

## RESEARCH ARTICLE

# Influence of psychological stress and coping styles in the professional identity of undergraduate nursing students after the outbreak of COVID-19: A cross-sectional study in China

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**Abstract**

**Aim:** To investigate the influencing factors in professional identity of undergraduate nursing students after the outbreak of COVID-19.

**Design:** Cross-sectional study.

**Methods:** The study covered 2,999 nursing students in six undergraduate nursing schools. Several self-report questionnaires were used to collect the general information, psychological stress, coping styles and professional identity of the undergraduate nursing students.

**Results:** The overall average score of the professional identity of nursing students ( $3.67 \pm 0.51$ ) has increased significantly after the outbreak of COVID-19. The professional identity of the undergraduate nursing students was negatively correlated with psychological stress ( $r = -0.23, p < .001$ ), expectation ( $r = -0.12, p < .001$ ) and avoidance ( $r = -0.16, p < .001$ ), but was positively correlated with solving problems ( $r = 0.18, p < .001$ ) and seeking support ( $r = 0.12, p < .001$ ). Academic performance, positions, grades, reasons for choosing a nursing profession, parents or relatives engaged in nursing work and the risk degree of residence were the factors influencing the professional identity score of undergraduate nursing students' ( $p < .001$ ).

**KEYWORDS**

COVID-19, nursing students, professional development, psychological and social coping, stress

## 1 | INTRODUCTION

Professional identity refers to the learners' acceptance and recognition of their major, and the willingness to learn and explore with a positive attitude and active behaviour. Nursing students are the reserve force

of nursing development in the future, and their professional identity is an important part of the quality training of modern nursing talents. The researchers interpreted different connotations of nursing professional identity from different perspectives. Ohlén and Segesten, 1998, believe that nursing professional identity refers to the state in which

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nursing students identify with the nature and characteristics of nursing work, and it is the perception and identification of undergraduate nursing students to their professional cognition, emotion, expectation, will, values and ability. Simone K (Kirpal, 2004) believes that nursing students' professional identity is a process and state. In the process of theoretical study and practice, nursing students gradually determine the role of nurses they are engaged in, and the degree of recognition of nursing careers by nursing students through theoretical and practical learning. Lindstrom (Lindstrom, 1983) believes that professional identity includes the mastery of professional skills, professional ethics and other professional core concepts, and is reflected in the operation mode of professional practice.

Although the definition of professional identity is different, it is generally accepted that in the nursing industry, professional identity is an important predictor of continuing to do the job (Chênevert et al., 2016; Sabanciogullari et al., 2015). Many studies have pointed out that nursing students' professional identity has a positive effect on nursing students' academic success, learning motivation and professional development, and it is also the most important factor affecting nursing students' future career choice and a sense of career achievement (Browne et al., 2018; Sun et al., 2016). The professional identity of nursing students will directly affect the stability of the nursing team. Under the background of the COVID-19 pandemic, nursing students' professional cognition is affected to a certain extent, but at present, the research on the influence of nursing students' professional identity under the background of the COVID-19 pandemic is still limited.

## 2 | BACKGROUND

At the beginning of 2020, the outbreak of the COVID-19 pandemic has become a public health emergency that caused international concern (WHO, 2020). COVID-19 has a high incidence, strong infectivity and certain mortality, which seriously threatened the life and health of all mankind (Hui et al., 2020). In the face of this grim situation, nurses, as the main force in this highly dangerous anti-epidemic war, have played an important role in winning phased victories in the anti-epidemic war, and have enhanced their sense of professional identity. This urges us to examine the responsibility and value of nurses under the epidemic of major infectious diseases. At the same time, this pandemic also caused us to think deeply about the education of undergraduate nursing students. Different from ordinary college students, college nursing students, as the reserve force that is about to embark on nursing posts, are in the learning stage of professional knowledge, and they have the characteristics of insufficient clinical experience, weak protection awareness and insufficient understanding of diseases. The dual role may have brought more complex emotional experience to nursing students, which can easily affect their value orientation and professional attitude. Whether the occurrence of this pandemic has an impact on the professional identity of the nursing students, and what kind of impact it has is worthy of attention.

