Knowledge, Risk Perceptions and Depression Related to COVID-19: The Comparison between Nurses and other Professionals in Nanjing, China

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Authors' contributions

This work was carried out in collaboration among all authors. Authors TYL, YZ and JJ designed the study and wrote the protocol. Author TYL wrote the first draft of the manuscript. Authors FL, ZT and JJ collected the data. Authors TYL, ZT and TS performed the analysis. All authors read and approved the final manuscript.

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ABSTRACT

Background: COVID-19 is a deadly infectious disease that dramatically affects the safety of hospital professionals. Their knowledge, risk perception, and depression levels towards COVID-19 need to be understood.
Purpose: This study aimed to compare the differences in knowledge, risk perceptions, and depression related to COVID-19 between nurses and other professionals in hospital settings.
Methods: A cross-sectional survey was conducted in Nanjing, China at the beginning of the COVID-19 pandemic with four standardized questionnaires, including (a) demographic data, (b)

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knowledge about COVID-19, (c) risk perceptions, and (d) depression. Data from the two groups of participants were analyzed by Chi-square tests, correlations, and t-tests.

Results: The mean correct answer rate of knowledge for nurses was 76.42%, and for other professionals was 73.94%. T-tests indicated significant differences in total mean knowledge score and mean scores in four out of five subscale scores (p<.05). All significant differences in scores showed that nurses' knowledge was higher than other professionals, except one subscale score, which revealed that nurses' knowledge of pets could spread COVID-19 was lower than other professionals. The highest perceived risk scores in both groups were contracting influenza. The second highest was scores on COVID-19 and H1N 1 the third. T-tests indicated significant differences between these two groups in scores of contracting these three infectious diseases, with nurses higher than other professionals (p≤.001). T-test also showed that the depression of nurses was higher than other professionals (p<.000). Positive relationships existed between risk perceptions and depression (p<.001).

Conclusions: More education is needed to improve hospital professionals' knowledge of COVID-19. Since nurses' risk perceptions of contracting COVID-19 and dying from this deadly infection were higher than other professionals; further studies might help researchers understand the underlying reasons better. Hospital leaders should pay attention to workers' mental health and initiate proper strategies to reduce their depression related to COVID-19. Further investigation is needed since few publications mention the relationship between the perceived risk of hospital professionals and home and food accidents.

1. INTRODUCTION

At the end of 2019, a severe acute respiratory disease hit Wuhan city, Hubei province, China. It is now named coronavirus disease 2019 (COVID-19), and the causing virus is named SARS-CoV-2 by World Health Organization [1]. Businesses, schools, and our lifestyles are all changed due to the pandemic. Although the world is embracing the good news that several vaccines are available and inoculation has been given to various populations, including frontline medical professionals, the confirmed COVID-19 cases continue to escalate worldwide. The recently identified variants of the virus in several countries have made the vaccine efficacy a big concern by the public [2]. Millions of patients had passed away because of this dreadful disease. Scientists have predicted that the COVID-19 pandemic could last very long due to its high contagiousness and asymptomatic transmission. Clinical nurses have historically taken a significant role in taking care of patients to fight against serious illnesses; a challenging time introduced by the COVID-19 provides opportunities for the public to appreciate the importance of their work and demonstrate their professionalism and leadership [3].

Studies regarding COVID-19-related knowledge levels among hospital professionals have shown different results. Several studies reported that hospital professionals in their research had inadequate knowledge and training about COVID-19 [4-6]; while two studies were done in Nepal, moderate correct answer rates were achieved [7,8]. In addition, Roupa et al. [9] found that the Cyprus nurse officers' knowledge of the COVID-19 was generally satisfied with the percentage ratio of correct answers ranged from 86.9% to 98.3%. Malik et al. revealed that 94.8% of Pakistan hospital professionals scored adequately for COVID-19-related knowledge [10]. Taghrir et al. reported that the average correct answer rate for Iranian medical students was 86.96% [11].

