

# Knowledge, Preventative Practices and Depression of Chinese university students in Korea and China During the COVID-19 Pandemic: An Online Cross-sectional Study

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## Research article

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# Abstract

(1) *Background:* To investigate the knowledge, preventative practices, and depression of Chinese university students living in South Korea ('International Group') and Mainland China ('Mainland Group') during the Coronavirus Disease 2019 (COVID-19) outbreak, and furtherly explore the determinants of depression among these students;

(2) *Methods:* The study was conducted using an online questionnaire tool designed by the Yonsei Global Health Center, with preventative knowledge and practice questions on COVID-19, as well as PHQ-9 (used to diagnose depression for patients). 420 Chinese college students were finally included in the analysis (171 students in South Korea and 249 students in mainland China). This data was collected from March 23 to April 12, 2020;

(3) *Results:* Majority of these students had a good level of knowledge of COVID-19. The 'International Group' did better than the 'Mainland Group' students regarding preventative practices, but the percentage with moderate-to-severe depression was higher among the 'International Group'. Highly concerned about family members, highly concerned about getting COVID-19, and having a suspicion of contact with patients increased the depression state among the respondents. Meanwhile, taking preventative behaviors more comprehensively decreased the depression state of both groups;

(4) *Conclusions:* During the pandemic of COVID-19, the depression status of 'International Group' students was significantly severer than that in 'Mainland Group' ( $\chi^2 = 5.50$ ,  $p < 0.05$ ). While the high-level of depression status of these two groups' students was affected by highly concerning family members and getting COVID-19 and having a suspicion of contact with patients. Therefore, psychological counseling and education programs are needed in order to support and improve the mental health of 'International Group' students.

## 1. Introduction

An increasing number of infectious diseases recently [1] have led to serious economic and social consequences around the world [2]. Studies have shown that these emergent public-health events not only result in physical pain but could also have a profound psychological impact [3,4], such as panic, anxiety, and depression [5,6]. It was evidenced that psychological stress could lead to immune dysfunction that negatively impacts human health [7]. For instance, the SARS virus brought a series of psychological problems such as post-traumatic stress disorder (PTSD) to the public [8]. Therefore, it is necessary to find out the population's mental health status during a health emergency as early as possible and to make recommendations and provide interventions.

Coronavirus Disease 2019(COVID-19) broke out in Wuhan, Hubei Province, China at the end of January 2020, and quickly spread to 188 countries and regions worldwide as of 20 May 2020 [9]. On January 30, 2020, the World Health Organization (WHO) declared that it was a "pandemic" [10]. And it has been causing confirmed cases and deaths so far. The disease is contagious, widespread, and lacking in

targeted drugs [11,12]. More and more confirmed patients, suspected cases, and outbreak-affected provinces made the Chinese people feel worried and scared [13,14]. Coupled with the ongoing social distancing and isolation measures implemented in more countries and regions, this outbreak is leading to additional mental health problems such as stress, anxiety, depressive symptoms, insomnia, and fear [15] around the world [16,17]. WHO also noted that mental health and psychological well-being in different target groups should need to be taken into considerations during the COVID-19 outbreak [18].

College students who are entering adulthood, may not only have to take the stress related to academic performance but face the task of taking on more adult-like responsibilities without having yet mastered the skills and cognitive maturity of adulthood [19]. Past research related to emergency found that there were quite a few college students who lack the experience of an emergency, lack analytical and speculative skills, with impulsive behavior, vulnerable and unstable mood [20,21]. Many researchers put forward that mental health problems are increasingly common among college students [22,23,24]. Potential anxiety, stress, and depression problems predicted less year-end degree commitment and lower their academic performance [25,26]. The outbreak of COVID-19 coincided with the Chinese lunar New Year holiday and the opening of South Korean universities, shared fields in the two countries have been affected, directly or indirectly. To prevent the outbreak from escalating, universities in China and South Korea have postponed the start of the semester and canceled all campus events such as workshops, conferences, sports, and other activities [27]. The mental health of college students who are forced to stay at home for a long time with decreasing collective activities may be affected, leading to anxiety or depressive symptom [28,29]. Thus, the psychological conditions of college students cannot be overlooked and are necessary to be monitored.