The formation of professional identity is a process of continuous development, influenced by factors such as media, environment,

education, psychology and experience (Browne et al., 2018). Studies have shown that major experiences before entering clinical practice often affected personal social cognition and adaptation, academic and professional development. In the fight against the pneumonia, nursing staff played their professional advantages and values, which greatly stimulated the professional pride of the nursing students. But on the other hand, with the public reports of medical workers being infected or even sacrificed, nursing students had to re-examine the risk of their future career, which may affect their career choice, and even led to the loss of talent in the nursing team and affected the stability of the nursing team.

Stress is also an important factor that threatens the best development of nursing students' professional identity (Hensel et al., 2011). The study found that psychological distress related to the COVID-19 pandemic and the high symptom burden of acute stress disorder were common among health professional students, accounting for 37.73% (Li et al., 2020). The nursing students' high degree of attention the COVID-19 pandemic, risk perception ability and the superimposed impact of the pandemic (Ye et al., 2020) have caused the nursing students to bear excessive pressure, which may produce psychological imbalance and negative psychological emotions such as tension and anxiety, which in turn led to their low learning enthusiasm, and led to little or unwillingness to engage in professional medical work in the future. In addition, positive coping styles helped to improve the individual's adjustment ability in a stressful situation, while on the contrary, it could have a negative impact on a person's adjustment ability. As a stress event, the COVID-19 pandemic has triggered many changes in our physiology, brain, psychology and behaviour. Different nursing students had different situations of perceived stressors and degrees, and their coping styles would be different, but how this will affect the level of professional identity of nursing students is still a research issue worthy of discussion. Therefore, based on the psychological crisis stressor and coping style as potential factors, it is particularly important to explore the professional thinking and psychological state of the nursing students under public health emergencies.

The transition of the nursing students to professional identity is the main focus of nursing education, and professional identity is an important achievement of nursing education. Focusing on nursing students, this study aims to understand the current status and influencing factors of professional identity of the nursing students during the COVID-19 pandemic, and to formulate targeted intervention strategies for retaining nursing talents, stabilizing and improving nursing students' professional identity and their ability to effectively deal with public health emergencies.

### 2.1 | Aim.

To evaluate the level and correlation of psychological crisis stress, coping style and professional identity of nursing students under the background of the COVID-19 pandemic.

To determine the impact of potential factors such as epidemic-related factors, psychological crisis pressure, and coping styles on

the professional identity of nursing students under the background of the COVID-19 pandemic.

### 3 | METHODS

#### 3.1 | Design

This study was designed as a cross-sectional in mainland China.

#### 3.2 | Sample

A simple random sampling method was adopted to recruit undergraduate nursing students from six medical schools in Hebei Province, China. These colleges offer a 4 year Bachelor of Science degree, consisting of three years of professional study and one year of clinical practice. During the investigation, all college students in Hebei Province were in the home isolation stage and taught through the online platform. The senior students also stopped hospital internships for home study.

#### 3.3 | Instruments

The surveyed demographic characteristics involve gender, age, grade, present residence, university, academic performance, service as class cadres or not, parents or relatives engaged in nursing work or not, reasons for choosing nursing profession, familiarity with the frontline medical staff fighting against COVID-19 and history of exposure to COVID-19.

The Professional Identity Questionnaire for Nursing Students (PIQNS) was used to measure the professional identity of the nursing students (Hu, 2007). This questionnaire included 30 items to evaluate the following six aspects of the profession: professional knowledge, professional emotion, professional will, professional value, professional skill and professional expectation. This questionnaire had 25 ordinal variable items accessed by a 5-point Likert scale (1 = "complete in conformity" to 5 = "complete conformity"). The total scores were calculated as the sum of all 25 ordinal variable items, with higher scores indicating greater levels of professional identity. The retest reliability of each dimension of the questionnaire was above 0.7, and the content validity index was 0.856.