Although professionally educated and trained, hospital professionals are still at risk during their tasks and duties. Their contributions need to be acknowledged and praised. However, at the same time, they are also ordinary human beings; they have their concerns and worries when facing a new and unknown disease as COVID-19. Therefore, it is necessary to explore the risk perception, knowledge, and depression levels of those who work in hospitals.

The COVID-19 pandemic is a worrying and stressful time for everyone on the planet. A study involving ten countries found that the public who have had direct personal experience with COVID-19 perceive more risk than those who have not had direct experience [12]. It is not hard to understand that people who work in hospital facilities experience lots of stress, anxiety, and

risk of infection [13]. As a contagious respiratory disease, COVID-19 requires special preventive and precautious restrictions limiting physical and emotional contact between the patients and other people, including their family members. Therefore, hospital professionals such as nurses spend more time with patients and carry the weight of taking care of the patients on their shoulders despite the potential risks to their health [14].

Furthermore, the latest news of an increasing number of hospital professionals infected with SARS-CoV-2 or dying in the line of duty places many stressors for other hospital professionals [15]. Clinical nurses are often the first persons who have close contact with the confirmed cases of COVID-19. They need to use evidence-based practice to provide formal and informal education to patients and the public about signs and symptoms of COVID-19 and different protective measures to stop the virus from spreading. Nurses also need to use appropriate knowledge to collaborate with other professionals to treat affected patients. To do so, they need to well-equip themselves by obtaining valuable and trustworthy information. COVID-19 is a new disease; with progressive investigation and research, scientists know better about this disease. Many details of this novel disease are available; nurses need to identify and acquire timely and current knowledge to help themselves and their patients [16]. They need to know how to contain the COVID-19 virus and guidelines to protect the public. Before the COVID-19 pandemic, there are many non-web-based resources medical professionals can use to get information and knowledge, such as conferences, workshops, and in-hospital libraries; however, with the shut-down of many facilities, all these resources seem impossible.

Besides, some knowledge is inconsistent, for example, the debate about using face masks by healthy individuals indoor or outdoor where social distancing is a challenge [17,18]. At the beginning of the COVID-19 pandemic, WHO didn't suggest wearing a mask for the public, although it encourages face masks or coverage later. Other COVID-19 related knowledge, such as physical distancing, washing hands frequently, is well received by the public and hospital professionals. However, pets' transmission [19,20] and vertical transmission from a pregnant woman to her child is not well-known by the public and some hospital professionals [21-24]. As primary caretaking figures, nurses are

acquired to know better than their patients. How they capture scientific knowledge related to COVID-19 during this challenging period deserves further investigation.

According to the International Council of Nurses [25] report, more than 1,500 nurses worldwide have died due to COVID-19 infection, and approximately 230,000 hospital workers have contracted the virus [15]. A press release in May 2020 reported that the risk for frontline hospital professionals infecting COVID-19 is much higher than the Public [26]. Wang and colleagues said that the transmission rate of COVID-19 from patients to hospital workers is about 29% [27]. Although working in a contagious environment is expected by hospital professionals, when battling against COVID-19, they worry about their safety and bringing the infection home to their families, and contributing to spread in their communities [28,29]. A study conducted in Iran revealed that the risk perception of contracting with COVID-19 for frontline medical students is moderate, with females having lower risk perception than males (mean 4.6 vs. 3.72, total score 8). If those medical students had received appropriate training, the risk perception would be decreased [11]. Besides, the heavy workload brought from taking care of COVID-19 patients might make already exhausted nurses at greater risk of having a work injury [30,31]. Nurses' perspectives toward COVID-19 may be different from other professionals due to heavy workload and close contact. Therefore, the purpose of this study was to compare the differences in knowledge, risk perceptions, and depression related to COVID-19 between nurses and other professionals in hospital settings.

