

Psychological and behavioral responses of nursing interns from 12 Chinese universities during the COVID-19 epidemic: a knowledge, attitude and practice survey

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Abstract

Background: Coronavirus disease 2019 (COVID-19) has spread globally and resulted in the COVID-19 pandemic worldwide. To depict the psychological and behavioral responses, and knowledge of nursing interns who are facing the COVID-19 epidemic in China, we conducted a knowledge, attitude, and practice (KAP) survey using a convenience sample in the First People's Hospital of Lianyungang, Kangda College of Nanjing Medical University, Jiangsu Province, China.

Methods: A combination of a face-to-face questionnaire survey and an online survey was used for nursing interns from 12 Chinese universities. The Symptom Checklist 90 was used to investigate anxiety and depression of the nursing interns during the COVID-19 epidemic. Self-designed questionnaires were used to investigate behavioral responses, COVID-19-related knowledge, and preventive measures.

Results: During the COVID-19 epidemic, the mean score of anxiety of 237 surveyed nursing interns were not statistically significantly different with that of the Chinese norm (1.42 vs. 1.39, $P = 0.354$). However, the mean score of depression of them were lower than that of the Chinese norm (1.22 vs. 1.50, $P < 0.001$). However, no statistically significant difference in the anxiety or depression was found between demographic subgroups. The most common way for the nursing interns to seek for help was asking for instructor or other medical professionals (89.45%). When the nursing interns had suspected symptoms, they will most likely go to the hospital for treatment (97.89%). The nursing interns have good knowledge regarding the origin and prevention of COVID-19 (correct percentage $> 94\%$), however less knowledge regarding treatment and incubation (correct percentage $< 10\%$).

Conclusion: The nursing interns showed relative lower depression in the face of COVID-19 public health emergencies, and took proper preventive measures during the epidemic, however, were lack of certain epidemiology knowledge about COVID-19.

Background

Coronavirus disease 2019 (COVID-19), as a global public health emergency, is an infectious disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)[1]. The disease broke out in Wuhan, Hubei, China in December 2019, and has spread globally and resulted in the COVID-19 pandemic [2, 3]. According to the National Health Commission of China, till February 29, 2020, a total of 79,824 confirmed COVID-19 cases were reported in China, with 41,625 cured and 2,870 died [4]. The main source of infection are the COVID-19 infected patients, while the asymptomatic infected people may also be a source of infection [5]. Two main routes of COVID-19 transmission are respiratory droplets and person-to-person contact [6]. When exposed to high concentration aerosols for a long time in a relatively closed environment, there is the possibility of aerosol transmission [7]. China has made great efforts to effectively curb the COVID-19 spreading and reduced its harm to public health by a comprehensive strategy, including early detection, early diagnosis, and early treatment for the infected cases, standardized management of potentially exposed persons, guidance for the public about personal

protection, and strict disinfection for specific places. Experience from China provides a successful example to prevent and control against the spreading of COVID-19 and to treat the infected patients [8].

Medical health personnel face the challenge of a higher risk of infection when they treat COVID-19 patients. It has been reported that some physicians and nurses were infected when they treated COVID-19 patients [9]. Nursing interns have gained certain clinical ability and knowledge of infection prevention after years of training and clinical practice. However, due to limited knowledge of COVID-19, a completely new virus to human, and limited clinical skills and experience, nursing interns tend to have higher risk of infection when they care for COVID-19 patients during the outbreak. Lack of knowledge about infection may not only increase the risk of infection but also cause anxiety, depression, and fear among nurses who care for patients with confirmed or suspected infection [10, 11]. Nursing interns have to work in clinical areas outside their usual practice or unfamiliar surroundings during a COVID-19 epidemic. Their knowledge, attitude, and psychological responses may affect their practice substantially, and are critical to provide timely, necessary, and quality care for COVID-19 patients. Our study aimed to depict the psychological and behavioral responses, and knowledge of the nursing interns who are facing public health emergency such as COVID-19 epidemic, which may provide useful information to design relevant training program, and to improve their nursing skills and consciousness to take effective measures to prevent and control COVID-19 infection in their work.