The Psychological Stress Questionnaire for College Students (PSQCS) was used to measure the source and degree of psychological stress of the nursing students (Cui, 2009). It included 35 items to evaluate the following five aspects of the stress: emergency stress, economic stress, employment stress, school stress, social and interpersonal stress. It was a self-reported measure rated by a 5-point Likert scale (1 = Unaffected to 5 = Very severely affected). Higher scores indicate greater psychological stress. The Cronbach  $\alpha$

coefficient of the questionnaire was 0.926, the internal consistency was good, and the structural validity was high.

The Coping with Psychological Stress for College Students (CPSCS) was used to measure how the nursing students dealt with psychological stress (Cui, 2009). It consisted of 22 items to evaluate the following four ways in dealing with psychological stress: solving problems, seeking support, expectation and avoidance. It was a self-reported measure rated by a 5-point Likert scale (1 = "complete in conformity" to 5 = "complete conformity"). The Cronbach  $\alpha$  coefficient of the questionnaire was 0.778, the internal consistency was good, and the structural validity was high.

#### 3.4 | Data collection

Before the questionnaire survey, we have contacted the college counsellors and introduced the design scheme to them. The investigation was officially started in May 2020, use the online questionnaire survey software in Mainland China (web link: <https://www.wjx.cn>) to create an electronic questionnaire. After the counsellors explained the purpose of the survey to the nursing students, the questionnaire was sent to the class group for the nursing students to fill in voluntarily. All nursing students answered the questionnaire in accordance with the instructions. The questionnaire was only allowed to be filled in once and submitted anonymously after the answer was completed. After excluding invalid questionnaires, 2,999 valid questionnaires were finally recovered, with an effective rate of 99.4%.

#### 3.5 | Analysis

SPSS 25.0<sup>®</sup> was used for statistical analysis. Descriptive statistical analysis was conducted on the demographic characteristics, psychological stress, coping styles, professional identity of the nursing students, quantitative variables were presented as mean  $\pm$  standard deviation, whereas categorical variables were presented as frequencies. *t* Test or one-way analysis of variance was used for comparison between different groups. Pearson's correlation coefficient was used to analyse the correlations among the professional identity, psychological stress and coping styles of undergraduate nursing students. Multiple linear regression analysis was used to analyse the factors influencing nursing students' professional identity. *p*-value <.05 was regarded to be statistically significant.

#### 3.6 | Ethical

This study has been reviewed and approved by the Ethics Committee of Hebei Medical University (No.2020112). Informed consent was obtained from participants prior to their completion of the questionnaires.

## 4 | RESULTS

A total of 2,999 undergraduate nursing students completed the questionnaire survey. The average age of participants was  $(20.66 \pm 1.53)$  years old, and the ratio of male to female nursing students was 1:5.4 (15.5% vs 84.5%). The average scores of the professional identity of the nursing students before and after the outbreak of COVID-19 were  $(3.46 \pm 0.47)$  points and  $(3.67 \pm 0.51)$  points, respectively, and the score of professional identity of the nursing students increased significantly after the pandemic ( $p < .01$ ) (Table 1).

The undergraduate nursing students with significantly higher professional identity are those whose academic performance is above 90 points ( $F = 18.726, p < .001$ ), the freshmen ( $F = 12.346, p < .001$ ), class cadres ( $F = 46.885, p < .001$ ), students choosing nursing profession out of personal interest ( $F = 94.509, p < .001$ ), students with parents or relatives engaged in nursing work ( $t = 6.788, p < .001$ ) and students living in areas where 100–499 people have been diagnosed with COVID-19 ( $F = 10.799, p < .001$ ). Also, there

was no significant difference in students' professional identity score in terms of gender, familiarity with the frontline medical staff and COVID-19 exposure history ( $p > .05$ ) (Table 2).

PIQNS was significantly correlated with PSQCS and CPSCS ( $p < .01$ ). The professional identity of the undergraduate nursing students was negatively correlated with stress ( $r = -0.23, p < .01$ ), expectations ( $r = -0.12, p < .01$ ) and avoidance ( $r = -0.16, p < .01$ ). It was positively correlated with solving problems ( $r = 0.18, p < .01$ ) and seeking support ( $r = 0.12, p < .01$ ) (Table 3).