2. MATERIALS AND METHODS

2.1 Design and Instruments

This study was a cross-sectional survey conducted on an online platform with four standardized questionnaires, including (a) demographic data, (b) knowledge about COVID-19, (c) risk perceptions, and (d) depression levels. The demographic data include participants' gender, age, occupation, whether providing care or support to the wards with COVID-19 patients. Knowledge about the COVID-19 questionnaire contains 19 items developed based on the Advice for the public published on the WHO website [1,32]. Factor analysis identified five factors (subscales): Factor 1 has eight items about face masks use and common myths

related to COVID-19, factor 2 five items related to how to prevent or treat COVID-19, factor 3 has three items about detection, factor 4 two items about pregnant women, and factor 5 has one item about the spreading of COVID-19 by pets. A correct answer was scored 1 point, and an incorrect answer or "I am not sure" was scored 0 points (Appendix 1).

The risk perceptions questionnaire contains three parts. Part I has eight items to measure participants' perceived risk of acquiring COVID-19 and other adverse events, including H1N1, influenza, cancer, heart attack, traffic accidents, accidents at home, and food poisoning, in the coming year. Part II explores participants' perceived risk of death due to the eight adverse events mentioned above. Part III has four items for which participants indicate the extent of their concerns of themselves contracting COVID-19, their family members contracting COVID-19, the spread of COVID-19 to the areas in which they live, and the likelihood of others contracting COVID-19. A five-point Likert Scale was used, ranging from 1=very unlikely to 5=very likely or 1=not worried at all to 5=very worried [32,33].

Participants' depression was assessed using a modified version of the 20-item Hopkins Symptom Checklist Depression Scale [34,35]. One item regarding sexual interest and pleasure was removed from the questionnaire due to a cultural taboo to express opinions regarding sex openly in China [32]. The remaining 19 items were rated on a 5-point scale ranging from 0= not at all to 4= extremely. Details about the risk perceptions and depression questionnaires have been published [32,33].

In this study, the internal reliability for knowledge questionnaire was 0.86, for risk perception was 0.70, and for depression was 0.96. The inclusion criteria were medical professionals who worked in the hospital and were willing to answer the survey.

2.2 Data Collection Procedure

Data were collected through an online questionnaire in Nanjing, China, in February 2020. The hospital staff contacted potential participants and informed them that clicking the final "Submit" button would affirm their consent to participate in the study. Instructions on how to fill out and submit the questionnaire online were provided. All personal information, such as the participants' names, addresses, and phone numbers, were not collected to protect the participants' privacy and confidentiality. The questionnaire was accessible to only the research team.

2.3 Data Analysis

Descriptive statistics (mean, SD, and frequency) were used to analyze the participants' characteristics. The differences among various study variables (knowledge, risk perceptions, and depression) between groups were explored by inferential statistics (Chi-square tests, correlations, and t-tests). All statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 27.0. The level of significance was set at α =0.05.

3. RESULTS

3.1 Demographic Data of Participants

A total of 496 hospital professionals participated in this study, with 366 nurses (group 1) and 130 other professionals (radiology technicians, laboratory technicians, therapists, group 2). The mean age of the participants was 32.58 $\pm$ 8.17. Among them, 13.3% were males, and 13.1% had experience taking care of COVID-19 patients. Chi-square tests indicated no differences in gender or experiencing taking care of COVID-19 between these two groups.

3.2 Knowledge Related to COVID-19

The mean correct answer rate of knowledge for group 1 was 76.42%, and group 2 was 73.94%. T-tests and mean scores of the five factors and the total mean knowledge score between group 1 and group 2 were presented in Table 1. From table 1, we can see that there were significant differences in total mean knowledge score and mean scores in four out of five subscale scores. All significant differences in scores showed that group 1 was higher than in group 2, except for factor 5.

3.3 Risk Perception

Group differences in perceived risk of contracting COVID-19 and experiencing other adverse events were analyzed using t-tests and presented in Table 2. The highest perceived risk scores in both groups were contracting influenza. The second highest was scores on COVID-19 and H1N 1 the third. Significant differences between these two groups were found in scores of contracting these three infectious diseases, with group 1 higher than group 2.

T-tests were also used to analyze the perceived risk of deaths due to COVID-19 and other adverse events between group 1 and group 2. Significant differences were found between these two groups in death due to COVID-19, car, home, and food accidents. No difference was found in the rest adverse events (Table 3).