Methods

Study design and participants

This is a knowledge, attitude and practice (KAP) questionnaire survey, and was conducted in the First People's Hospital of Lianyungang, Kangda College of Nanjing Medical University, Jiangsu Province, China, China between February 15th and 29th, 2020. As a descriptive and explorative study, the study used a convenience sampling method, and no predefined power and type I error were used for sample size determination [12]. We used a combination of a face-to-face questionnaire survey and an online survey using the Questionnaire Star (Ranxing Technology Company Ltd., Changsha, China). The target study population was all the nursing interns who were conducting their internship at the First People's Hospital of Lianyungang during the COVID-19 epidemic period and had at least eight months of clinical practices. In total, we sent the questionnaire to 240 qualified nursing interns who were from 12 universities of China. Two hundred and thirty-seven nursing interns returned the questionnaires. We got 237 valid questionnaires with a response rate of 98.8%. The study was approved by the Ethics Committee of First People's Hospital of Lianyungang (Approval number: 20200215) and informed consent was obtained from all the participants.

Structure of the survey instrument

The questionnaire used in the survey consists of three parts. The first part is a brief introduction to the survey, including the aim of the study and guidance of how to fill in questionnaire.

The second part is demographic information of the respondent, which includes sex, age, religion, educational background, area of residence during the epidemic, hometown, and whether the respondent has relatives or friends who were infected.

The third part are psychological and KAP questions, including psychological responses, behavioral response, knowledge, and preventive measures of COVID-19 during the epidemic period.

Psychological response questions

Psychological responses of the nursing interns were investigated using the Symptom Checklist 90 (SCL-90). The SCL-90 is a widely used mental health assessment scale with good reliability and validity, which is mainly used to investigate the existence and severity of certain psychological symptoms in a group of people over a period of time. It is designed to measure the intensity of nine different symptoms, including somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, psychoticism, and global distress index [13, 14].

The SCL-90 includes 90 factors of distress and the respondents may give response to each factor using Likert scale 0–4 points corresponding to five levels: 0 = not at all; 1 = a little; 2 = moderately; 3 = quite a bit; 4 = extremely. The higher the score is, the more serious is a psychological response that the respondent presents [15]. The SCL-90 may also be used to estimate incidence of each symptom during a certain period. In the current study, we only focused on the symptoms anxiety and depression.

The factors of anxiety used in SCL-90 are 10 factors as following:

2) nervousness or shakiness inside; 17) trembling; 23) being suddenly scared for no reason; 33) feeling fearful; 39) heart pounding or racing; 57) feeling tense or keyed up; 72) spells of terror or panic; 78) feeling so restless you could not sit still; 80) feeling familiar things strange or unreal; 86) having thought to get things done quickly. The Cronbach's reliability α of the 10 items for anxiety was 0.87 [16].

The factors of depression are 13 factors as following:

5) loss of sexual interest/pleasure; 14) feeling low in energy - slowed down; 15) suicidal thoughts; 20) crying easily; 22) feelings of being trapped; 26) blaming yourself for things; 29) feeling lonely; 30) feeling blue; 31) worrying too much about things; 32) feeling no interest in things; 54) feeling hopeless about the future; 71) feeling everything is an effort; 79) feeling of worthlessness. The Cronbach's reliability α of the 13 items for depression was 0.91 [15].

The total score of anxiety or depression was converted into a percentile in later analysis. The higher value of the convert score indicates worse psychological response [17].

Behavioral response, knowledge, and practice questions

According to the issues that are generally concerned during COVID-19 epidemic, we designed 3 questions for behavioral response as following: When the epidemic is approaching, 1) Whom would you like to ask

for advices/help first? 2) What will you do if you present suspected symptoms? 3) What kind of information that you will pay more attention to? The respondents may select multiple choices that we provide or write down their own answers.

The questions for COVID-19-related knowledge were designed according to the Diagnosis and Treatment Protocol for Novel Coronavirus Pneumonia (the sixth edition) and the Prevention and Control Strategy for New Coronavirus Infection (the third edition) published by the National Health Committee of the People's Republic of China [18, 19]. There are in total of 17 questions, including epidemiological characteristics of COVID-19 (5 questions), source and transmission route of infection (2 questions), clinical manifestations (1 question), test/diagnosis (2 questions), treatment (1 question), prevention (5 questions), and patient care (1 question). The nursing interns may answer True or False for each question. A correct answer was scored 1 and a wrong one was scored 0. A higher total score of the answers indicates better knowledge of COVID-19.