Hierarchical Multiple Regression model analysis was used to analyse the factors influencing the professional identity of the undergraduate nursing students after the outbreak of COVID-19. There was no evidence of significant multicollinearity in the model. The tolerance of this model was 0.247 ~ 0.991 ( $>0.10$ ), and the variance inflation factor (VIF) was 1.009 ~ 4.054 ( $<10$ ). In the first-step hierarchy with demographic characteristics, the explanatory power was 17.1% ( $F = 52.698, p < .001$ ). Among the input variable, positive predictors of PIQNS involve academic performance, service as

Questionnaires	Dimensions	Average score		Total score	
		Mean	SD	Mean	SD
PSQCS	Emergency pressure	1.95	1.06	11.68	6.37
	Economic pressure	2.16	0.80	12.94	4.78
	Employment pressure	2.45	0.89	17.17	6.21
	School pressure	2.28	0.76	13.66	4.54
	Social and interpersonal pressure	1.74	0.77	17.43	7.67
	Total	2.11	0.73	72.87	25.26
CPSCS	Solving problems	3.26	0.81	16.29	4.05
	Seek support	2.90	0.73	17.42	4.41
	Expectations	2.39	0.73	11.96	3.67
	Avoidance	2.41	0.65	14.47	3.91
	Total	2.74	0.58	60.14	12.84
PIQNS (Before the COVID-19)	Professional knowledge	3.20	0.70	15.98	3.52
	Professional emotions	3.27	0.70	16.37	3.48
	Professional will	3.43	0.55	20.56	3.29
	Professional values	3.47	0.84	3.47	0.84
	Professional skill	4.08	0.54	20.38	2.72
	Professional expectations	3.21	0.47	9.62	1.42
	Total	3.46	0.47	86.39	11.84
PIQNS (After the COVID-19)	Professional knowledge	3.78	0.77	18.92	3.83
	Professional emotions	3.53	0.75	17.63	3.74
	Professional will	3.53	0.55	21.17	3.30
	Professional values	3.64	0.86	3.64	0.86
	Professional skill	4.17	0.54	20.86	2.69
	Professional expectations	3.21	0.47	9.62	1.41
	Total	3.67	0.51	91.84	12.67

**TABLE 1** The Scores of PSQCS, CPSCS and PIQNS of the Undergraduate Nursing Students

Abbreviations: CPSCS, The Coping with Psychological Stress for College Students; PIQNS, The Professional Identity Questionnaire for Nursing Students; PSQCS, The Psychological Stress Questionnaire for College Students; SD, Standard Deviation.

**TABLE 2** Demographic Characteristics of the Undergraduate Nursing Students ( $n = 2,999$ )

Characteristics	No. (%) of Participants	PIQNS (Mean $\pm$ SD)	t or F	p
Gender				
Male	465(15.51)	3.69 $\pm$ 0.58	0.755	.451
Female	2,534(84.49)	3.67 $\pm$ 0.49		
Academic performance				
$\geq 90$ points	104(3.47)	3.92 $\pm$ 0.53	18.726	<.001
80–89 points	1,316(43.88)	3.73 $\pm$ 0.49		
70–79 points	1,307(43.58)	3.63 $\pm$ 0.50		
60–69 points	266(8.87)	3.52 $\pm$ 0.55		
<60 points	6(0.20)	3.35 $\pm$ 0.30		
Grade				
Freshman	862(28.74)	3.71 $\pm$ 0.52	12.346	<.001
Sophomore	835(27.84)	3.70 $\pm$ 0.49		
Junior	994(33.14)	3.66 $\pm$ 0.50		
Senior	308(10.27)	3.52 $\pm$ 0.51		
Position				
Student Union Officer	178(5.94)	3.76 $\pm$ 0.53	46.885	<.001
Class cadres	610(20.34)	3.84 $\pm$ 0.51		
No	2,211(73.72)	3.62 $\pm$ 0.49		
Reasons for choosing a nursing profession				
Personal interest	925(30.84)	3.91 $\pm$ 0.48	94.509	<.001
Parents' advice	776(25.88)	3.64 $\pm$ 0.47		
Adjustments	642(21.41)	3.48 $\pm$ 0.51		
Future employment easily	457(15.24)	3.59 $\pm$ 0.45		
Other	199(6.64)	3.51 $\pm$ 0.47		
Parents or relatives engaged in nursing work				
Yes	803(26.78)	3.78 $\pm$ 0.50	6.788	<.001
No	2,196(73.22)	3.64 $\pm$ 0.50		
Familiar with the frontline medical staff fighting against COVID-19				
Yes	395(13.17)	3.70 $\pm$ 0.53	1.103	.270
No	2,604(86.83)	3.67 $\pm$ 0.50		
COVID-19 contact history				
Yes	10(0.33)	3.42 $\pm$ 0.49	-1.610	.107
No	2,989(99.67)	3.67 $\pm$ 0.51		
Number of diagnosed in COVID-19 risk area				
$\leq 99$ people	31(1.03)	3.52 $\pm$ 0.38	10.799	<.001
100–499 people	2,718(90.63)	3.69 $\pm$ 0.51		
500–999 people	177(5.90)	3.50 $\pm$ 0.47		
1000–99999 people	73(2.43)	3.53 $\pm$ 0.44		