Participants' worries about contracting COVID-19 themselves (self), their family members contracting COVID-19 (family), the spread of COVID-19 to the areas in which they live (place), and the likelihood of others contracting COVID-19 (others) were analyzed using t-tests and presented in Table 4. The results showed that group 1 worried more than group 2.

3.4 Depression

Mean scores of depressions were 36.46 $\pm$ 15.09 for group 1 and 30.71 $\pm$ 13.23 for group 2. A significant difference in depression scores was found between these two groups, with group 1 higher than group 2 (t=3.85, p < .000).

Table 1. The t-tests and mean scores of the five factors and the total mean knowledge score between nurses (Group 1) and other professionals (Group 2)

	G1	G2	t-test	p-value
Factor 1	7.07 $\pm$ .87	6.99 $\pm$ 1.15	0.98	.327
Factor 2	2.28 $\pm$ .75	2.11 $\pm$ .99	2.19	.030*
Factor 3	3.54 $\pm$ 1.16	3.28 $\pm$ 1.49	2.14	.034*
Factor 4	1.37 $\pm$ .76	1.23 $\pm$ .82	2.40	.017*
Factor 5	0.27 $\pm$ .44	0.44 $\pm$ .50	-3.45	.001**
Total mean score	14.52 $\pm$ 2.30	14.05 $\pm$ 3.59	2.35	.019*

*P<0.05; ** p<0.01*

Table 2. Perceived risk of contracting COVID-19 and experiencing other adverse events between group 1 and group 2

Perceived risk	G1 mean $\pm$ SD	G2 mean $\pm$ SD	t-test	p-value
1-influenza	3.61 $\pm$ 1.02	2.92 $\pm$ 1.28	4.83	<.001***
2-COVID-19	2.90 $\pm$ .99	2.37 $\pm$ 1.18	4.19	<.001***
3-H1N1	2.70 $\pm$ .99	2.29 $\pm$ 1.12	3.41	.001**
4-Car accident	2.38 $\pm$ .97	2.03 $\pm$ .99	3.25	.001**
5-Home accident	2.29 $\pm$ .95	1.99 $\pm$ .99	2.78	.006*
6-Food accident	2.24 $\pm$ .98	2.02 $\pm$ .96	1.91	.057
7-Cancer	2.13 $\pm$ .93	2.01 $\pm$ 1.01	1.03	.304
8-Heart disease	2.09 $\pm$ .98	1.92 $\pm$ .99	1.52	.129
Total risk	20.34 $\pm$ 6.10	17.75 $\pm$ 7.28	3.18	.002**

*P<0.05; **p<0.01; ***P<0.001*

Table 3. Perceived risk of death due to COVID-19 and other adverse events between group 1 and group 2

Perceived risk of death	G1 mean $\pm$ SD	G2 mean $\pm$ SD	t-test	p-value
1-COVID-19	2.34 $\pm$ 1.09	2.00 $\pm$ 1.02	2.73	.007**
2-Car accident	2.22 $\pm$ .99	1.91 $\pm$ .98	2.76	.006**
3-Home accident	2.15 $\pm$ .98	1.82 $\pm$ .92	2.97	.003**
4-H1N1	2.13 $\pm$ .99	1.93 $\pm$ .96	1.74	.083
4-Influenza	2.13 $\pm$ 1.09	1.94 $\pm$ 1.01	1.48	.140
6-Food accident	2.06 $\pm$ .97	1.81 $\pm$ .91	2.35	.019*
7-Heart disease	2.02 $\pm$ .99	1.85 $\pm$ .94	1.56	.119
8-Cancer	1.99 $\pm$ .97	1.85 $\pm$ .95	1.28	.201
Total Risk	17.04 $\pm$ 7.08	15.13 $\pm$ 7.10	2.35	.019*

*P<0.05; **p<0.01; ***P<0.001*

Table 4. Worries about the self, family, place, others contracting with COVID-19 between group 1 and group 2