Taking timely and correct preventive measures may prevent self-infection and virus transmission to other people. For practice, we used the 13 recommended preventive measures including not meeting with friends or eating together, and not using public transportation etc. to prevent COVID-19 infection and transmission [19]. The participants may get 1 score if she/he took one measure during the epidemic, and a higher total score of the 13 measures means that she/he took better individual prevention during the COVID-19 epidemic.

In a pilot study, we tested the KAP questions among 20 interns who were not included in the formal survey. The content validity and the Cronbach's reliability α were 0.92 and 0.87 for knowledge-related questions, and 0.91 for 0.84 for preventive measure questions, respectively.

Statistical Analysis

The data obtained was managed and analyzed using statistical software SPSS version 20.0 (IBM Co., Ltd., Armonk, New York). Frequency and percentage were used for count data. Mean \pm standard deviation (SD) was used for continuous data. The Student t-test or analysis of variance (ANOVA) were used for comparing mean values between groups. A two-sided p-value less than 0.05 was considered as statistically significant.

Results

Demographic characteristics and psychological responses

The demographic characteristics of the studied nursing interns are shown in Table 1. The average age of the interns is 20.9 (\pm 1.5) years, and most of them (92.0% of 218) are female. Only one (0.4%) interns was graduated or had religion or had COVID-19-infected relatives and/or friends (Table 1).

Table 1

Demographic characteristics and scores of psychological responses (self-rating symptom scale n = 237)

Variables	N (%)	Anxiety			Depression		
		Mean \pm SD	<i>t</i> or <i>F</i>	<i>p</i>	Mean \pm SD	<i>t</i> or <i>F</i>	<i>p</i>
Gender			0.42	0.672		0.24	0.810
Male	19(8.0)	1.48 \pm 0.61			1.62 \pm 0.63		
Female	218(92.0)	1.42 \pm 0.61			1.58 \pm 0.58		
Age (years)			0.24	0.788		1.03	0.358
≤ 20	101(42.6)	1.39 \pm 0.56			1.61 \pm 0.61		
21 ~ 22	175(79.5)	1.44 \pm 0.62			1.60 \pm 0.60		
≥ 23	32(13.5)	1.44 \pm 0.68			1.45 \pm 0.24		
Religion			NA			NA	
Yes	1(0.4)	3.00 \pm 0.00			1.90 \pm 0.00		
No	236(99.6)	1.42 \pm 0.60			1.58 \pm 0.46		
Education level			0.47	0.637		1.16	0.247
Junior undergraduate	181 (76.4)	1.41 \pm 0.60			1.55 \pm 0.53		
Senior undergraduate	55(23.2)	1.45 \pm 0.59			1.65 \pm 0.63		
Graduated	1 (0.4)	1.30 \pm 0.00			1.40 \pm 0.00		
Area of residence			0.38	0.703		0.06	0.951
Hospital	17 (7.2)	1.48 \pm 0.62			1.58 \pm 0.62		
Home	220(92.8)	1.42 \pm 0.61			1.59 \pm 0.57		
Location of home			0.44	0.640		1.79	0.169

Note: SD = standard deviation

Variables	N (%)	Anxiety			Depression		
		Mean ± SD	<i>t</i> or <i>F</i>	<i>p</i>	Mean ± SD	<i>t</i> or <i>F</i>	<i>p</i>
City	54 (22.8)	1.48 ± 0.62			1.69 ± 0.70		
Town	78(32.9)	1.38 ± 0.59			1.60 ± 0.64		
Countryside	105 (44.3)	1.42 ± 0.61			1.52 ± 0.42		
Having infected relatives and/or friends			NA			NA	
Yes	1(0.4)	3.00 ± 0.00			3.90 ± 0.00		
No	236(99.6)	1.42 ± 0.60			1.58 ± 0.56		
Note: SD = standard deviation							

Student t-test for two groups and ANOVA for three groups.