Abbreviations: PIQNS, The Professional Identity Questionnaire for Nursing Students; SD, Standard Deviation.

class cadres, choosing nursing profession out of personal interest or following their parents' advice, parents or relatives engaged in nursing work, being junior and senior nursing students, the degree of COVID-19 risk area. In Model 2, factors related to PSQCS were added, and the explanatory power increased 5.5% compared to the

first stage, to 22.6% ( $F = 52.466$ ,  $p < .001$ ). Emergency pressure, employment pressure, social and interpersonal pressure were also predictors of PIQNS. Finally, when CPSCS was added to the model, the explanatory power increased 8.7% compared to the first stage, to 25.8% ( $F = 50.719$ ,  $p < .001$ ). Coping styles, included solving

**TABLE 3** Correlation of PSQCS, CPSCS and PIQNS of the Undergraduate Nursing Students ( $n = 2,999$ )

Questionnaires	Dimensions	PIQNS
PSQCS	Emergency pressure	-0.07 <sup>a</sup>
	Economic pressure	-0.23 <sup>a</sup>
	Employment pressure	-0.29 <sup>a</sup>
	School pressure	-0.22 <sup>a</sup>
	Social and interpersonal pressure	-0.18 <sup>a</sup>
	Total	-0.23 <sup>a</sup>
CPSCS	Solving problems	0.18 <sup>a</sup>
	Seek support	0.12 <sup>a</sup>
	Expectations	-0.12 <sup>a</sup>
	Avoidance	-0.16 <sup>a</sup>

Abbreviations: CPSCS, The Coping with Psychological Stress for College Students; PIQNS, The Professional Identity Questionnaire for Nursing Student; PSQCS, The Psychological Stress Questionnaire for College Students.

<sup>a</sup> $p < .01$ .

problems, seeking support, expectations and avoidance, significantly affect professional identity ( $p < .001$ ) (Table 4).

## 5 | DISCUSSION

Due to the high infectivity and pathogenicity of the coronavirus, the pandemic has brought great challenges to the medical workers, and created a huge and far-reaching impact on the professional identity of the medical students who will engage in medical work in the future. The current professional identity of undergraduate nursing students has been analysed from the aspects of stresses they were facing and the coping styles they were taking, so as to help them make rational career plans and establish a career path with a clear direction.

Influencing factors for the professional identity of undergraduate nursing students during the outbreak of COVID-19.

After experiencing the COVID-19 pandemic, these undergraduate nursing students showed a positive level of professional identity. The total average score of professional identity was between 3 and 4 points (out of 5 points). Professional identity levels increased significantly after the COVID-19 pandemic ( $3.46 \pm 0.47$  versus  $3.67 \pm 0.51$ ,  $p < .001$ ). Similar findings were made during the SARS pandemic in Hong Kong in 2003 (Cui, 2009). The undergraduate nursing students investigated had a high overall professional level and personal quality.