Because China was the first country to have a virus outbreak, the Chinese have been targeted and blamed for the COVID-19 and stigmatized internationally, for example, the use of the term “China virus” and the use of terms such as “Wuhan virus” by the media [30]. Among foreign students studying in South Korea, the proportion of Chinese students is the biggest [31]. Most of them are living alone on their own and have ever known or experienced a severe outbreak in China firstly. Experience demonstrated that the transition of studying abroad adds another layer of stress that can exacerbate and amplify mental problems if they already existed [32]. Their loneliness abroad [33] paired with discrimination globally and stress over the epidemic in Korea are also probable to affect their academic performance and depression level.

Although some researches have been conducted in different countries to identify the risk and protective factors contributing to depression and anxiety of college students during the COVID-19 pandemic [34,35,36,37,38,39], there is no research examined the knowledge and risk factors of depression during COVID-19 among overseas Chinese students. Particularly, the Chinese students in South Korea have become one of the underprivileged groups. Therefore, using the online questionnaire survey, this study aimed to explore the conditions and determinants of the knowledge, preventative practices and depression of the Chinese students in mainland China and South Korea during the COVID-19 pandemic.

## 2. Materials And Methods

### 2.1. Sampling Method

Firstly, the sample size needed for the study was calculated using the G\*Power 3.19 program. When calculated based on parameters of the two-sided test,  $\chi^2$  test, a residual variance of 0.83,  $\alpha$  probability = 0.05, and power = 0.95 for F tests and linear multiple regression analysis, the minimum total sample size was estimated to be 356 overall.

Secondly, 461 respondents were finally collected in this study from 23 March to 12 April 2020<sup>[1]</sup> via Snowball Sampling method (recruit respondents from among acquaintances). Respondents were 180 Chinese in South Korea collected during March 23-April 8, 2020, and 281 Chinese in mainland China during April 2-12, 2020. In line with the research aim, which was to survey college students, the respondents of those who stated “Employed”, “Unemployed” and “Others” in the occupation question were removed, leaving a total of 420 students (171 Chinese in South Korea, named as “International Group”, and 249 Chinese in mainland China, named as “Mainland Group”). All respondents expressed a willingness to participate and understand the background and purpose of the study.<sup>[1]</sup>

### 2.2. Data Collection

The online questionnaire surveys were distributed using the Naver Online Survey (Tool) for International Group and Surveystar Online Survey (Tool) for Mainland Group respectively. The questionnaires for the two groups were at the same design and written in Simplified Chinese Characters. Before conducting the survey, we did the revision and verification of the contents of the questionnaire through the online pilot survey and to make sure that the statements are appropriate and understandable. During the initial screening of the online questionnaire, the purpose of the research, and the confidentiality and privacy of individuals was ensured in written format on the first page of the survey questionnaire. Only after reading and clicking “AGREE” to make the consent, the filling of the questionnaire could begin. In addition, we stipulated that the main questions in the survey were mandatory questions, which means the participants have to complete all answers before they submitted the online questionnaire. All the measures above made the response rate of our study was 100%.

### 2.3. Research Tools

This study was combined with 1) YGHC COVID-19 Online Survey Tool and 2) Patient Health Questionnaire-9. YGHC COVID-19 Online Survey Tool was designed and updated by Yonsei Global Health Center (YGHC), aiming to evaluate the target respondents’ basic demographics characteristics, knowledge about COVID-19, preventive practices against COVID-19, depressive symptoms. Questions in the YGHC COVID-19 Online Survey Tool were found to own a reasonable validity and reliability in Wang’s research on the Chinese general population [15]. YGHC made changes on Part E (Precaution measures) and Part F (Additional information) according to the specific situation in the two countries. The Patient Health Questionnaire-9 (PHQ-9) was added to the study to provide a baseline for the incidence of depression.

