19 Phobia Scale (C19P).

Results The mean COVID-19 Phobia Scale (C19P-SC) score was 52.92 (\pm 13.02), indicating moderate levels of phobia, with gender, chronic disease, and perceived susceptibility being significant predictors. 11.67% of the students reported an infection history, while 81.39% knew an infected individual. Notably, fourth-year students showed significantly higher phobia level than first-year. Gender, chronic disease, perceived susceptibility, and risk significantly predicted COVID-19 phobia, explaining 16.4% of the variance. Results of the thematic analysis revealed four main themes related to COVID-19 phobia and career choice among nursing undergraduates: concerns of infection risk, professional commitment, compromise and acceptance, and confronting phobia.

Conclusions This study discovered a significant level of COVID-19 phobia among undergraduate nursing students and identified several risk factors, including being female, having chronic diseases, perceiving a high susceptibility to the virus, and perceiving a high level of harm after infection. These findings highlight the importance of educators focusing on the mental well-being of nursing students, particularly seniors, to reduce the impact of phobia on their social interactions and career aspirations. This will help ensure that they are well-prepared for their future roles in healthcare.

Keywords Undergraduate nursing students, COVID-19 phobia, Career intention, Thematic analysis

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Introduction

Nursing is a specialised discipline that integrates theoretical and practical knowledge. Students need guidance to apply theory to practice because the acquisition of comprehensive care skills requires practice, reflection, and collaboration [1]. However, COVID-19 has increased remote teaching, which has reduced face-to-face interactions with clinical nurses and patients [2], which may impact nursing students' mental health, professional identity, professional skills, and employment intentions. A systematic review showed that the most prevalent health problem among nursing students was depression (52%), followed by fear (41%), anxiety (32%), stress (30%) and sleep disorders (27%) [3]. The recent scoping review found that nursing students' level of professional identity has remained essentially unchanged despite an improved social image of nurses after the COVID-19 pandemic, with scores on the professional identity tool ranging between 66% and 80% of the total score and both positive and negative effects on individual and social factors [4]. A qualitative synthesis of nursing graduates' clinical experience during the pandemic mentioned the barriers remote teaching poses to senior nursing students regarding clinical skills and patient communication [5]. Another scoping review indicated that the COVID-19 stage was stressful for nursing students as their courses were conducted online, and nursing students not only feared the COVID-19 virus, but also experienced anxiety and tension [6]. Furthermore, a survey conducted in China from September to October 2020 showed that fear of COVID-19 ($\beta=0.226$, $P<0.001$) significantly affected nursing students' intentions to leave the nursing profession [7].

COVID-19 phobia (C19P), an excessive and persistent fear of COVID-19, is a specific type of phobia as outlined in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V), and researchers have developed a scale to measure its level in the population [8]. Several studies have surveyed the status of COVID-19 phobia at population level in different countries. The findings suggested that higher resilience scores were associated with lower levels of C19P, and the United States ranked highest in resilience, followed by Europe, Pakistan, India and Indonesia, with resilience levels varying according to factors such as age, marital status, education level, and employment status [9]. Furthermore, as the global economy contracted, respondents around the world were increasingly anxious about their careers, with C19P factors significantly impacting occupational anxiety [10]. A narrative review suggested that media, policies, public awareness, unscientific inferences, and conflicting research reporting can contribute to COVID-19 phobia and fear along with the intrinsic nature of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus [11].

During the first two years of the pandemic, China implemented a "dynamic zero-COVID policy" to control the virus's spread, leading to low infection rates among students and extended periods of online learning and strict control measures [12]. In December 2022, the policy shifted to Class B management, changing the focus from infection prevention to handling severe cases [13]. The change was associated with a foreseeable surge in infections and fluctuating phases of the pandemic [14], which could significantly affect students' psychological states [15]. In previous studies, the focus has primarily been on the general population or university students as a whole. However, there has been little focus on addressing the differences in COVID-19 phobia between nursing students and other groups. Due to their clinical exposure and the nature of their education, nursing students may encounter unique challenges. The COVID-19 pandemic has had a significant impact on the psychological well-being of undergraduate nursing students in China, especially after prolonged periods of low infection rates and strict measures. There is a noticeable gap in the literature regarding C19P during periods of policy transitions. Therefore, this study aims to investigate how C19P affects nursing students, identify the key factors contributing to this phobia, and explore how these factors influence their career intentions.