Worries	G1 mean $\pm$ SD	G2 mean $\pm$ SD	t-test	p-value
Worry self	3.37 $\pm$ 1.00	2.79 $\pm$ 1.21	4.50	<.001[***]
Worry family	3.62 $\pm$ 1.02	2.90 $\pm$ 1.30	5.16	<.001[***]
Worry place	3.55 $\pm$ .96	2.92 $\pm$ 1.29	4.71	<.001[***]
Worry others	3.59 $\pm$ .89	2.92 $\pm$ 1.27	5.01	<.001[***]
Total worry	14.13 $\pm$ 3.31	11.52 $\pm$ 4.84	5.14	<.001[***]

[*]$P<0.05$；[**]$P<0.01$；[***]$P<0.001$

Correlations among demographic data, knowledge, risk perceptions, and depression were analyzed. Depression had positive correlations with the three parts of risk perceptions (p< .001). The rest did not correlate with one another.

4. DISCUSSION

4.1 Knowledge Related to COVID-19

This study compared COVID-19 related knowledge, risk perceptions, and depression differences between two hospital professionals: nurses vs. other professionals. Participants in this study obtained moderate average correct answer rates of COVID-19 knowledge (76.42% vs. 73.94%). Using the same questionnaire, the pregnant women in Lee et al.'s study [32] had similar correct answer rates. However, using a 15-item COVID-19 related knowledge questionnaire, it was reported that Iranian medical students had a high average correct answer rate of 86.96% [11], which was a little higher than the participants in our study. Furthermore, studies from Cyprus and Pakistan reported much higher correct answer rates of COVID-19 knowledge [9,10]. Although the questions were not the same, it is an alarming sign, meaning that it is critical to improving the knowledge of hospital professionals in our study. Educational interventions are needed to familiarize themselves with advanced knowledge related to COVID-19 to serve their patients better and contain the rapid spread of the infection.

It is pleasant to see that other professionals had the same knowledge level on wearing masks (factor 1) with nurses. Three important ways to slow the spread of COVID-19 are wearing a mask, staying at least 6 feet from others, and washing hands frequently [17]. It may be due to the government and mass media continuing to urge the public to reduce the spread by wearing masks, and the nature of their working environment was perceived to place other professionals at risk of infection, so they were equally aware of the importance of wearing a mask.

It is not surprising that the results of this study showed that nurses had higher knowledge main total score and three subscale scores (factor 2, 3, & 4) than other professionals. Although COVID-19 is a new contagious disease, the basic principles and theories to prevent contracting the disease are similar to other infectious respiratory diseases. With formal medical education of infection control, nurses can easily use those principles and theories as guidance when facing the challenges to provide care to COVID-19 patients, especially when infection control measures within the healthcare system were not totally in place yet in early February 2020, knowledge acquisition from credible sources could be crucial at this stage.

However, both groups had low mean scores in factor 4, which is worth further investigating. Factor 4 had two questions related to COVID-19 knowledge on pregnant women: one for vertical transmission and another for susceptibility. As for the vertical transmission, at this moment, there is no evidence to support that a fetus or baby can be infected with the virus from a mother with COVID-19 during pregnancy or delivery. Scientists have not found any active virus in fluid samples around the baby in the uterus or breastmilk [21,22,24]. However, in this present study, we found that 31.5 % (Factor 4) of nurses thought that there was a possibility that pregnant women could transmit the COVID-19 to their fetus. Interestingly, Lee et al. reported that 39.5 % of pregnant women in their study also agreed that the possibility of transplacental transmission [32].

As for susceptibility, although at the beginning of the COVID-19 pandemic, several researchers mentioned that there is not enough evidence to support the claim that pregnant women were more susceptible to COVID-19 than the general

population [22,24], a recent report showed that the risk for severe illness from COVID-19 and death in pregnant population was higher than non-pregnant population [21]. Pregnant women often obtain knowledge about COVID-19 from healthcare professionals. It is essential for nurses in our study to understand this disease to offer correct information to their patients [13]. For a new disease like COVID-19, the more research emerges, the more healthcare professionals should learn about its impact on pregnancy. Considering that some participants in our study are still uncertain about pregnant women's transplacental transmission and susceptibility towards COVID-19, more education is needed. The education can also benefit pregnant nurses who may work in the frontline.