During the COVID-19 epidemic period, the nursing interns presented statistically lower depression scores compared to those of the Chinese norm (mean score 1.22 ± 0.58 vs. 1.50 ± 0.59 , $p < 0.001$) (Table 2) [20]. For anxiety (1.42 ± 0.61 vs. 1.39 ± 0.43 , $p = 0.354$), it did not show statistically significant difference.

Table 2
Anxiety and depression scores of the nursing interns and the norm in China

Items	Nursing interns (n = 237)	Norm in China (n = 1388)	<i>t</i>	<i>p</i>
Anxiety	1.42 ± 0.61	1.39 ± 0.43	0.93	0.354
Depression	1.22 ± 0.58	1.50 ± 0.59	6.77	0.000

In the demographic subgroup analysis, for anxiety and depression, there was no statistically significant difference observed (Table 1). Even so, compared to the junior undergraduates or the interns who live in countryside, the senior undergraduate or the interns who live in cities show higher anxiety and depression scores (Table 1).

Behavioral responses

During the COVID-19 epidemic period, the most common way for nursing interns to seek for advices/help is instructor or other medical professionals (89.5%); followed by family, friends or classmates (58.7%); and Social media (42.6%). If they had suspected symptoms, the nursing intern would most probably go to

the hospital for treatment (97.9%) or consult with their instructor or other professionals (66.2%). Few of them would stay at home and treat it by themselves (2.1%). None of them would go to other cities for safety or ignore it. During the epidemic, they paid more attention to people with suspected symptoms (87.8%) and preventive measures (86.9%), followed by the number of suspected and/or confirmed patients (84.0%), and research on vaccine and medication (79.8%). But some of them also paid more attention to and daily necessities (53.2%) (Table 3).

Table 3
Behavioral response to COVID-19 epidemic (n = 237)

Items	N	Percentage (%)
When the epidemic is approaching:		
Whom would you like to ask for advices/help first?		
Instructor or other medical professionals	212	89.5
Family, friends or classmates	139	58.7
Social media	101	42.6
What will you do if you present suspected symptoms?		
Consult instructor or other medical professionals	157	66.2
Go to the hospital for treatment	232	97.9
Stay at home and treat it by myself	5	2.1
Go to other cities for safety	0	0.0
Ignore	0	0.0
What kind of information that you will pay more attention to?		
Preventive measures	206	86.9
The number of suspected/confirmed cases	199	84.0
Research on vaccine or medication	189	79.8
Anyone with suspected symptoms around	208	87.8
Rising prices and shortage of daily necessities	126	53.2

COVID-19-related knowledge

The average correct score of the nursing interns' knowledge about COVID-19 is 14.81 ± 0.82 , or averagely they answered 15 of the 17 (88.2%) questions correctly. The most correctly answered items are "To prevent COVID-19 infection, people need to wear a face mask, wash hands frequently, and ventilate rooms." (100.0%) and "For the residential communities and similar places where transmission or

contagious epidemic have occurred, disinfection and control measures such as restriction on gathering and entering should be taken.” (100.0%). The least correctly answered items are “According to epidemiological investigations, the incubation period of COVID-19 is 3–14 days, mostly 3–7 days.” (5.9%) and “COVID-19 can be treated by antibiotics.” (11.4%). The correct percentages of other question range from 94.5–99.2% (Table 4).

Table 4
The nursing interns' knowledge about COVID-19 (n = 237)