Methods

Design and sample

This study employed a cross-sectional design. It investigated the current state of C19P and its influencing factors among nursing undergraduates in southwestern China. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist was followed to report the study process. The G*Power (3.1.9.7) computer programme was used to determine the power analysis of the sample [16]. The minimum sample size required was calculated to be 217 with a medium effect size (Cohen's $f^2=0.15$), a 0.05 error level with a 95% confidence interval (CI), 95% power, and 19 predictors according to the linear multiple regression statistical power analysis.

Participants

This study was started in December 2022 and utilized a convenience sampling method to select participants from a medical university in Chengdu, Sichuan Province, China. The inclusion criteria were full-time undergraduate nursing students in grades one to four.

Data collection

Data collection was carried out using the Wenjuanxing platform, which facilitated the collection of responses from participants through questionnaire links. In order to ensure the credibility of the research, the researchers

implemented WeChat account authentication and item omission checks to prevent duplicate responses or incomplete surveys. Participants were only able to access the survey through WeChat links. Prior to initiating the survey, all participants were informed of the study's purpose and provided with informed consent. The researchers guaranteed the confidentiality of personal information and allowed participants to withdraw from the study at any time. A total of 320 questionnaires were collected, three excluded due to completion in two minutes, resulting in a response rate of 99%.

Instrument

The survey comprised 19 questions covering general sociological information, experiences related to the COVID-19 pandemic, and concluded with an open-ended question about future career. Sociological data included gender, age, and grade level. Additionally, specific questions were asked about experiences related to the pandemic, such as mental health, vaccination status, past infections, exposure to infected individuals, isolation experiences, psychological support experience, perceived susceptibility, perceived threats, knowledge, and information sources.

The C19P scale, developed by Arpacı et al., is a reliable and valid tool for assessing C19P, demonstrating strong convergent and discriminant validity, with internal consistency coefficients ranging from 0.85 to 0.90, and supported by confirmatory factor analyses (CFA) and multivariate analysis of variance (MANOVA), while average variance extracted (AVE) and composite reliability (CR) values exceed the recommended thresholds of 0.50 and 0.70, respectively [8]. The Chinese version of the scale, C19P-SC, was translated by Chinese scholars and the reliability and validity index of C19P-SC has reached an acceptable level [17]. This self-rated tool comprises 20 psychological, psychosomatic, economic, and social factors. Each item is rated from “strongly disagree (1)” to “strongly agree (5)”, with a score range of 20–100 points; the higher the score, the greater the fear. In this study, the overall Cronbach α result of the scale was 0.905.

Ethical considerations

The Institutional Review Board approved this study (December 2022). Participants are given the option to confirm their informed consent at the beginning of the questionnaire. If they choose otherwise, the questionnaire immediately terminates. All participants have voluntarily provided their informed consent for this study. To ensure participant anonymity, no personally identifiable information was collected. Each participant was assigned a unique code to anonymize the data. Additionally, all data were securely stored in a password-protected database accessible only to the research team.

Data analysis

The data was analyzed using SPSS24.0. Normal distribution measurement data was presented as mean \pm standard deviation ($M \pm SD$), and counting data as frequency and percentage. Welch's ANOVA with the Games-Howell post-hoc test was used for variables not meeting the homogeneity of variance assumption. When all assumptions were met, one-way ANOVA with Tukey's post hoc test was used. Statistical significance was set at $P < 0.05$ for two-sided tests with 95% confidence intervals (CI). Multiple linear regression was used for further univariate analysis. The final open-ended question was analyzed using Braun and Clarke's thematic analysis to examine the responses in detail [18], which involved six steps: becoming familiar with the data, coding the data, searching for themes, reviewing themes, defining and naming themes, and generating reports.

Results

Descriptive statistics of COVID-19 phobia among undergraduate nurses

The survey included 317 students of four different grades, with an average age of 19.67 ± 2.08 years old. The sample consisted of 45 (14.20%) males and 272 (85.80%) females. Of these, 22 (6.94%) students reported having one or more chronic diseases related to the respiratory or cardiovascular systems. Furthermore, 41 (12.93%) students admitted to experiencing symptoms of insomnia, anxiety, and social phobia in the past month. Of note, 315 (99.37%) of the students had already received at least one dose of the COVID-19 vaccine, and 258 (81.39%) had received three or more doses. Thirty-seven students (11.67%) confirmed that they had been infected with COVID-19, and 258 (81.39%) knew someone infected.