## 2.4. Variables Description

### 2.4.1. General Demographics Data

In this study, to reflect the demographic characteristics of the respondents, the basic survey asked questions related to: “sex”, “age”, “education level”, “marital status”, “family size”, “whether you had medical insurance”, “whether you had chronic diseases”, “whether you had traveled abroad in the past 14 days”, and “whether you had experienced quarantine”. The educational level was divided into “Undergraduate” and “Graduate”, and the marriage status comprised of “Single” and “Married”. Family size includes “1-person family”, “2-person family”, “3~5 persons family” and “more than 6-member family”. The questions about having “Medical insurance”, “Chronic illness”, “Travelled abroad”, and “Self-quarantined” had two possible answers: “no” and “yes”. The question about the “Self-assessed physical condition” was also included: “above good” and “below fair”.

### 2.4.2. Knowledge and perception about COVID-19

Understanding and perception of COVID-19 and other topics were assigned in a self-enumeration questionnaire, including knowledge on transmission pathway, information satisfaction, sources of related information, confidence about diagnose, degree of concern about this disease, perceived probability, and concern about family members.

### 2.4.3. Preventive practices of COVID-19

Nine basic preventive practices were incorporated into the questionnaire. We gave the score corresponding to the degree to which a measure was practiced on a daily basis (1 = “Never do this” and 5 = “Do this every day”) and added total points to all the questions to calculate the total preventive practices. Cronbach's Alpha coefficient of preventive practices of the COVID-19 scale was 0.78.

### 2.4.4. Patient Health Questionnaire-9

Depressive symptoms could be diagnosed based on the 9 criteria for depression in the Diagnostic and Statistical Manual of Mental Disorders published by the American Psychiatric Association [40]. To understand the response to these question, each question was divided into 4 categories: “not at all” (0 points), “several days” (1 point), “more than half the days” (2 points), and “almost every day” (3 points) [41]. According to the scoring criteria, the score on PHQ-9 was divided into five groups: 0–4, 5–9, 10–14, 15–19, 20–27, which corresponded to “minimal or none”, “mild”, “moderate”, “moderately severe”, and “severe” depression, respectively [42]. The higher the score, the more intense the level of depression.

The symptoms of depression were able to be assessed based on the 10 scores in PHQ-9. With a sensitivity of 88% and a specificity of 88% for detecting major depressive disorders, a score of 10 has been recommended as the cut-off score for diagnosing depression [43]. Thus, in this study, 10 and more

points were classified as “moderate-to-severe”, and less than 10 points were classified as “minimal-to-mild”. Cronbach's Alpha coefficient of the scale in this study was 0.89.

## 2.5. Statistical Analysis Approach

In this study, STATA 15.0 and SPSS 24.0 were used to conduct statistical analysis. The specific analytical methods are as follows:

(1) Firstly, descriptive statistics, t-test, and Chi-squared tests were performed in each variable between “International Group” and “Mainland Group”.

(2) Secondly, to explore the determinants of the different depression levels, hierarchical regression was performed.

[1] From WHO, date as of 31 March 2020: China: Total confirmed cases 82,545, total deaths 3314; Korea: Total confirmed cases 9,786, total death 162

## 3. Results

### 3.1. General Characteristics

(Table 1) Significant differences among these general demographic characteristics of the two groups were found in the “Age” ( $t = 5.427$ ,  $p < 0.001$ ), “Educational level” ( $\chi^2 = 8.509$ ,  $p = 0.004$ ), “Marital status” ( $\chi^2 = 4.153$ ,  $p = 0.042$ ), “Family size” ( $\chi^2 = 32.126$ ,  $p < 0.001$ ), “Medical insurance” ( $\chi^2 = 10.699$ ,  $p = 0.001$ ), and “Self-quarantine” ( $\chi^2 = 42.230$ ,  $p < 0.001$ ). The mean age for “International Group” was  $24.08 \pm 4.14$  compared with that of “Mainland Group”. The proportions of Graduate students, and the Married, and whose Family size is 1 or 2 members in “International Group” were higher than those of “Mainland Group”. In addition, the “International group” had a higher percentage who did have medical insurance (16.4%). In the contrast, nearly half (47.8%) of the “Mainland Group” students had the experience of self-quarantined. Totally, more than 90% of respondents reported good results of self-assessed physical condition.