Unexpectedly, nurses had lower knowledge scores on factor 5 than other professionals in this study. Factor 5 had one question and was related to the spreading of COVID-19 by pets. As of January 2021, the World Organization for Animal Health has not reported any evidence that pets can spread COVID-19 to humans, although some animals (cats, dogs, minks, gorillas, et al.) can be infected by the disease [19,20]. However, the report of some farmers who might have contracted COVID-19 from minks in the Netherlands is worrisome, which might contribute to why many nurses in this study agreed that pets might be one source of spreading the virus. Further information on animal-to-human transmission is needed.

4.2 Risk Perceptions

Both groups perceived their risks of contracting influenza and H1N1 were higher than the risks of contracting COVID-19 (Table 2). A probable explanation may be attributed to the timing of data collection. The data were collected at the beginning of the COVID-19 pandemic, while the confirmed cases were about 80,000 globally. Before the pandemic, the CDC has reported that there have been 9–45 million infected influenza cases, 140,000–810,000 hospitalizations, and 12,000–61,000 deaths annually since 2010 [32]. Our data demonstrated that participants' beliefs reflected the statistics as reported by the CDC. The risk perceptions might be different if the data were collected more recently.

Understandably, nurses perceived their risks to contract COVID-19, influenza, and H1N1 to be higher than other professionals; after all, the formers offer direct care to patients and often

have more close contact with patients with COVID-19, influenza, and H1N1. The result is consistent with Dryhurst et al.'s finding that people with direct contact with the COVID-19 virus or other influenza viruses would perceive more risk than people without direct contact [12]. As a new contagious disease, there was not much information about how to treat COVID-19 at the onset of this pandemic; it is understandable that nurses perceived their risk of dying from COVID-19 to be higher than other professionals. However, it is surprising that they perceived their risks to die from a car, home, and food accidents also higher than other professionals. The possible explanation might be from nurses' working characteristics. It is acknowledgeable that nurses worked extended work shifts, including working at night, which makes them experience shorter sleep durations, and difficulties remaining awake at work, which increased the likelihood of drowsy driving and traffic accidents [31]. Many nurses stated that they struggled to stay awake when driving home from work [30]. The COVID-19 pandemic may make their working situation worse. Hospital policymakers need to pay attention and implement strategies to prevent healthcare professionals from drowsy driving to ensure public safety.

One of the aims of this study was to compare the differences in risk perceptions related to COVID-19; further discussing the risk perceptions of home and food accidents is out of this study's purpose. However, we recommend that interested researchers conduct further investigation since few publications mention the relationship between the perceived risk of healthcare professionals and home and food accidents.

Nurses showed more worries about the self, family, place, others contracting with COVID-19 than other professionals in our study, which were consistent with other studies. Rathore et al. stated that when asking nurses their concerns related to COVID-19 at a personal level, 72% reported that they feared the risk of infection to themselves and their family [6]. Some of them worried about the essential food supply and housing during a lockdown. Transportation to and from the workplace during lockdown was also a big concern for nurses. The medical students in Taghrir et al.'s study showed moderate risk perception of being infected with COVID-19 [11]. Healthcare professionals' concern is not unfounded. Nguyen et al. did a

large prospective, observational cohort study [28]. They indicated that the incidents of a positive COVID-19 test are higher in frontline healthcare workers than in the general community and could account for 10–20% of all related diagnoses because of their close personal exposure to patients with COVID-19. Therefore, hospital systems need to develop appropriate strategies to relieve hospital professionals' worries about contracting COVID-19.