Regarding previous experiences, 156 (49.21%) students had participated in volunteer activities related to COVID-19 prevention, 21 (6.62%) had been officially notified by the Centres for Disease Control (CDC) as close contacts, 133 (41.96%) had undergone centralised or home isolation as notified by the CDC, and 23 (7.26%) had received professional psychological support for reasons related to the pandemic (such as isolation, support, close contact or after infection). A total of 165 (52.05%) students believed that they were likely or very likely to become infected (or reinfected) with COVID-19, 147 (46.37%) believed that infection with COVID-19 would pose a significant or considerable risk to their health, 273 (86.12%) claimed to understand the knowledge about the COVID-19 infection, and 297 (93.69%) claimed to understand daily protection knowledge. Furthermore, 186 (58.68%) students reported that they frequently obtained information about COVID-19 through social networks (daily or three times a week), while 101 (31.86%) obtained

information through professional channels such as Wanfang, PubMed and academic journals. Finally, only 20 (6.31%) students explicitly stated that the COVID-19 pandemic affected their willingness to work in nursing, and 70 (22.08%) remained uncertain about their career.

The univariate analysis in Table 1 reveals significant differences in C19P-SC scores between various groups based on factors such as gender, chronic underlying diseases, psychological distress, acquaintance with an infected person, isolation experience, perceived susceptibility, perceived threats, knowledge of COVID-19, use of social networks, and career intentions ($P < 0.05$).

Comparison of scores in various dimensions of COVID-19 phobia among nursing undergraduates in four grades

Table 2 compares scores on different sub-scales among undergraduate nursing students of four grades. The study found no significant differences in psychological, psychosomatic, and economic subscale fear scores. However, in the social subscale, fourth-grade students had a statistically significant higher fear score of 1.92 points (95%CI: 0.13-3.71, $P < 0.05$) than first-grade students.

Results of multiple linear regression analysis of COVID-19 phobia in nursing undergraduates

According to the findings presented in Table 3, the results of multiple linear regression indicate that four factors affect the phobia of COVID-19. There are gender ($\beta = -0.129$, $P < 0.05$), chronic underlying disease ($\beta = 0.146$, $P < 0.01$), perceived susceptibility ($\beta = -0.167$, $P < 0.01$), and perceived threats ($\beta = -0.263$, $P < 0.01$). These variables account for 16.4% of the variance ($R^2 = 0.217$, adjusted $R^2 = 0.164$, $F = 4.094$, $P < 0.001$).

Findings of the thematic analysis of COVID-19 phobia and career choice of nursing undergraduates

According to the responses to open-ended questionnaires, four themes were identified about the influence of COVID-19 factors on the career choices of nursing students, including: "Concerns of infection risk", "Professional commitment", "Compromise and acceptance", and "Confronting phobia".

Concerns about infection risk

A total of 78.86% of nursing students have not yet contracted COVID-19. Therefore, some students mentioned their concerns about the risk of infection, worried about the impact on their health, symptoms discomfort, and lack of labor protection if they work while sick.

"If I work in nursing, the risk of encountering infectious diseases is great, which makes me waver whether to work in nursing in the future." (N30).

"Being sick is very uncomfortable, but I heard that even if medical staff gets COVID-19, they have to continue working. I may not be able to bear the pain." (N105).

Professional commitment

This theme primarily focused on nursing students with a strong sense of responsibility. These students were willing to work in nursing work even when they knew the risk of infection and the potential health hazards it poses to themselves. They believed that helping others was their responsibility and were willing to take risks.

"It is precisely because of the COVID-19 pandemic that I realise that every Chinese should assume their responsibility. I am happy to be a medical worker to help everyone." (N25).

"I chose the nursing to serve others and take care of my family. It will not change because of the pandemic." (N100).

Compromise and acceptance

Some nursing students acknowledged their concerns, but ultimately chose to work in nursing after weighing the pros and cons.

"There are good and bad aspects in the nursing profession. I have accepted both the good and the bad." (N39).

"I have to work and live, there is no other way. No matter how dangerous, I have to support my family." (N186).