### 3.2. Knowledge about COVID-19

Table 2 showed knowledge about COVID-19 in these respondents. About 99.8% of them knew that the virus can spread through droplets, followed by the thoughts that it could be transmitted via contacting contaminated objects (88.8%) and the air (66.9%). The “Infected cases”, “Death cases”, and “Recovered cases” information were also updated among the two groups. Regarding the sources of information, 92.14% of respondents got information using one source to three sources like the internet, TV, or family members. Overall, the respondents realized a good level of basic COVID-19 information satisfaction.

Between the “International Group” and “Mainland Group”, the significant differences were founded in “Confidence in diagnose” ( $\chi^2 = 15.647$ ,  $p < 0.001$ ), “Concern about the disease” ( $\chi^2 = 4.246$ ,  $p = 0.039$ ), and “Get infected probability (highly)” ( $\chi^2 = 12.379$ ,  $p < 0.001$ ). Although the “Mainland Group” had bigger proportions of the respondents who were highly confident in the diagnose and who highly concerned about the disease, higher percentages of received probability results appeared in the “International Group”. In “International Group” students, 34.5% of them thought they were highly likely to be infected (19.3% in “Mainland Group”), but they still had more proportion of students who thought they were more likely to survive after infection (91.8% in “International Group” VS. 86.7% in “Mainland Group”). Furthermore, no statistically significant difference was found in the “Concern about family members”.

### 3.3. Differences in preventative practices between the Chinese students in the two countries during COVID-19

Table 3 illustrated the performance results between the “International Group” and “Mainland Group” on preventative practices against COVID-19. On the whole, there were seven practices out of the total that showed significant differences between the two groups. The mean scores of “International Group” in the first six practices were higher than those in “Mainland Group”. Statistically significant differences were reported between the two groups’ mean scores in “Covering mouth when coughing and sneezing” ( $t = 3.28$ ,  $p < 0.001$ ), “Washing hands with soap and water” ( $t = 2.93$ ,  $p < 0.001$ ), “Wash hands immediately after coughing, rubbing nose or sneezing” ( $t = 1.76$ ,  $p < 0.05$ ), “Washing hands after touching contaminated objects” ( $t = 7.11$ ,  $p < 0.001$ ) and “Avoiding public transportation” ( $t = 2.23$ ,  $p < 0.05$ ), but excluding the practice: “Wearing mask regardless of the presence or absence of symptoms”. On the contrary, the “Mainland Group” achieved higher levels of performance than that of “International Group” in the last three practices. Particularly, the mean scores of “Sitting in one row while having a meal” ( $t = -5.81$ ,  $p < 0.001$ ) and “Avoiding meeting more than 10 people” ( $t = -10.13$ ,  $p < 0.001$ ) showed the significant differences between the two groups.

### 3.4. Depressive symptoms resulting from the analysis

The Chi-Square Test was performed to find the relationship between the level of depression symptoms between the “International Group” and “Mainland Group”. The depressive symptoms were categorized into “minimal-to-mild” and “moderate-to-severe” (cut-off score of 10) in this study. As Table 4 shown, the difference between the two groups which was confirmed as statistically significant ( $\chi^2 = 5.50$ ,  $p < 0.05$ ), the depression status of “International Group” was severer than that of Mainland Groups’.

A simple linear stepwise regression analysis was firstly conducted to explore factors of the depression status of the respondents including all variables. The results showed in Table 5 found that “information satisfaction”, “patients’ contact history”, “concern about family members”, and “self-assessed physical condition” were statistically significantly related to the respondents’ depression. So the four variables

were put in place of the hierarchical regression in different models in combination with the variables of demographics characteristic, knowledge score, and preventative score.