Items (correct answer: T, true; F, false)	Correct answers	
	N	Percentage (%)
COVID-19 is a respiratory infectious disease. (T)	229	96.6
Some COVID-19 patients have been detected in Wuhan, Hubei Province. (T)	235	99.2
2019-nCoV has more than 85% homology with bat SARS-like coronavirus (bat-SL-CoVZC45). (T)	232	97.9
2019-nCoV is sensitive to ultraviolet rays and heat. 56 ° C for 30 minutes, and lipid solvents such as ether, 75% ethanol, chlorine-containing disinfectant, peracetic acid, and chloroform can effectively deactivate the virus. (T)	224	94.5
The main symptoms of COVID-19 patients are fever, dry cough, and fatigue. A few patients have symptoms of nasal congestion, runny nose, sore throat, myalgia, and diarrhea. (T)	233	98.3
COVID-19 is transmitted by droplets and close person-to-person contact through respiratory tract.(T)	233	98.3
The main transmission source of COVID-19 is 2019-nCoV-infected patients. (T)	229	96.6
According to epidemiological investigations, the incubation period of COVID-19 is 3–14 days, mostly 3–7 days. (F)	14	5.9
COVID-19 patients had normal or decreased total white blood cells in peripheral blood, decreased lymphocyte count, and positive sputum nucleic acid test. (T)	229	96.6
COVID-19 patients have multiple patchy and ground glass shadows on the chest image, and lung consolidation may occur in severe cases. (T)	230	97.1
Isolation and medical observation should be taken for the people who have close contact with COVID-19 patients, and body temperature should be measured at least twice a day. (T)	229	96.6
To prevent COVID-19 infection, people need to wear a face mask, wash hands frequently, and ventilate rooms. (T)	237	100.0
For the residential communities and similar places where transmission or contagious epidemic have occurred, disinfection and control measures such as restriction on gathering and entering should be taken. (T)	237	100
When caring for patients with suspected or confirmed COVID-19 infection, nurses should wear N95 mask or surgical mask, protective clothing and eye glasses, face shield, and other necessary protective equipment. (T)	233	98.3
COVID-19 can treated by antibiotics. (F)	27	11.4
Medical staff should strengthen hand hygiene, and may use alcohol-based quick-drying hand disinfectants or wipe hands with 75% ethanol directly. (T)	230	97.1

Items (correct answer: T, true; F, false)	Correct answers	
	N	Percentage (%)
Medical or healthcare institutions should clean and disinfect medical equipment, contaminated items and surfaces, and floors sufficiently.(T)	229	96.6

Preventive measures

The average score of the nursing interns' preventive measures against COVID-19 infection is 11.00 ± 0.80 , or averagely they took 11 of the 13 (84.6%) recommended measures. The most adopted measure are "I wear a mask when I go out or work in the hospital." (100.0%), "I follow the progress of the epidemic every day from TV, internet, etc." (100.0%), and "If I had a fever and respiratory symptoms, I will consult a doctor in time and go to the hospital." (100.0%). The least adopted measures are "Every time when I wash my hands I follow the recommended seven-step method." (88.6%) and "I disinfect door handles and object surfaces frequently." (90.3%). Other preventive measures are adopted by at least 96.6% of the interns during the epidemic (Table 5).

Table 5
Preventive measures against COVID-19 infection (n = 237)

Items (answer: Yes or No)	Yes	
	N	Percentage (%)
I don't meet or eat with friends and classmates.	235	99.2
I avoid to use public transportation.	235	99.2
I avoid to go to crowded places such as shopping mall.	236	99.6
I wear a mask when I go out or work in the hospital.	237	100.0
I open the windows of my room twice a day for at least 30 minutes each time.	233	98.3
I avoid coughing or sneezing in public.	236	99.6
Every time when I wash my hands I follow the recommended seven-step method.	210	88.6
I wash my hands more often than usual.	232	97.9
I disinfect door handles and object surfaces frequently.	214	90.3
I follow the progress of the epidemic every day from TV, internet, etc.	237	100.0
I discuss with my family about how to prevent COVID-19 infection.	236	99.6
If I had a fever and respiratory symptoms, I will consult a doctor in time and go to the hospital.	237	100.0
I exercise at home to increase immunity.	229	96.6

Discussion

Although the new infectious disease COVID-19 caused some negative psychological responses like anxiety and depression among the nursing interns in our survey, their anxiety was not statistically different with that of normal Chinese people and the magnitudes of their depression were averagely lower than that of Chinese norm (Table 2). This is consistent with the findings from a previously published study, in which the researchers found that a new infectious disease could cause negative psychological responses such as anxiety, depression, fear, and panic among patients, their contactor, relatives and surrounding people [21]. The potential reason might be the lack of knowledge and understanding of the disease. As a new infectious disease, when COVID-19 appears, the country needs time to explore, understand, and learn its pathogenesis, transmission routes, preventive measures, and treatment methods. The public also needs time and information channels to learn relevant knowledge. During the lag time period when the infection cases increase, both the healthcare professionals and the public may worry about the infectious disease not being controlled in time, being infected, or unable to study, work, or live normally. In our study, the nursing interns had studied at medical universities for about two or three

years and practiced in the hospital for about eight months, therefore they showed certain basic medical knowledge and skill in the prevention. We should note that, when COVID-19 outbreaked, most of the nursing interns had been at home and did not take care for COVID-19 patients. It might contribute to the less risk of infection and lower mental stress.