Confronting phobia

Some nursing students may have proactively taken measures to reduce the phobia associated with COVID-19. These measures included harm reduction, active learning, and improving their protective capabilities. As a result, they established a sense of balance and adaptability within themselves.

"COVID-19 infection is a problem that each of us has to face. As a future medical staff, I should not evade, but strive to learn and strive to defeat COVID-19." (N35).

"The pandemic is rampant, which emphasises the ability to spread infection. I must take the initiative to understand relevant information for the safety of myself and my family. As a nurse, I should use my professional knowledge to encourage the people

Table 1 Demographic characteristics and COVID-19 phobia scores among nursing students

Characteristics	N (%)	C19P-SC Score	Statistic	P-value
Grade				
1	85 (26.81%)	51.52 ± 12.35	F = 2.222	0.086
2	98 (30.91%)	52.13 ± 12.92		
3	66 (20.82%)	52.23 ± 12.28		
4	68 (21.45%)	56.47 ± 14.27		
Gender				
Male	45 (14.20%)	49.2 ± 11.65	F = 4.322	0.038*
Female	272 (85.80%)	53.53 ± 13.15		
Chronic disease				
Yes	22 (6.94%)	57.64 ± 15.22	F = 9.681	0.000**
No	251 (79.18%)	51.33 ± 12.43		
Unclear	44 (13.88%)	59.64 ± 12.7		
Mental health distress in the recent 1 month				
Yes	41 (12.93%)	58.61 ± 15.11	F = 6.804	0.001**
No	245 (77.29%)	51.51 ± 12.67		
Unclear	31 (9.78%)	56.55 ± 10.03		
Whether to receive the COVID-19 vaccination?				
Yes	315 (99.37%)	52.9 ± 13.03	F = 0.051	0.821
No	2 (0.63%)	55 ± 16.97		
COVID-19 vaccination dosage				
0	2 (0.63%)	55 ± 16.97	F = 0.365	0.778
1	2 (0.63%)	43.5 ± 3.54		
2	56 (17.67%)	52.91 ± 11.4		
3 and above	257 (81.07%)	52.98 ± 13.39		
Have you ever been infected with COVID-19?				
Yes	37 (11.67%)	53.54 ± 15.83	F = 1.622	0.199
No	250 (78.86%)	52.3 ± 12.5		
Unclear	30 (9.47%)	57.33 ± 13.07		
Do you know anyone who has been infected with COVID-19?				
Yes	258 (81.39%)	53.71 ± 12.95	F = 5.188	0.023*
No	59 (18.61%)	49.46 ± 12.88		
Have you participated in any volunteer work related to COVID-19 prevention and control?				
Yes	156 (49.21%)	48.52 ± 12.15	F = 1.042	0.308
No	161 (50.79%)	47.2 ± 10.86		
Have you ever been identified as a close contact by the Centers for Disease Control(CDC)?				
Yes	21 (6.62%)	54.33 ± 15.65	F = 0.265	0.607
No	296 (93.38%)	52.82 ± 12.84		
Have you experienced home or centralized quarantine as notified by the CDC?				
Yes	133 (41.96%)	54.74 ± 13.9	F = 4.560	0.034*
No	184 (58.04%)	51.6 ± 12.22		
Have you received professional psychological support due to pandemic-related reasons?				
Yes	23 (7.26%)	53.22 ± 13.26	F = 0.013	0.909
No	294 (92.74%)	52.89 ± 13.02		
Perceived susceptibility: Please assess the probability that you will contract (or re-contrast) COVID-19				
High(>80%)	86 (27.13%)	58.42 ± 14.75	Welch F = 7.617	0.000**
Moderately high(60–80%)	79 (24.92%)	54.2 ± 12.5		
Moderate(20–50%)	99 (31.23%)	50.7 ± 11.01		
Low(<20%)	30 (9.46%)	46.03 ± 9.85		
None	7 (2.21%)	39.14 ± 11.87		
Uncertain	16 (5.05%)	49.69 ± 9.07		
Perceived threats: Please evaluate the extent to which you believe a COVID-19 infection would pose a risk to your health.				

