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Factors Affecting Infection Control Behaviors to Prevent COVID-19: An Online Survey of Nursing Students in Anhui, China in March and April 2020

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Data Collection B
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Manuscript Preparation E
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Background: The pandemic of coronavirus disease 2019 (COVID-19) has become a major public health challenge all over the world. People's knowledge, attitudes, and preventive behaviors about diseases affect the degree of adherence to control measures. This study aimed to survey the affecting factors of COVID-19 prevention behavior among nursing students in China.

Material/Methods: Six-hundred thirteen nursing students in Anhui, China participated in an online survey from March 30 to April 5, 2020. The survey collected demographic information, electronic health (eHealth) literacy, COVID-19-related knowledge, attitudes, and prevention behavior data using descriptive analysis and multinomial logistic regression to analyze the data.

Results: The mean age of study participants was 20.88 years, of which 31.8% were male (n=613). Television (84.9%) and WeChat (79.6%) were the major sources of their information. Nursing students had good knowledge (14.68±2.83), had positive attitudes (4.03±0.59), had good practices (3.92±0.65), and had basic eHealth literacy (30.45±6.90). Nursing students with higher eHealth literacy (odds ratio [OR]=0.89, *P*<0.01), good knowledge (OR=0.89, *P*<0.01), and positive attitudes (OR=0.24, *P*<0.01) took more preventive behaviors. Students living in the countryside (OR=0.09, *P*<0.01) and of a young age (OR=1.51, *P*<0.05) seldom took preventive actions. Men, compared with women, were less likely to take preventive measures. (OR=1.44, *P*<0.05).

Conclusions: Good eHealth literacy, good knowledge, and a positive attitude were the most important variables that affected the prevention behavior against COVID-19. Targeted health education should be conducted for male students and students living in the countryside by providing reliable and effective online sources.

MeSH Keywords: Attitude • COVID-19 • Knowledge • Students, Nursing

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Background

Novel coronavirus disease 2019 (COVID-19) is a new viral respiratory illness. Since its first outbreak in Wuhan, China in December 2019, coronavirus disease has become a major health problem, rampantly spreading to many countries within a short time [1–3]. As of this study on April 10, 2020, the World Health Organization has reported a total of 1 610 055 laboratory-confirmed cases of COVID-19 and 96 365 deaths due to COVID-19 in 210 countries and territories all over the world [4].

Apart from global public health, COVID-19 has been also affecting the economy and social affairs [5]. The rapid increase in the number of deaths from the disease has caused public anxiety, fear, and depression, which further complicates efforts to prevent the spread of the disease. Faced with such challenges, the government has adopted the following measures to prevent the spread of the disease on the basis of severe acute respiratory syndrome prevention and control experience. Methods include sealing the city in the epidemic areas, community closure management, isolation of suspected cases and infected persons, closure of public places and recreational facilities, closure of schools, wearing masks when going out, travel restrictions, and so on. Countries around the world had also blocked the borders to prevent COVID-19 spread.

In facing the global pandemic of COVID-19, nurses are the primary caregivers for COVID-19 patients, responsible for providing knowledge and facilitating effective care interventions. However, healthcare workers who are at the front lines in the fight against infectious disease are the most vulnerable [6]. Evidence has been given by several investigators that taking care of an infected individual increased the risk of acquiring COVID-19 [7,8].

Nursing education in China is provided through a 4-year curriculum, which includes knowledge of preventive medicine for infectious diseases. In the Fundamental Nursing undergraduate course, nursing students learn basic personal protection knowledge such as hand washing and isolation gown wearing. However, nursing students who are exposed to the hospital settings during their clinical practice coursework are prone to infection because they may provide care to patients who are suspected of or diagnosed with COVID-19 infection [8,9]. Hence, as future health educators and healthcare providers, nursing students need more comprehensive knowledge and skills to deal with the epidemic and spread of disease, which may improve the country's ability to respond to pandemics.

Electronic health (eHealth) literacy refers to the ability to find, discover, understand, and evaluate the knowledge gained from eHealth information sources and applications to solve health problems [10], and has been identified as an important skill set, especially in face of global healthcare challenges.

Some previous studies have analyzed the knowledge and attitudes of students from Indonesia [11], Pakistan [12], Egypt [13], Jordan [14], and Spain [15]. However, no articles have analyzed factors influencing COVID-19 preventive behavior among nursing students in China, and no study has found the association between electronic literacy and preventive behavior.

The purpose of this study was (1) to determine the level of nursing students' knowledge, attitudes, and preventive behavior toward COVID-19 and the level of eHealth literacy; and (2) to survey the factors affecting COVID-19 prevention behavior among nursing students in China.