Although no statistically significant difference, compared to the junior undergraduates, the senior undergraduates showed higher anxiety and depression scores (Table 1). The possible reason might be that the higher level of education of the interns, the better ability the interns may have to acquire and analyze necessary or relevant knowledge and information, to understand the situation, and know the risk. Therefore they may face the COVID-19 epidemic with more pressure. From Table 1, we also see that the interns who live in cities showed higher anxiety and depression scores. The possible reason might be that in China the large and top hospitals with high quality and complete facilities are mainly located in urban areas, and few are in suburban or countryside. When Chinese people are sick, they tend to visit large and top hospitals first [22, 23]. When people were diagnosed with COVID-19 infection, they would be transferred to the hospitals in cities. In this case, the number of infected patients would be more and more in cities. During the COVID-19 epidemic, the local and central Chinese government required people to stay at home as much as possible [19]. Furthermore, the public traffic was restricted or even canceled in order to prevent virus transmission and spread of the disease. Although internet hospitals or online medical services have been adopted more and more, where people can seek for help from medical professionals, being afraid of failure in getting proper diagnosis or treatment in a timely manner may cause the nursing interns' anxiety.

It is interesting that the nursing interns would like to seek for help from different resources. We also see that they prefer their instructors instead of family or friends, social media, or other medical professionals when they would like to ask for advices/help. Most of nursing interns would go to the hospital for treatment if they suspected symptoms (Table 3). The potential reason might be as following:

When the epidemic was approaching, few ($n = 17$) nursing interns who remained on duty received relevant training on the latest knowledge of COVID-19 in the hospital or department, and participated in the work against the epidemic together with their teachers or instructors. Therefore, when they appeared suspicious symptoms or wanted help they would ask for their teacher or other healthcare professional in the department or see a doctor in the hospital first. In this hospital, there is an online "Wechat" group including all nursing interns and their teachers and instructors who may discuss about COVID-19. Teachers and instructors may provide consultation immediately and continuously.[24] Nowadays the internet have been very popular in China, searching information from the internet is ubiquitous among adolescents [25]. The nursing interns can also learn the incidence and progress of the disease throughout the local area to the country, and extract related information and knowledge through various news medias and the internet, and change their behaviors or make corresponding reactions [26]. It is also a convenient and quick way to obtain necessary information or knowledge rather than bother their instructors. The COVID-19 epidemic began during the Chinese traditional Spring Festival holiday, 220 (92.8%) of the 237 nursing interns went back hometown for vacation, and the rest of the interns remained

on duty or did not went back to hometown due other reasons. Therefore, there are more nursing interns who selected seeking for advices/help online or from family or friends. But we should be aware of that there are many fake news and wrong information about COVID-19 on the internet[27], the instructors and teachers should teach the nursing interns how to distinguish between true and false information.

Because the nursing interns have certain medical knowledge, they pay more attention to preventive measures, the number of suspected patients and patients instead of other information (Table 3). When the local and national governments advocate and require all the people to stay at home, which will help the medical professional fight against the epidemic, at the same time, the governments have only taken measures to maintain the basic daily life of the people, for example, people can apply for medical masks and buy various living necessities through official online shops or platforms. For all these reasons, some nursing interns worry about probably rising prices and shortages of daily necessities in the future.