Table 1 (continued)

Characteristics	N (%)	C19P-SC Score	Statistic	P-value
High	28 (8.83%)	64.25 ± 17.66	Welch F = 14.697	0.001**
Moderately high	119 (37.54%)	56.77 ± 11.21		
Moderate	125 (39.43%)	48.72 ± 11.16		
Low	25 (7.89%)	45.4 ± 10.61		
None	2 (0.63%)	34 ± 4.24		
Uncertain	18 (5.68%)	51.5 ± 11.97		
Do you have knowledge of COVID-19 related information?				
Yes	273 (86.12%)	52.77 ± 13.08	F = 3.116	0.046*
No	9 (2.84%)	44.44 ± 13.07		
Unclear	35 (11.04%)	56.26 ± 11.62		
Are you familiar with the daily protective measures against COVID-19?				
Yes	297 (93.69%)	52.97 ± 12.92	F = 1.189	0.306
No	3 (0.95%)	41.67 ± 3.51		
Unclear	17 (5.36%)	54.06 ± 15.27		
How frequently do you actively seek out information about COVID-19 through social media?				
Always(everyday)	50 (15.77%)	47.98 ± 11.28	Welch F = 3.626	0.023*
Often(≥ 3 times per week)	136 (42.91%)	52.97 ± 11.47		
Seldom(<3 times per week)	8 (2.52%)	55.75 ± 15.32		
Occasionally(<1 times per month)	123 (38.80%)	54.68 ± 14.67		
How often do you actively seek out knowledge related to COVID-19 through professional databases (such as PubMed)?				
Always(everyday)	28 (8.83%)	52.18 ± 16.46	F = 0.715	0.543
Often(≥ 3 times per week)	73 (23.03%)	52 ± 12.09		
Seldom(<3 times per week)	42 (13.25%)	55.52 ± 11		
Occasionally(<1 times per month)	174 (54.89%)	52.79 ± 13.26		
Would you consider leaving the nursing profession due to the COVID-19 pandemic?				
Yes	20 (6.31%)	65.7 ± 19.29	Welch F = 12.891	0.000**
No	227 (71.61%)	50.5 ± 11.63		
Uncertain	70 (22.08%)	57.11 ± 12.11		

Note: * $P < 0.05$ is considered statistically significant

** $P < 0.01$ is considered highly statistically significant

around me to take proper protective measures.”
(N300).

Discussion

Undergraduate nursing students have a certain degree of COVID-19 phobia during the policy transition period

The results of this study shown that undergraduate nursing students scored an average of 52.92 ± 13.02 on the C19P during the policy transition phase, indicating a moderate level of C19P. This score suggested a decrease in phobia levels compared to earlier stages of the pandemic, which could be attributed to the changing public health context and evolving perceptions of the virus risk. For instance, this score was lower than the average of 65.42 ± 14.09 reported in a survey of adult C19P in Turkey at the beginning of 2020, a period characterized by high uncertainty and fear [8]. Similarly, it was lower than the score of 59.08 ± 14.44 observed among university students in Pakistan in May 2021, when the pandemic was still in an acute phase with ongoing restrictions and

high perceived risks [19]. However, the current score remained higher than that of the medical staff of a Turkish hospital during the pandemic in August 2020, which was 50.1 ± 17.3 [20]. It also exceeded the average total score of 50.5 reported in a cross-national comparative study in May 2022 among university students in China, Japan, and South Korea [19]. These differences may reflect varying levels of exposure, public health strategies, and social dynamics at different times and locations, highlighting the importance of considering social contextual factors when interpreting C19P levels.

Undergraduate nursing students had an average score of 19.52 on the psychological sub-scale and 14.47 on the social sub-scale. These scores were higher than the average psychological score of 17.3 reported in another study in China, and the social score exceeded the highest social dimension score of 13.1 [19]. Moreover, the scores on both the psychological and social sub-scales surpassed those found in a 2020 survey of the general adult population in the United States, which recorded averages of

Table 2 Comparison of scores in different sub-scales among undergraduate nursing students of four grades