Material and Methods

Design

The descriptive cross-sectional survey was performed among nursing students to investigate knowledge, attitudes, preventive behaviors, and the eHealth literacy level regarding the 2019 novel coronavirus. The survey was conducted in an online questionnaire for 6 days (30 March–5 April 2020).

Data collection

The online questionnaire link had been posted on WeChat because WeChat is the most common and widely used social media in China [16]. Study participants were chosen through a cluster-stratified sampling process. First, all nursing students were stratified by grades. Second, within every grade, simple random sampling was done using a random number table. A professor who was willing to send the link to the students was found in every grade. After informed consent, the purpose of the survey was explained to the students by the professor.

Considering the authenticity and validity of the survey, the same Internet protocol address can only be used once. The questionnaire, which was automatically monitored by the system, was allowed to be submitted anonymously after completing all questions. Students could withdraw from the test at any time. A response time of less than 160 s was considered invalid.

Participants

All nursing students were recruited from a medical college located in Anhui Province in China. The inclusion criteria for the participants were (1) being first- to fourth-year undergraduate nursing students; (2) voluntarily participating in the study.

In consideration of nonresponses, the sample size was increased to 912. After excluding 67 students who submitted

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invalid questionnaires and 214 students unwilling to participate, 631 of the samples were used.

Ethical issues

Approval to conduct the study was obtained from the Ethics Committee of the School of Nursing of Wannan Medical College (no. 20200003.10) and was performed in accordance with the Declaration of Helsinki.

Measurements

Questionnaire

The survey comprised 5 sections: demographics, knowledge of COVID-19 (diagnosis, treatment, and preventive measures), attitude, practice, and the eHealth literacy level. A self-administered structured survey questionnaire was based on information given by the National Health and Family Commission of China and some previous related surveys [17–24].

1. Demographics

This section contained 7 items assessing general characteristics, including age, gender, grade, etc.

2. Knowledge about COVID-19.

This section is mainly to discern the knowledge level of different groups about coronavirus by using 21 items. This scale included questions about the facts of COVID-19 (3items); symptom (3items); transmission (6items); diagnosis (4items); and treatment (5 items). A correct answer was assigned 1 point, whereas a wrong answer or "don't know" were assigned 0 points. The total score ranged from 0 to 21. A higher score indicated a higher level of knowledge. Items 11, 13, 14, and 17 received more incorrect answers than correct. Cronbach's alpha coefficient of the knowledge scale was 0.646.

3. Attitude toward COVID-19.

Thirteen items were provided for the participants to survey their attitudes and beliefs. Each item used a 5-point Likert scale coded from 1 "strongly disagree" to 5 "strongly agree." Total attitude scores ranged from a minimum of 13 to a maximum of 65. A high score was considered a good attitude. Cronbach's alpha coefficient of attitude scale was 0.917.

4. Preventive behaviors for COVID-19.

A total of 8 questions was included to evaluate the performance of COVID-19 prevention and used a 5-point Likert scale coded from 1 "never" to 5 "always." Total scores ranged from 8 to 40. A higher score means that the respondent practices better COVID-19 prevention behavior. Cronbach's alpha coefficient of preventive behaviors scale was 0.852.

5. eHealth Literacy Scale (eHEALS).

Developed by Norman and Skinner [10] in 2006, eHEALS was translated into a Chinese version and revised by Guo et al. [25] in 2014. Assessment of eHealth literacy level among nursing students was carried out through an 8-item eHealth scale. Five-point Likert-type scales were applied, ranging from "strongly disagree" (1 point) to "strongly agree" (5 points). The total score ranged from 8 to 40 points and a score ≥32 meant that nursing students had basic literacy levels. Cronbach's alpha coefficient of eHEALS was 0.975.

Statistical analyses

IBM SPSS version 21.0 (Chicago, IL, USA) was used for all statistical analyses. The distribution of continuous variables was described by means and standard deviations. The distribution of categorical variables was described by frequencies and percentages. Data were verified to have normal distribution before analysis by using the Kolmogorov-Smirnov test and examining normality plots.

The Mann-Whitney *U* and the Kruskal-Wallis tests were performed to identify contributory factors associated with knowledge, attitude, and practices regarding coronavirus. Spearman's rank correlation test was used to analyze the correlations among variables. Multinomial logistic regression was used to analyze the correlation between preventive behavior and the main variables. $P<0.05$ was considered statistically significant for all statistical analyses.