Regarding COVID-19-related knowledge, the nursing interns participating in the survey have a good grasp of the prevention, followed by sources of infection and routes of transmission, clinical manifestations, test/diagnosis, the guidelines for patient care, however have relative less knowledge on disease epidemiological characteristics of COVID-19 and treatment (Table 4). In order to find every suspicious patients, provide accurate treatment to every confirmed or suspected patients, and avoid the spreading of infection in medical institutions, for each latest updating of the diagnosis and treatment guidelines, the medical institutions provide relevant training to all the staff including both the nursing interns on duty and on vacation through various on-line, off-line, or on-site forms, and take immediate implementation and supervision [28]. However, there are still some nursing interns who took vacation at hometown and did not timely attend the latest training on the updated diagnosis and treatment guidelines issued by the National Health Commission of China.

We are glad to see that the nursing interns show a relative good score (84.6% recommended measures were adopted) for preventive behaviors (Table 5), which indicates that they had high compliance, and took good prevention and control measures during the COVID-19 epidemic. The research team believes that this is related to the national propaganda campaign and policies [28]. When the epidemic emerged, people were required to wear masks when going out and wash their hands when entering home. In residential communities and public places, there are volunteers who check and remind people to wear mask. Supermarkets and shops have set temporary regulation that customers should wear mask and those who did not follow the regulation would be rejected to enter [19]. The hospital (and other hospital also) requires washing hands with seven-step method and daily disinfection of floors and object surfaces, such as door handles, using chlorine-containing disinfectants or 75% alcohol [19]. Although the interns may conduct routine clearing when they stay at home, they cannot conduct disinfection as frequent as what they do in hospital. It might be the reason that the percentage of "Every time when I wash my hands I follow the recommended seven-step method." and "I disinfect door handles and object surfaces frequently." are low. In addition, because many nursing interns live at home, they may not have an appropriate place and venue to exercise, it might be the reason the percentage of "I exercise at home to increase immunity." is also low.

Limitation and strength

There are several advantages in our study. First, to our knowledge, this is the first KAP survey that investigated the psychological and behavioral responses of the nursing interns working during the COVID-19 epidemic, which provides first-hand information regarding the psychological and educational intervention for the nursing interns to both improve their caring for the COVID-19 patients and protect themselves. Second, although the survey used a convenience sample, the nursing interns are from 12 universities in China, which to some extent may be representative of COVID-19-related KAP of nursing interns at least at a regional level. Third, the study was conducted in the country where COVID-19 epidemic broke out first and has a large amount of confirmed patients, therefore its results may provide references for other countries.

However, there are also limitations in our study. First, considering the efficiency and response rate of the survey, we only investigated 2 of 9 psychological symptoms in the SCL-90, which cannot reflect the overall psychological responses of the nursing interns. Second, because the study was only limited within nursing interns due to the pedagogy-driven objectives, which cannot reflect the situation among the general nurse practitioners. Last but not least, the inherent limitation in the study design hinders the generalization of the results. A follow-up study using a representative sample with larger sample size is needed to provide deeper insights in this field.

Conclusion

Compared to the Chinese norm, the nursing interns from 12 Chinese universities showed lower depression in the face of COVID-19 public health emergencies. Although the nursing interns presented good prevention during the epidemic, to some extent they lack certain epidemiology knowledge of COVID-19. The battle against the COVID-19 seems a tough and long-term task worldwide, the nursing departments or schools should strengthen training for the interns to improve the compliance in preventing infection, face the public health emergencies calmly and deliberately, and implement effective and feasible measures for patient care.

Abbreviations

ANOVA: analysis of variance; COVID-19: Coronavirus disease 2019; KAP: knowledge, attitude, and practice; SARS-CoV-2: severe acute respiratory syndrome coronavirus 2; SCL: Symptom Checklist; SD: standard deviation;

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Committee of the First People's Hospital of Lianyungang (Approval number: 20200215) and informed consent was obtained from all the participants. There is no personal identification disclosed in our data.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Authors' contribution

X.F. designed the study; Y.C., H.Z., and Y.W. conducted the survey; Y.Z. analyzed the data; X.F. and Y.C. prepared the manuscript. All authors gave critical review and final approval for publication and agree to be accountable for all aspects of the work.

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Data availability

The data are publicly available at the Dryad data repository (doi: [10.5061/dryad.0p2ngf1wx](https://doi.org/10.5061/dryad.0p2ngf1wx), <https://datadryad.org/stash/share/DjuemkC5W9W0nCJIjyvvdGcAeKsRRyyHjDrZlftEaICY>).

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