Sub-scale	Total Number	M ± SD	Statistic	P-value
Psychological	317	19.52 ± 4.82		
Grade 1	85	19.12 ± 4.90	F = 0.956	0.414
Grade 2	98	19.33 ± 5.08		
Grade 3	66	19.44 ± 4.54		
Grade 4	68	20.37 ± 4.61		
Psycho-somatic	317	8.95 ± 3.79		
Grade 1	85	8.72 ± 3.72	F = 1.198	0.311
Grade 2	98	9.01 ± 3.62		
Grade 3	66	8.45 ± 3.59		
Grade 4	68	9.62 ± 4.24		
Economic	317	9.98 ± 3.69		
Grade 1	85	9.88 ± 3.49	F = 1.362	0.254
Grade 2	98	9.65 ± 3.69		
Grade 3	66	9.79 ± 3.84		
Grade 4	68	10.76 ± 3.78		
Social	317	14.47 ± 4.30		
Grade 1	85	13.8 ± 3.98	F = 2.851	0.038*
Grade 2	98	14.14 ± 4.41		
Grade 3	66	14.55 ± 4.04		
Grade 4	68	15.72 ± 4.60		

Note: SD indicate standard deviation; * $P < 0.05$ is considered statistically significant

14.54 ± 4.59 and 10.32 ± 3.78, respectively [21]. This finding suggested that students are increasingly adapting to the impacts of the pandemic. Nevertheless, despite this adaptation, they continued to exhibit a relatively high level of phobia compared to countries that have rapidly relaxed public health policies, such as quarantine and isolation, indicating a persistent phobia during the policy transition period.

Previous studies have indicated that nursing students tend to exhibit moderate levels of C19P. During the policy transition period, their phobia levels were found to be slightly higher than the total C19P scores of nursing students in other countries. For example, the C19P score recorded among nursing students in Turkey from August to September 2020 was 49.26 ± 15.88 [22], and the total C19P score observed among the nursing student population in Turkey from March to July 2021 was 47.85 ± 12.87 [23]. It is worth noting that only a small percentage of students (11.67%) had contracted COVID-19, while a vast majority (81.39%) know someone who has been infected. This indirect exposure could result in a heightened phobia among those who have not experienced COVID-19 infection firsthand.

Table 3 Multiple linear regression analysis of undergraduate nursing students' COVID-19 phobia

Independent variable	B	SE	Beta (β)	t	Significant	95.0% Confidence interval lower bound	95.0% Confidence interval upper bound
Constants	8.850	20.616		0.429	0.668	-31.723	49.423
Age	0.531	0.785	0.060	0.676	0.499	-1.014	2.075
Grade	0.075	1.120	0.006	0.067	0.946	-2.128	2.279
Gender	-4.823	2.012	-0.129	-2.397	0.017*	-8.782	-0.864
Chronic disease	4.211	1.525	0.146	2.760	0.006**	1.209	7.213
Mental health distress	-0.051	1.478	-0.002	-0.034	0.973	-2.960	2.858
Whether to receive the vaccination	14.200	10.109	0.086	1.405	0.161	-5.694	34.095
Vaccination dosage	1.182	1.796	0.042	0.658	0.511	-2.352	4.716
Infected with COVID-19	2.621	1.530	0.093	1.713	0.088	-0.390	5.631
Familiar who has been infected with COVID-19	-3.126	1.848	-0.094	-1.692	0.092	-6.763	0.510
Volunteer experience	0.256	1.419	0.010	0.180	0.857	-2.536	3.048
Home or centralized quarantine	0.489	2.896	0.009	0.169	0.866	-5.211	6.190
Professional psychological support	0.566	2.641	0.011	0.214	0.830	-4.631	5.763
Perceived susceptibility	1.653	0.574	0.167	2.879	0.004**	0.523	2.782
Perceived threats	3.045	0.646	0.263	4.714	0.000**	1.774	4.316
Knowledge related to COVID-19	1.765	1.182	0.087	1.493	0.136	-0.562	4.092
Knowledge of daily protective measures	-0.577	1.623	-0.020	-0.355	0.723	-3.772	2.618
Social media search behavior	0.951	0.667	0.084	1.426	0.155	-0.361	2.262
Professional search behavior	-0.838	0.679	-0.068	-1.235	0.218	-2.174	0.497
Career intentions	-0.304	1.419	-0.012	-0.214	0.831	-3.095	2.488

Note: $R^2 = 0.217$, $F = 4.094$, $P < 0.001$

* $P < 0.05$ is considered statistically significant

** $P < 0.01$ is considered highly statistically significant

Senior nursing students have a relatively higher phobia of COVID-19 in the social dimension