Results

Response rates and demographics

The response rate was 67.21%. The average age of the 613 students was 20.88 years (SD=1.55; range 17–25), of which 31.8% were men; 35.8% of the students lived in the city. The final study sample comprised 161 freshman, 175 sophomores, 124 juniors, and 153 seniors. Also, 46.3% of students experienced clinical practice; 54.1% of the participants (score ≥32) had basic eHealth literacy levels; 21 students had flulike symptoms during the COVID-19 outbreak.

The nurses listed television (84.3%), WeChat (79.6%), blog (78.1%), and school network platform (75.5%) as the most frequent sources of education about COVID-19. Most of the participants wished to know information on epidemic trends

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Table 1. Sample characteristics (N=613).

Variables	Characteristics	N	%
Sex	Male	195	31.8
	Female	418	68.2
Living areas	City	220	35.9
	Countryside	393	64.1
Grade	First year	161	26.3
	Second year	175	28.5
	Third year	124	20.2
	Fourth year	153	25.0
Clinical practice experienced	Yes	284	46.3
	No	329	53.7
eHealth literacy	Low	281	45.9
	High	332	54.1
Current health status	Good	502	81.9
	Neither good nor bad	90	14.7
	Bad	21	3.4
Sources of information	Newspapers/magazines	409	66.7
	School network platform	463	75.5
	Television	517	84.3
	WeChat	488	79.6
	Blog	479	78.1
	Community	284	46.3
	Classmates/friends/family	447	72.9
Information wish to know	Epidemic trends	559	91.2
	Medical progress	551	89.9
	Government prevention and control measures	527	86.0
	Progress in vaccine research	545	88.9
	Protective measures	526	85.8

(91.2%), medical progress (89.9%), progress in vaccine research (88.9%), government prevention and control measures (86.0%), and protective measures (85.8%) (Table 1).

Knowledge

The mean score on knowledge about COVID-19 was 14.68 of 21 points (SD=2.83). Most students had a good level of knowledge on COVID-19. A majority of students held misconceptions that antiviral drugs (81.4%, 499/613) and antibacterial drugs (60.5%, 371/613) can be used to treat the virus. Of the participants, 76.3% incorrectly believed that the COVID-19 virus can be vertically transmitted from mother to child. Over 90% of students were aware that new coronavirus pneumonia is a fatal respiratory disease that can be spread through droplets and virus-contaminated objects (Table 2). There was a significant difference in knowledge on the basis of grade (χ^2_{kw}=53.40, P<0.001), clinical practice experience (Z_{mwu}=–6.71, P<0.001), and eHealth literacy (Z_{mwu}=–4.48, P<0.001) (Table 3).

Attitude

The mean score on attitude about COVID-19 was 4.03 of 5 points (SD=0.59). About 70-80% of the students agreed that infection can be prevented by following the guidelines, wearing a mask when going out, and isolating infected patients. Over 30% of the students were not sure about vaccine injection and carrying out a clinical internship in the hospital with infected patients (Table 4).

The results of the attitude score were significantly different in sex (Z_{mwu}=–4.31, P<0.001), grade (χ^2_{kw}=12.68, P=0.005),

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Table 2. Level of knowledge of COVID-19 (N=613).

Items	Correct answers		Incorrect answers	
	N	%	N	%
Fact				
Q1. COVID-19 is a respiratory infectious disease caused by coronavirus (T)	585	95.4	28	4.6
Q2. The first case of human infection with COVID-19 reported in Wuhan China in 2019 (T)	401	65.4	212	34.6
Q3. Coronavirus can be fatal (T)	584	95.3	29	4.7
Symptoms				
Q4. Ultraviolet light, heat sensitivity, 56°C for 30 min, ether, 75% alcohol, chlorine disinfectant, peracetic acid, chloroform inactivate virus (T)	485	79.1	128	20.9
Q5. The main symptoms are fever, dry cough, and fatigue. Other symptoms are stuffy nose, runny nose, sore throat, myalgia, and diarrhea (T)	559	91.2	54	8.8
Q6. Severe symptoms are dyspnea and/or hypoxemia, acute respiratory distress syndrome, multiorgan dysfunction, septic shock (T)	538	87.8	75	12.2
Transmission (COVID-19 spread trough)				
Q7. Respiratory droplets (sneezing, coughing) (T)	590	96.2	23	3.8
Q8. Close contact with the patient (T)	431	70.3	182	29.7
Q9. Contact with virus-contaminated objects (T)	563	91.8	50	8.2
Q10. Aerosol (T)	544	88.7	69	11.3
Q11. Transplacental transmission (F)	145	23.7	468	76.3
Q12. COVID-19 infection was believed to originate in bats(T)	423	69.0	190	31.0
Treatment				
Q13. Antibiotics can help treatment (F)	114	18.6	499	81.4
Q14. Antiviral can help treatment (F)	242	39.5	371	60.5
Q15. Rehabilitated plasma helps treatment (T)	443	72.3	170	27.7
Q16. Traditional Chinese medicine (Huoxiang Zhengqi capsule/Lotus Qingwen capsule) helps treatment (T)	296	48.3	317	51.7
Q17. Vaccines to prevent new coronavirus infections are available (F)	183	29.9	430	70.1
Diagnosis				
Q18. The population is generally susceptible to infection (T)	459	74.9	154	25.1
Q19. Real-time reverse transcription polymerase chain reaction can help to diagnose COVID-19 (T)	370	60.4	243	39.6
Q20. Viral next-generation sequencing can help to diagnose COVID-19 (T)	480	78.3	133	21.7
Q21. The incubation period of coronavirus is from 1 to 14 days (T)	498	81.2	115	18.8