The overall average score of the professional identity increased with academic performance ( $\beta = 0.148$ ,  $p < .001$ ). The academic performance of the undergraduate nursing students reflects their initiative and ability in learning. The academic performance of nursing undergraduates reflects their initiative and ability to learn. The positive emotions (Wang et al., 2019) and sufficient knowledge reserved

during the learning process enabled the majority of nursing students to deal with the COVID-19 pandemic situation scientifically and positively, so they had a higher professional identity.

The nursing students who acted as student cadres had a higher level of professional identity than those who did not. The cultivation of individual leadership could improve students' self-confidence, enhance their professional identity and expand their skills (Miskelly et al., 2014).

Compared with freshmen, senior nursing students had lower levels of professional identity ( $\beta = -0.104$ ,  $p < .001$ ). With the continuous progress of professional study, the professional identity of nursing students could be diminished by the tremendous challenges met in the process of learning. At the same time, facing the career choice, they were more aware of the high risk and high intensity of their future work, which thus affected their professional confidence and satisfaction.

Intrinsic motivation is the prime mover for excellent performance (Marie, 2017). This study found that students who chose the nursing major because of their interests had a higher level of professional identity. The nursing students who voluntarily chose the nursing major would comprehensively consider their personality and ability, as well as career development prospects and other factors, which has contributed to the recognition of the nursing profession.

The undergraduate nursing students whose parents or relatives were engaged in nursing had a higher professional identity after the outbreak of COVID-19. ( $\beta = 0.076$ ,  $p < .001$ ). Nursing educators, as role models, continue to influence students' professional development (Felstead et al., 2016). It is beneficial for nursing students to enhance their sense of professional identity to play an active role of example.

The professional identity was negatively correlated with the risk degree of residence ( $\beta = -0.061$ ,  $p < .001$ ). People living in high-risk areas would feel more fearful and helpless (Tang et al., 2020). The undergraduate nursing students in these areas had a more intuitive understanding of the risks and uncertainties of the nursing work, and were concerned about their value and ability to perform the nursing work, which would affect their professional identity. Previous studies had similar findings (Chang et al., 2006; Speroni et al., 2015).

The correlation among psychological stress, coping styles and the professional identity of the undergraduate nursing students.

The outbreak of COVID-19 triggered great stress of undergraduate nursing students, which would easily lead to some negative emotions such as anxiety. Excessive anxiety would interfere with their cognitive function and weaken their coping ability, which would change the nursing students' professional values and career choices (Houslay et al., 2018; Li, Cao, et al., 2020).

Stress was negatively correlated with the professional identity of the undergraduate nursing students ( $r = -0.23$ ,  $p < .01$ ). Among the stresses, employment pressure was the most prominent. Affected by COVID-19, many hospitals or other medical organizations stopped or postponed the recruitment of new nurses, and the quarantine at home led to the inaccessibility to the recruitment information, which brought tremendous employment pressure to the nursing graduates.

TABLE 4 Multiple Linear Regression Analysis of PIQNS of the Undergraduate Nursing Students After the Outbreak of COVID-19 (n = 2,999)