Our research indicated that senior students experience heightened levels of social phobia, potentially linked to the extended social isolation and remote learning measures implemented over the past two years. Moreover, this increase in phobia may be further influenced by their demands of compulsory professional activities, like clinical internships and job searches, which involved essential social contact. These requirements could intensify phobia in light of the eroded social skills caused by prolonged isolation. Thus, senior nursing students, whose field necessitates close interpersonal interactions, have been particularly affected by C19P. A study conducted in Portugal in early 2020 revealed that nursing students experienced a shift to home learning, reduced contact with friends, and greater emphasis on online communication due to the suspension of courses, which caused significant stress [24]. A March 2020 qualitative study in Croatia found that nursing students experienced adverse impacts during the COVID-19 pandemic, including difficulties with public transportation, dormitory accommodations, and fear of clinical environments [25]. A 2020 survey in the Middle East found high participation in remote emergency teaching among undergraduate nursing students, but low satisfaction with teaching quality and social presence [26]. Similarly, a survey conducted in Turkey at the end of 2020 revealed that reducing social interaction levels and interaction in social situations during the pandemic could negatively impact the development of social intelligence in nursing students and induce feelings of loneliness [27].

Gender, chronic disease, perceived susceptibility, and perceived threats affect nurses' COVID-19 phobia

This study identified gender, chronic illness, perceived susceptibility, and perceived threats as the main determinants influencing nursing students of C19P. Among these, being female, having a chronic disease, having high perceived susceptibility, and perceiving more significant harm after infection are risk factors for C19P. Gender has been the most consistent predictor in previous studies on C19P and fear. A systematic review and meta-analysis showed that the mean score of fear of COVID-19 among women in the general population was higher than among men (20.67 vs. 18.21) [28]. The same result was found in a systematic review and meta-analysis among university students, with women scoring higher (17.11, 95% CI 16.59–17.64) than males (15.21, 95% CI: 14.33–16.08) [29]. Some researchers suggested that women experience more intense fear and negative emotions related to COVID-19 than men [30]. It is a well-known fact that nursing is a female-dominated profession,

further highlights gender differences in phobia and fear among nursing students.

Individuals with chronic diseases who perceived a high susceptibility to COVID-19 may experience a higher level of phobia towards the virus. Nursing students, in particular, expressed concerns about their health conditions and the potential risk of being harmed by the virus, especially during the policy transition stages. These concerns were not only related to gender factors but also stemmed from their perceived susceptibility and threats associated with COVID-19. A survey conducted in August 2020 on Israeli university students showed that having chronic diseases significantly influenced students' fear of COVID-19 [31]. Chilean adults in July–August 2020 showed that health factors helped predict fear of COVID-19, and there was a positive correlation between fear of COVID-19 and chronic disease conditions [32].

Furthermore, a study conducted in various European countries from March to May 2020 suggested that predictors of fear included concerns about food supply shortage and perceived susceptibility to COVID-19 [33]. Another study conducted on nursing students in Saudi Arabia from April to May 2020 showed that lack of knowledge, perceived severity of the disease, perceived risk of infection, and use of specific coping strategies were all predictors of fear [34]. Existing studies also indicated that, compared to men, women have significantly higher susceptibility, perceived risk, and fear of COVID-19 and significantly increased preventive behaviors [35]. Similarly, even a year after the pandemic hit Japan, women were more anxious and fearful and perceived greater susceptibility to infectious diseases than men [36]. Therefore, despite the absence of collinearity observed between different variables in our study, considering the above research results, gender factors can also exacerbate nursing students' C19P through perceived susceptibility, perceived risk, and threat.

Nursing students adopted different regulatory strategies to deal with phobia

The findings of this study suggested that only a few students explicitly expressed that the COVID-19 factor affects their future employment intentions. Thematic analysis of open-ended questions yielded four findings, "Concerns of infection risk", "Professional commitment", "Compromise and acceptance", and "Confronting phobia" revealing that nursing students may adopt different psychological regulatory strategies to deal with phobia, such as acceptance, sublimation, retreat, and repression. Especially, the theme of "Professional commitment" showed that under the influence of collectivist culture, Chinese nursing students were willing to sacrifice individual values to help others, which was consistent with the sense of responsibility required by traditional Chinese culture for

individuals to accept obligations and actively fulfil social responsibilities [37]. Due to differences in culture, pandemic stages, and public health policies, students worldwide showed different regulatory strategy preferences in dealing with phobia and fear. For example, a study on the coping strategies of Saudi nursing students in dealing with fear of COVID-19 showed that higher frequency use of denial strategies, lower frequency of substance use, and acceptance strategies were significant predictors of greater fear [34]. Another longitudinal study conducted among university students in the United States from April to May 2020 showed that, compared with baseline data before the pandemic in 2019, reducing self-blame and substance use as the preferred method of coping enhanced students' ability to adapt and accept unfavorable environments [38].