clinical practice experience (Z_{mwu}=–3.70, P<0.001), eHealth literacy (Z_{mwu}=–7.89, P<0.001), and health status (χ^2_{kw}=17.01, P<0.001) based on participants' characteristics. In comparison with men, women had a more positive attitude. The overall attitude of higher-grade students about COVID-19 was more positive. Students who had clinical practice experience showed a more positive attitude. The higher applicability of eHealth literacy would result in a more positive attitude. Students in good health kept a good attitude (Table 3).

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Table 3. Level of knowledge, attitude, and prevention behavior according to demographic characteristics (N=613).

Variables	Characteristics	N (%)	Knowledge			Practice			Attitude			eHEALS		
			Mean rank	Z_{mwu}	P	Mean rank	Z_{mwu}	P	Mean rank	Z_{mwu}	P	Mean rank	Z_{mwu}	P
Sex	Male	195 (31.8)	290.15	–1.62	0.105	259.93	–4.50	0.000**	261.94	–4.31	0.000**	274.90	–3.11	0.002**
	Female	418 (68.2)	314.86			328.96			328.02			321.97		
Living areas	City	220 (35.9)	307.11	–0.01	0.991	347.73	–4.27	0.000**	312.43	–0.57	0.570	312.45	–0.58	0.563
	Countryside	393 (64.1)	306.94			284.20			303.96			303.95		
Clinical practice experienced	Yes	284 (46.3)	358.25	–6.71	0.000**	321.55	–1.89	0.058	335.43	–3.70	0.000**	325.41	–2.43	0.015*
	No	329 (53.7)	262.76			294.44			282.46			291.11		
eHEALS	Low	281 (45.9)	272.44	–4.48	0.000**	241.23	–8.48	0.000**	245.77	–7.89	0.000**	141.00	–21.66	0.000**
	High	332 (54.1)	336.25			362.67			358.83			447.50		

Variables	Characteristics	N (%)	Knowledge			Practice			Attitude			eHEALS		
			Mean rank	χ^2_{kw}	P	Mean rank	χ^2_{kw}	P	Mean	χ^2_{kw}	P	Mean rank	χ^2_{kw}	P
Grade	First year	161 (26.3)	241.31	53.40	0.000**	310.24	5.104	0.164	288.82	12.68	0.005**	314.61	9.88	0.02*
	Second year	175 (28.5)	281.20			283.64			280.69			273.70		
	Third year	124 (20.2)	353.45			328.39			342.98			313.85		
	Fourth year	153 (25.0)	367.99			312.97			327.06			331.53		
Current Health status	Good	502 (81.9)	309.81	2.32	0.314	318.77	12.303	0.002**	320.66	17.01	0.000**	325.28	30.47	0.000**
	Neither good nor bad	90 (14.7)	304.51			254.23			250.63			226.81		
	Bad	21 (3.4)	250.50			251.79			221.95			213.79		

Mann-Whitney *U* test and Kruskal-Wallis test. * *P*<0.05; ** *P*<0.01.

Prevention behavior

The mean score on prevention behavior about COVID-19 was 3.92 of 5 points. (SD=0.65). In COVID-19 prevention of behavioral problems, 28.87, 25.87, and 11.09% of the participants had never or rarely performed items 1, 3, and 4, respectively (Table 5).