4.3 Depression

Several studies revealed that the high infection and mortality rates of COVID-19 had devastated people's mental health. The associated restrictions made the situation worse, especially quarantine and its effects on many people's usual activities, routines, or livelihoods. Physically isolating combined with extensive news coverage on the pandemic and an unknown future made people feel lonely and depressed. It is not surprising that this study found that group 1 had a higher depression score than group 2. Except following those restrictions, nurses need to take care of patients with COVID-19 and other diseases. Mo et al. mentioned that nurses who fight against COVID-19 were generally under pressure [29]. The study done by Rathore et al. found that 16% of participants were anxious all the time, 11% feared all the time, and 12% had stress all the time while caring for patients with COVID-19 [6]. The positive relationship between risk perceptions and depression in this study provided further evidence that high worry about COVID-19 was closely related to high levels of depression. Hospital leaders should pay attention to nurses' mental health and initiate proper strategies to reduce their depression related to COVID-19.

5. CONCLUSION

More education is needed to improve hospital professionals' knowledge of COVID-19. Since nurses' risk perceptions of contracting COVID-19 and dying from this deadly infection were higher than other professionals; further studies might help researchers understand the underlying reasons better. Appropriate hospital strategies may be initiated to reduce nurses' depression related to COVID-19. Further investigation is needed since few publications mention the relationship between the perceived risk of hospital professionals and home and food accidents.

6. LIMITATIONS

The primary limitation to the generalization of the study results is the timing of data collection. The data were collected at the beginning of the pandemic, so the results may not represent what happened during the more advanced pandemic phases. Further research is needed before the results can be generalized. Secondly, although our participants were from three affiliated hospitals of a medical university, they were not representatives of China's entire hospital professionals. Further research is needed to determine whether the current results can be generalized to the broader hospital professionals in China or other countries. Participants who voluntarily joined this study might affect the representativeness of the finding as well.

CONSENT

Data were collected through an online questionnaire in Nanjing, China, in February 2020. The hospital staff contacted potential participants and informed them that clicking the final "Submit" button would affirm their consent to participate in the study.

ETHICAL APPROVAL

The study was approved by the Ethics Review Board of a medical university located in Nanjing, Jiangsu province, China (Approval number: 2020-SR-005). Participants were from three affiliated hospitals of the university.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

Appendix 1. Items used to assess knowledge about COVID-19

Item Correct	Answer G1	Rate % G2
Factor 1		
1. If you are healthy, you need to wear a mask only if you are taking care of a person with suspected COVID-19.	94%	86%
2. You should wear a mask if you have been coughing or sneezing.	78%	81%
3. Masks are effective only when you frequently clean your hands with alcohol-based hand sanitizer or soap and water.	44%	51%
4. Before wearing a mask, you should clean your hands with alcohol-based hand sanitizer or soap and water.	98%	96%
5. You should cover your mouth and nose with a mask and make sure that there are no gaps between your face and the mask.	99%	96%
6. You should avoid touching the mask while using it; if you end up touching the mask, you should clean your hands with alcohol-based hand sanitizer or soap and water.	96%	95%
7. You should replace a mask with a new one as soon as it becomes damp, and you should not reuse single-use masks.	99%	98%
8. You should remove the mask from behind (i.e., you should not touch the front of mask). You should immediately discard the used mask in a closed bin and clean your hands with alcohol-based hand sanitizer or soap and water.	99%	97%
Factor 2		
9. Ultraviolet lamps should be used to sterilize hands or other areas of the skin.	70%	72%
10. Thermal scanners can detect those who have not developed a fever.	96%	82%
11. Spraying alcohol or chlorine all over your body will kill the novel coronavirus.	61%	57%
Factor 3		
12. It is safe to receive a letter or package within China.	46%	39%
14. Vaccines against pneumonia can protect you from COVID-19.	52%	54%
15. Eating garlic can protect you from COVID-19.	79%	75%
16. Antibiotics are effective in preventing and treating COVID-19.	80%	72%
17. Currently, there are specific medicines that can be used to prevent or treat COVID-19.	97%	88%
Factor 4		
18. The vertical transmission of COVID-19 from a pregnant woman to her fetus has been confirmed.	69%	57%
19. Pregnant women are more susceptible to COVID-19 than the general population.	69%	66%
Factor 5		
13. Pets (dogs or cats) can't spread COVID-19.	27%	44%