Limitations

This study has several limitations. First, the selection of research subjects focused solely on a single medical university in Sichuan, which may not represent the broader population of nursing students in China. Secondly, the survey was conducted during policy changes in the Chinese pandemic response, when only a few students had confirmed cases of COVID-19. Longitudinal data is needed to compare the evolution of C19P characteristics after a more significant number of infections. A longitudinal design could provide a more comprehensive understanding of how C19P evolves over time, especially as infection rates rise and policies continue to shift. Future research should therefore expand its scope by incorporating stratified sampling across multiple centers and nationwide. When the changes in psychological characteristics of nursing students are compared through different phases of emerging infectious diseases, the representativeness of the research results could be enhanced. In addition, qualitative methods, such as in-depth interviews, could be used in future studies to explore students' lived experiences and provide a richer, more nuanced understanding of how they navigate the pandemic's challenges. Lastly, since participation in the survey was voluntary, there may be a selection bias among the nursing students who responded. To mitigate this, the study provided open-ended questions and encouraged students to express their true feelings. The final thematic analysis presented various findings, reflecting this diversity of perspectives.

Conclusions

In the particular periods of policy transitions, we noted that while only a minority of students had personally contracted COVID-19, many were acquainted with individuals who had been affected. Our research disclosed that undergraduate nursing students were beset by a

discernible degree of C19P, with senior nursing students manifesting heightened levels in the social dimension. Female students, those with chronic ailments, and those with a heightened perception of susceptibility were identified as being at greater risk. The study underscores the necessity for tailored mental health support, particularly for senior nursing students who may be more susceptible to the psychological repercussions of emerging infectious diseases. Nursing educators should prioritize the provision of psychological resources and career guidance to aid these students in navigating the challenges posed by the pandemic. Further research is imperative to appraise the evolution of C19P and to devise customized interventions aimed at bolstering the mental well-being and professional advancement of nursing students during public health crises.

Implications

Even though we have entered the post-pandemic era, emerging infectious diseases still pose challenges to healthcare systems and the training of healthcare professionals. Our findings suggest that Chinese nursing students face unique challenges related to policy shifts and the rapid transition from "zero-COVID" measures to more relaxed public health strategies. This contrast highlights potential cultural and policy-related differences in how C19P manifests across different populations. Our study contributes to the growing body of literature on the mental health effects of the pandemic, particularly among vulnerable populations like nursing students, and suggests that further research should explore the long-term effects of policy changes on mental health in different cultural contexts.

Our study highlights the need for educators to provide targeted support strategies to certain high-risk student groups, such as senior undergraduate nursing students who may be affected by C19P. In response to this issue, nursing institutions may consider implementing targeted interventions. This could involve the establishment of mental health resources, including counseling services and stress management workshops. Furthermore, modifications to the curriculum could be introduced to better prepare students for pandemic conditions, such as the integration of modules focusing on the management of infectious disease outbreaks and the provision of practical scenarios reflecting current healthcare challenges. Additionally, it is recommended to devise strategies aimed at alleviating the psychological burden on students as they approach graduation, potentially through the provision of career counseling sessions geared towards coping with pandemic-related stress and the facilitation of peer support groups. By prioritizing mental health, educators can ensure that undergraduate nursing students

are well-prepared to confidently take on their roles, ultimately strengthening the future healthcare workforce.

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Author contributions

Yunting Luo, Jisong Li and Mingyue Zheng wrote the main manuscript text, Xu Qiao and Jisong Li prepared Tables 1, 2 and 3. All authors reviewed the manuscript.

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Data availability

The data are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This project was approved by the Biomedical Research Ethics Committee, West China Hospital of Sichuan University (2022-1918). Participants provided written informed consent to participate in the study. All experiments were conducted in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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