There was a significant difference in prevention behavior according to sex (Z_{mwu}=–4.50, *P*<0.001), living area (Z_{mwu}=–4.27, *P*<0.001), eHealth literacy (Z_{mwu}=–8.48, *P*<0.001), and health status (χ^2_{kw}=12.30, *P*<0.001) (Table 3).

eHealth literacy

The participants' mean score was 30.45 of 40 on eHealth literacy (SD=6.90). Over 50% of participants had basic literacy

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Table 4. Attitude toward COVID-19 (N=613).

Items	Mean	SD	Strongly disagree	Partly disagree	Neutral	Partly agree	Strongly agree
			N (%)	N (%)	N (%)	N (%)	N (%)
A1. Promoting guidelines or programs for the care of new coronavirus infections can prevent the spread of disease	4.05	0.85	10(1.63)	13 (2.12)	109 (17.78)	284 (46.33)	197 (32.14)
A2. Agree to wear a mask when going outside	4.11	0.97	11 (1.79)	31 (5.06)	97 (15.82)	216 (35.24)	258 (42.09)
A3. Agree to close management of communities	3.90	0.87	10 (1.63)	15 (2.45)	159 (25.94)	273 (44.54)	156 (25.45)
A4. Agree to delay the resumption of work	3.85	0.86	9 (1.47)	19 (3.10)	168 (27.41)	279 (45.51)	138 (22.51)
A5. Agree to delayed school attendance	3.88	0.86	8 (1.31)	22 (3.59)	157 (25.61)	276 (45.02)	150 (24.47)
A6. Agree with the transportation department to take passenger registration and take temperature	4.20	0.75	5 (0.82)	6 (0.98)	75 (12.23)	301 (49.10)	226 (36.87)
A7. Agree to carry out clinical internship in hospitals receiving COVID-19 patients	3.81	0.81	5 (0.82)	14 (2.28)	198 (32.30)	272 (44.37)	124 (20.23)
A8. Agree to receive the newly developed vaccine	3.65	0.81	7 (1.14)	27 (4.40)	224 (36.54)	271 (44.21)	84 (13.70)
A9. COVID-19 suspects should be isolated	3.72	0.87	10 (1.63)	27 (4.40)	199 (32.46)	267 (43.56)	110 (17.94)
A10. COVID-19 patients should be isolated	3.89	0.82	4 (0.65)	17 (2.77)	166 (27.08)	280 (45.68)	146 (23.82)
A11. Carers of COVID-19 patients should be isolated for 14 days	4.30	0.75	4 (0.65)	3 (0.49)	73 (11.91)	259 (42.25)	274 (44.70)
A12. There are immigrants who, while segregated, actively inform themselves of their travel history	4.31	0.76	4 (0.65)	6 (0.98)	71 (11.58)	250 (40.78)	282 (46.00)
A13. COVID-19 discharged patients should continue to be isolated at home for 14 days, wear masks, reduce close contact with family members, and share meals	4.29	0.78	4 (0.65)	8 (1.31)	74 (12.07)	248 (40.46)	279 (45.51)

levels that would be helpful in accessing eHealth resources and to use information technology for health (Table 3).

Relationship between preventive behavior and other main variables

Preventive behavior for COVID-19 was significantly correlated with knowledge (r_s=0.177, P<0.01), attitude (r_s=0.406, P<0.01), eHealth literacy (r_s=0.416, P<0.01), sex (r_s=0.182, P<0.01), living area (r_s=–0.173, P<0.01), and health (r_s=–0.142, P<0.01) (Table 6).

Influencing factors on preventive behavior for COVID-19

In the multinomial logistic regression analysis model, the preventive behavior was always taken as the control. For every 1 year older, the nurses would choose less protective behaviors, which is 1.51 times that of choosing more protective behaviors (odds ratio [OR]=1.51, 95% confidence interval [CI]: 1.08, 2.10). Nursing students with low scores of eHEALS literacy (OR=0.83, 95% CI: 0.78, 0.88), knowledge (OR=0.74, 95% CI: 0.64, 0.85), and attitude (OR=0.32, 95% CI: 0.13, 0.78) tend to be less likely to take preventive measures. Students living in the countryside seldom took preventive actions, 11.11 times less likely than nursing students living in city (OR=0.09, 95% CI: 0.03, 0.30).

"Sometimes" preventive behaviors were regarded as the experimental group, whereas "always" behaviors were regarded as the control group. Nursing students with higher eHEALS literacy (OR=0.89, 95% CI: 0.87, 0.91), knowledge OR=0.89, 95% CI: 0.84, 0.94), and attitude (OR=0.24, 95% CI: 0.19, 0.32) scores always exhibit preventive behaviors. Male nursing students who sometimes take preventive actions increased by 44% compared with female nursing students (OR=1.44, 95% CI: 1.07, 1.95). Nursing students who live in the city and sometimes exhibit preventive behavior is 30% of "sometimes" nursing students who live in the countryside (OR=0.30, 95% CI: 0.23, 0.41).