	Model 1			Model 2			Model 3					
	B	$\beta$	t	p	B	$\beta$	t	p	B	$\beta$	t	p
Variables (reference)	3.327		47.436	<.001	3.546		49.956	<.001	3.478		47.856	<.001
Demographic characteristics												
Academic performance	0.106	0.148	8.811	<.001	0.090	0.126	7.576	<.001	0.075	0.104	6.366	<.001
Position (No)												
Student Union Officer	0.102	0.048	2.825	.005	0.085	0.040	2.441	.015	0.077	0.036	2.259	.024
Class cadres	0.163	0.129	7.629	<.001	0.134	0.106	6.444	<.001	0.117	0.093	5.760	<.001
Grade (Freshman)												
Sophomore	-0.008	-0.007	-0.354	.723	0.015	0.013	0.675	.500	0.016	0.014	0.728	.467
Junior	-0.061	-0.057	-2.840	.005	-0.042	-0.039	-1.985	.047	-0.044	-0.040	-2.101	.036
Senior	-0.174	-0.104	-5.668	<.001	-0.118	-0.071	-3.847	<.001	-0.116	-0.070	-3.856	<.001
Reasons for choosing a nursing profession (Other)												
Personal interests	0.346	0.315	9.539	<.001	0.326	0.297	9.264	<.001	0.314	0.286	9.099	<.001
Parents' advice	0.097	0.084	2.635	.008	0.086	0.074	2.405	.016	0.086	0.074	2.449	.014
Adjustments	-0.062	-0.050	-1.652	.099	-0.050	-0.040	-1.368	.171	-0.051	-0.041	-1.423	.155
Future employment easily	0.053	0.038	1.347	.178	0.057	0.040	1.491	.136	0.056	0.040	1.500	.134
Parents or relatives engaged in nursing work	0.088	0.076	4.518	<.001	0.060	0.052	3.190	.001	0.059	0.051	3.199	.001
COVID-19 risk area	-0.079	-0.061	-3.686	<.001	-0.078	-0.061	-3.764	<.001	-0.071	-0.056	-3.528	<.001
PSQCS												
Emergency pressure					0.079	0.165	6.476	<.001	0.065	0.136	5.407	<.001
economic pressure					-0.014	-0.023	-0.827	.408	-0.010	-0.015	-0.568	.570
Employment pressure					-0.119	-0.208	-7.117	<.001	-0.102	-0.178	-6.201	<.001
School pressure					0.030	0.045	1.401	.161	0.028	0.041	1.304	.192
Social and interpersonal pressure					-0.178	-5.953	<.001	-0.080	-0.121	-4.030	<.001	
CPSCS												
Solving problems									0.055	0.088	3.581	<.001
Seek support									0.085	0.123	4.530	<.001

(Continues)



TABLE 4 (Continued)

	Model 1			Model 2			Model 3			
	B	$\beta$	p	t	$\beta$	p	t	B	$\beta$	p
Expectations								-0.049	-0.072	.004
Avoidance								-0.102	-0.131	<.001
R <sup>2</sup> (adjR <sup>2</sup> )	0.175 (0.171)				0.230 (0.226)	0.264 (0.258)				
F(p)	52.698 (<0.001)		52.466 (<0.001)		50.719 (<0.001)					

Note:  $\Delta R^2$ : change in R<sup>2</sup>; Model I: Block1 (Demographic characteristics), Model II: Block1 (Demographic characteristics) + block 2 (PSQCS), Model III: Block1 (Demographic characteristics) + block 2 (PSQCS) + block 3 (CPSCS).

Abbreviations: CPSCS, The Coping with Psychological Stress for College Students; PIQNS, The Professional Identity Questionnaire for Nursing Students; PSQCS, The Psychological Stress Questionnaire for College Students.

With the increase of pressure, the level of professional identity of the nursing students also declined.

Social and interpersonal pressures were also significant factors that affected the professional identity of the nursing students ( $r = -0.18$   $p < .01$ ), similar to previous research results (Green, 2018). Most students depended on distance learning, leading to learning weariness and decreased efficiency due to the lack of help and support from their peers, which resulted in the reduced professional identity. The nursing students could achieve higher satisfaction when they felt that they were treated in a tolerant and supportive way during the learning process (Walker et al., 2016). Schools and families should put more emphasis on their cultivation of interpersonal skills during their education process, help them establish their social supporting networks and improve their social supporting levels.

The professional identity was positively correlated with the positive coping styles, such as problem-solving and help-seeking. ( $p < .01$ ), and negatively correlated with negative coping styles, such as avoidance and expectations ( $p < .01$ ), indicating that the undergraduate nursing students had a certain level of awareness and coping ability for difficulties and setbacks, and this was consistent with previous research results (Al-Zayyat et al., 2014; Al-Gamal et al., 2018).

This result of further regression analysis showed that the more positive coping behaviours the undergraduate nursing students had, the stronger the professional identity was. Positive coping styles could alleviate the level of stress and help the nursing students understand and solve problems more objectively and completely. Through the positive self-experience of problem-solving, a positive self-evaluation could be obtained, stimulating greater self-fulfilment, and thus improving the professional identity. The study found that self-efficiency not only had a positive role in maintaining optimism and solving problems, but also was an important resource for coping with stresses (Zhao et al., 2015). Therefore, it is important to enhance students' self-efficiency to reduce stress and actively adopt coping strategies in clinical practice.

## 6 | LIMITATIONS

First, there may be potential related factors affecting the professional identity, such as family income, parental work and participation in social practice, which are not included in the scope of the study, and therefore follow-up investigation is still needed. Second, this cross-sectional study cannot prove the causality between related variables and professional identity. Meanwhile, since the questionnaire is distributed in a one-time manner, there may be a recall bias in the survey of professional identity before the outbreak of COVID-19, so the survey results after the outbreak of COVID-19 were mainly analysed. Finally, qualitative research on nursing students' professional identity combined with in-depth interviews or individual narratives needs to be further developed.



## 7 | CONCLUSION

In summary, after the outbreak of COVID-19, the professional identity of the undergraduate nursing students in Hebei Province significantly increased. Dominant factors affecting the professional identity of these students include academic performance, positions, grades, motivation to choose a nursing major, parents or relatives engaged in nursing work, and the risk degree of residence. Besides, due to the influence of the pandemic, undergraduate nursing students experienced many stresses, among which employment was the main source. But it was worth noting that most undergraduate nursing students adopted positive coping styles such as problem-solving. Different sources of stress and coping styles directly or indirectly affected their professional identity. Therefore, higher requirements are placed on the cultivation of nursing talents. Schools are responsible for improving the coping ability of the undergraduate nursing students to respond to public health emergencies, strengthening their occupational protection awareness and formulating strategies to enhance their professional self-confidence.

### ACKNOWLEDGEMENT

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### CONFLICT OF INTEREST

None of the authors have any conflicts of interest to declare.

### AUTHOR CONTRIBUTIONS

Study Design: Haiying Chen, Yanyan Zhao; Data Acquisition: Bingfei Wang, Yan Zhao and Xinru Mu; Data Analysis and Interpretation: Qiang Zhou and Jie Li; Manuscript Writing: Yanyan Zhao, Qiang Zhou, Jie Li and Jiage Luan.

### DATA AVAILABILITY STATEMENT

The raw data set analysed in the current study is available from the corresponding author (Haiying Chen) on reasonable request.

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## APPENDIX

### STROBE STATEMENT—CHECKLIST OF ITEMS THAT SHOULD BE INCLUDED IN REPORTS OF CROSS-SECTIONAL STUDIES

	Item No	Recommendation	Page No.
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	1 ~ 3
Objectives	3	State-specific objectives, including any prespecified hypotheses	3
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	3 ~ 4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up and data collection	3 ~ 4
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	3
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders and effect modifiers. Give diagnostic criteria, if applicable	3 ~ 4
Data sources/measurement	8 <sup>a</sup>	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	3 ~ 4
Bias	9	Describe any efforts to address potential sources of bias	NA
Study size	10	Explain how the study size was arrived at	2
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	3

	Item No	Recommendation	Page No.
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	4 ~ 5
		(b) Describe any methods used to examine subgroups and interactions	4 ~ 5
		(c) Explain how missing data were addressed	4
		(d) If applicable, describe analytical methods taking account of sampling strategy	4
		(e) Describe any sensitivity analyses	NA
<b>Results</b>			
Participants	13 <sup>a</sup>	(a) Report numbers of individuals at each stage of study—For example, numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up and analysed	5
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14 <sup>a</sup>	(a) Give characteristics of study participants (e.g. demographic, clinical, social) and information on exposures and potential confounders	5 ~ 6
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15 <sup>a</sup>	Report numbers of outcome events or summary measures	5 ~ 6
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g. 95% confidence interval). Make clear which confounders were adjusted for and why they were included	5 ~ 6
		(b) Report category boundaries when continuous variables were categorized	NA
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—for example analyses of subgroups and interactions, and sensitivity analyses	NA
<b>Discussion</b>			
Key results	18	Summarize key results with reference to study objectives	6 ~ 8
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	8
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8
Generalizability	21	Discuss the generalizability (external validity) of the study results	8
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	The Department of Education of Hebei Province and the Bureau of Science and Technology of Hebei Province

<sup>a</sup> Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).