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Table 5. Level of preventive behavior for COVID-19 (N=613).

Items	Mean	SD	Never	Seldom	Sometimes	Often	Always
			N (%)	N (%)	N (%)	N (%)	N (%)
P1. Clean your hands with an alcohol-based hand sanitizer	3.10	1.08	42 (6.85)	134 (21.86)	229 (37.36)	136 (22.19)	72 (11.75)
P2. Cover your mouth and nose when you cough or sneeze	4.01	0.93	6 (0.98)	21 (3.43)	159 (25.94)	200 (32.63)	227 (37.03)
P3. Clean and disinfect items that can be easily touched with hands (ie door handles and surfaces)	3.15	1.10	46 (7.50)	112 (18.27)	240 (39.15)	135 (22.02)	80 (13.05)
P4. Avoid touching eyes, nose, and mouth	3.62	0.94	4 (0.65)	64 (10.44)	214 (34.91)	208 (33.93)	123 (20.07)
P5. Reduce unnecessary outings (meetings, dining, shopping, sports activities)	4.21	0.84	3 (0.49)	11 (1.79)	114 (18.60)	214 (34.91)	271 (44.21)
P6. Avoid close contact with people when they are sick	4.11	0.91	7 (1.14)	19 (3.10)	125 (20.39)	213 (34.75)	249 (40.62)
P7. Wear masks, gloves, goggles, etc in the crowded areas	4.05	0.94	5 (0.82)	27 (4.40)	145 (23.65)	192 (31.32)	244 (39.80)
P8. Avoid using public transportation	4.17	0.88	4 (0.65)	18 (2.94)	116 (18.92)	205 (33.44)	270 (44.05)

Table 6. Spearman correlation coefficients for the main variables (N=613).

	Knowledge	Preventive behavior	Attitude	eHEALS	Health status	Sex	Living area
Knowledge	1	0.177**	0.307**	0.212**	–0.038	0.066	0.000
Preventive behavior	0.177**	1	0.406**	0.416**	–0.142**	0.182**	–173**
Attitude	0.307**	0.406**	1	0.368**	–0.166**	0.174**	–0.023
eHEALS	0.212**	0.416**	0.368**	1	–0.223**	0.126**	–0.023
Health status	–0.038	–0.142**	–0.166**	–0.223**	1	0.014	–0.013
Sex	0.066	0.182**	0.174**	0.126**	0.014	1	0.037
Living area	0.000	–0.173**	–0.023	–0.023	–0.013	0.037	1

** $P<0.01$.

Compared with the group of nursing students that always take preventive behaviors, nursing students who had poorer eHealth literacy (OR=0.95, 95% CI: 0.78, 0.88), had insufficient knowledge about COVID-19 (OR=0.92, 95% CI: 0.64, 0.85), had a poorer attitude (OR=0.64, 95% CI: 0.13, 0.78), and lived in the countryside (OR=0.41, 95% CI: 0.03, 0.30) are more inclined to often take preventive action (Table 7).

Discussion

The current descriptive study assessed the factors influencing preventive behavior regarding COVID-19 among nursing students in China. This study revealed that COVID-19-related knowledge is relatively high among the participants. Positive attitudes and good precautionary measures were also reported among participants.

Social media (WeChat) at 79.6% is the second-highest source of information for the nursing students to learn about COVID-19, which was consistent with a study in Jordan (83.4%) [14]. The data show that students rely heavily on social media, reminding the government and professionals that they should pay more attention to improving reliable and effective online sources.

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Table 7. Multinomial logistic regression analysis of the factors affecting preventive behavior level toward COVID-19 among the nursing students (N=613).

Variables	N	Preventive behavior level								
		Seldom			Sometimes			Often		
		OR	95% CI	*P*	OR	95% CI	*P*	OR	95% CI	*P*
Age	613	1.51	1.08, 2.10	0.02*	1.01	0.93, 1.11	0.78	1.01	1.08, 2.10	0.80
eHEALS	613	0.83	0.78, 0.88	0.00**	0.89	0.87, 0.91	0.00**	0.95	0.78, 0.88	0.00**
Knowledge	613	0.74	0.64, 0.85	0.00**	0.89	0.84, 0.94	0.00**	0.92	0.64, 0.85	0.00**
Attitude	613	0.32	0.13, 0.78	0.01*	0.24	0.19, 0.32	0.00**	0.64	0.13, 0.78	0.00**
Male	706	2.37	0.88, 6.33	0.09	1.44	1.07, 1.95	0.02*	0.86	0.88, 6.33	0.22
Female	1625	Ref			Ref			Ref		
City	868	0.09	0.03, 0.30	0.00**	0.30	0.23, 0.41	0.00**	0.41	0.03, 0.30	0.00**
Countryside	1463	Ref			Ref			Ref		
Health status=good	1933	0.21	0.04, 1.17	0.08	0.51	0.18, 1.47	0.21	0.47	0.04, 1.17	0.13
Health status=Neither good nor bad	325	0.59	0.09, 3.97	0.59	0.88	0.29, 2.67	0.83	0.64	0.09, 3.97	0.38
Health status=bad	73	Ref			Ref			Ref		

* *P*<0.05; ** *P*<0.01. Ref – reference level; OR – odds ratio; CI – confidence interval.

The present study showed that the students were least knowledgeable toward the question of treatment of COVID-19. Surprisingly, 70.1% of students did not know that there was no vaccine available, which was higher than that of Pakistan (33%) [12]. Of the participants, 81.4% had insufficient knowledge regarding the uselessness of antibiotics for COVID-19. Transplacental transmission was incorrectly identified by 76.3% of the students. Since the quality of the information available on social media is insufficient, open-access journals on COVID-19 should be provided by the educators and the government to help improve the students' understanding of COVID-19.

Concerning attitudes, 35.5% of the students expressed a neutral or negative attitude about carrying out a clinical internship in hospitals receiving COVID-19 patients. The result of Cervera-Gasch et al. was in line with our findings [15]. This is likely to reflect the concerns of nursing students who are not ready to take care of infected patients. Only 59.91% of respondents stated that they were willing to inject a vaccine against COVID-19 if it is available. Another similar study stated that 26% of the participants would not use the vaccine [26]. Our findings suggest that greater emphasis should be placed on the rise of vaccine hesitancy.

This present study showed that 71.22% of the students wore masks, gloves, and goggles. Only about 50% of the participants were willing to wear face masks in a previous study [13]. The difference may be due to the rapid depletion of masks since the coronavirus pandemic.

Factors influencing the students' practice against COVID-19 were assessed. The correlation between students' knowledge, attitudes, and practice shows that sufficient knowledge and positive attitudes are affecting their actions against COVID-19. Knowledge is a prerequisite for establishing positive attitudes and promoting positive behaviors [13], although eHealth literacy can promote the acquisition and application of online health information to adopt a positive attitude and conduct health-promoting activities. Therefore, for nurse undergraduates, it is crucial to provide emergency disease training, increase eHealth literacy courses, and improve the curriculum with courses such as epidemiology and new emerging diseases.

The living area as a factor was correlated with prevention behaviors. In the present study, it was found that students living in rural areas adopt fewer protective measures. To prevent future spread, it is necessary for the government to intensify education for students living in rural areas.

Gender was another factor that affects nursing students' COVID-19 prevention behavior. The present study showed that in response to COVID-19, men were less likely to take protective behavior than women. This coincides with the research in Saudi Arabia and Pakistan [27,28]. Studies suggest that

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targeted health education should be conducted for this high-risk population that is particularly vulnerable to COVID-19.

The limitations of the study were that all participants were majoring in nursing; the findings are limited to Anhui, China; and there is a female predominance. The reason for vaccine hesitancy still unknown. Future studies addressing this point could help people receive immunization to end the pandemic.

Conclusions

Good eHealth literacy, good knowledge, and a positive attitude were the most important variables affecting prevention behavior against COVID-19. Targeted health education should be conducted for male students and students living in the countryside by providing reliable and effective online sources. It is crucial to provide emergency disease training, increase eHealth literacy courses, and improve the curriculum, such as adding epidemiology and new emerging diseases courses.

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Competing interests

None.

References:

1. Huang C, Wang Y, Li X et al: Clinical features of patients infect-ed with 2019 novel coronavirus in Wuhan, China. Lancet, 2020; 395(10223): 497–506
2. Paules CI, Marston HD, Fauci AS: Coronavirus infections – more than just the common cold. JAMA, 2020; 323(8): 707–8
3. Wang C, Horby PW, Hayden FG et al: A novel coronavirus outbreak of global health concern. Lancet, 2020; 395(10223): 470–73
4. Worldometer. COVID-19 coronavirus pandemic. Cited 2020 April 10. *https://www.worldometers.info/coronavirus/#countries*
5. Gupta M, Abdelmaksoud A, Jafferany M et al: COVID-19 and economy. Dermatol Ther, 2020 [Online ahead of print]
6. Christopher DJ, Isaac BT, Rupali P et al: Health-care preparednessand healthcare worker protection in COVID-19 pandemic. Lung India, 2020; 37(3): 238–45
7. Editorial. COVID-19: Protecting health-care workers. Lancet, 2020; 395(10228): 922
8. Chang D, Xu H, Rebaza A et al: Protecting health-care workers from subclinical coronavirus infection. Lancet Respir Med, 2020; 8(3): e13
9. Ojulong J, Mitonga KH, Iipinge SN: Knowledge and attitudes of infection prevention and control among health sciences students at University of Namibia. Afr Health Sci, 2013; 13(4): 1071–78
10. Norman CD, Skinner HA: eHEALS: The eHealth Literacy Scale. J Med Internet Res, 2006; 8(4): e27
11. Saefi M, Fauzi A, Kristiana E et al: Survey data of COVID-19-related knowledge, attitude, and practices among Indonesian undergraduate students. Data Brief, 2020; 31: 105855
12. Salman M, Mustafa ZU, Asif N et al: Knowledge, attitude and preventive practices related to COVID-19: A cross-sectional study in two Pakistani university populations. Drugs Ther Perspect, 2020 [Online ahead of print]
13. Hamza MS, Badary OA, Elmazar MM: Cross-sectional study on awareness and knowledge of COVID-19 among senior pharmacy students. J Community Health. 2020 [Online ahead of print]
14. Khasawneh AI, Humeidan AA, Alsulaiman JW et al: Medical students and COVID-19: Knowledge, attitudes, and precautionary measures. A descriptive study from Jordan. Front Public Health, 2020; 8: 253
15. Cervera-Gasch Á, González-Chordá VM, Mena-Tudela D: COVID-19: Are Spanish medicine and nursing students prepared? Nurse Educ Today, 2020; 92: 104473
16. Zhang X, Wen D, Liang J et al: How the public uses social media WeChat to obtain health information in China: A survey study. BMC Med Inform Decis Mak, 2017; 17(Suppl. 2): 66
17. Chan JF, Yuan S, Kok KH et al: A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: A study of a family cluster. Lancet, 2020; 395(10223): 514–23
18. Chen N, Zhou M, Dong X et al: Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: A descriptive study. Lancet, 2020; 395(10223): 507–13
19. Arons MM, Hatfield KM, Reddy SC et al: Presymptomatic SARS-CoV-2 infections and transmission in a skilled nursing facility. N Engl J Med, 2020; 382(22): 2081–90
20. Rothe C, Schunk M, Sothmann P et al: Transmission of 2019-nCoV infection from an asymptomatic contact in Germany. N Engl J Med, 2020; 382(10): 970–71
21. National Health Commission: Guidelines for the diagnosis and treatment of novel coronavirus pneumonia (trial version seventh). 2020, *http://www.nhc.gov.cn/yzygj/s7652m/202003/a31191442e29474b98bfed5579d5af95.shtml*
22. Lu R, Zhao X, Li J et al: Genomic characterisation and epidemiology of 2019 novel coronavirus: Implications for virus origins and receptor binding. Lancet, 2020; 395(10224): 565–74
23. He F, Deng Y, Li W: Coronavirus disease 2019: What we know? J Med Virol, 2020; 92(7): 719–25
24. The CDC Health Alert Network: Updated guidance on evaluating and testing persons for coronavirus disease 2019 (COVID-19). 2020, *https://emergency.cdc.gov/han/2020/han00429.asp*
25. Guo SJ, Yu XM, Sun YY et al: [Adaptation and evaluation of Chinese version of eHEALS and its usage among senior high school students.] Chin J Health Educ, 2014; 29(02): 106-08+123 [in Chinese]
26. COCONEL Group: A future vaccination campaign against COVID-19 at risk of vaccine hesitancy and politicisation. Lancet Infect Dis, 2020; 20(7): 769–70
27. Alahdal H, Basingab F, Alotaibi R: An analytical study on the awareness, attitude and practice during the COVID-19 pandemic in Riyadh, Saudi Arabia. J Infect Public Health, 2020 [Online ahead of print]
28. Hayat K, Rosenthal M, Xu S et al: View of Pakistani residents toward coronavirus disease (COVID-19) during a rapid outbreak: A rapid online survey. Int J Environ Res Public Health, 2020; 17(10): 3347

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