Table 6 displayed the results of hierarchical regression analysis on the determinants of depression on COVID-19 with 4 models. In Model 1 and Model 2, there was no statistically significant relationship between age, sex, education level, or marital status and depression scores of respondents. While the students who had a better assessment of their health got less depression scores ( $t = -1.865$ ,  $p < 0.05$ ). As more variables added in Model 3 and Model 4, the coefficients of “Not sure contact patients history” ( $p < 0.001$ ), “Highly concern about family members” ( $p < 0.01$ ), and “Highly concern about this disease” ( $p < 0.05$ ) were sufficient evidence that depression scores were statistically significantly increased when people had doubts about their past contact with the patient and were highly worried about the disease and their family members. In four models, the preventative practice scores all showed significant negative relationships with depression scores, which could be explained that the better preventative practices students did, the fewer depression scores they got. The value of Waston was close to 2, indicating that the observed value was independent. Although R was small, the  $p$  values of F value in these 4 models were less than 0.01, showing a strong correlation of the interpretive power of the models.

## 4. Discussion

### 4.1. Preventative Practices and Depression Status of the “International Group” and “Mainland Group” Students

This study found that these college students had a certain degree of knowledge of COVID-19. Combined with the results of information satisfaction and information sources, most of them had mastered how the virus transmitted and heard about the detailed information of cases. The results show that the publicity work and health education of schools, health institutions and mass media are showing impact. And it has been reported that public concern over the outbreak is growing as confirmed and suspected cases continue to increase, with the increasing number of provinces and countries affected by the outbreak [13].

Some studies have done early on the effects of the COVID-19 on Chinese university students' psychological state [15,28,36], but the related Chinese respondents investigated were only in mainland China. Because the “Patient No. 31” who had participated in a gathering in Daegu at the Shincheonji Church of Jesus the Temple of the Tabernacle of the Testimony led to a sudden outbreak of the epidemic in South Korea [44] that attracted worldwide attention, which suggested upgraded quarantine and isolation were needed [45]. Due to most of the “International Group” students in South Korea live alone, they are faced with the fear and further quarantine of the epidemic by themselves (83.14% of them had self-quarantined). The study also demonstrated that “International Group” students and “Mainland Group” students experienced similar worries and concerns about this disease and family members. But it should be taken seriously that a notable part of students believed they had a high perceived probability of getting an infection from this disease in “Mainland Group”. This is also consistent with the situation in mainland China, where COVID-19 has covered almost every province since January. In addition, as for the



preventative practices, only in “avoiding using elevator” and “sitting in one row while having a meal”, the “Mainland Group” did better than that in “International Group”. Therefore, effective measures to prevent the virus should be more publicized through health education and publicity work by health institutions and mass media in mainland China.

The depressive disorder is one of the most common mental disorders, with a lifetime prevalence of 6.9% and a 12-month prevalence of 3.6% in the Chinese general population [46]. The average scores of PHQ-9 in these two groups were 7.20 (CI: 6.390-7.800) for “International Group” and 6.20 (CI: 5.583-6.819) for “Mainland Group” respectively, and the proportion (28.7%) of “International Group” who experienced mild-to-severe symptoms was much higher than that in “Mainland Group” (18.9%) according to the cut-off 10 points. The depression result is higher than the average prevalence (12.6%) for college students in the general survey [47]. Under the stress of the coronavirus outbreak, the relationships of preventative practices, contact patients history, concern about family members, and concern about this disease, with depression scores in these respondents also showed that the outbreak of COVID-19 may have a certain impact on the psychological state of these college students. Especially for “International Group” students, the universities of South Korea urgently need to take necessary psychological interventions and health education measures for them.

Improving college students' knowledge and prevention of the virus is conducive to their psychological health. As demonstrated in this study, the more comprehensive preventive measures, the better the psychological state of college students, which were further manifested by the lower risk of mild depression and the more positive their response to the epidemic. Therefore, pertinent departments and universities should make good use of social networking platforms, social software, etc. to attract university students to receive relevant and comprehensive news and information, and education on COVID-19.

Psychological thoughts of college students could also affect college students' mental health. The results of the study showed that students who felt good about their bodies and did not suspect contact with the patient, in the low level of stress and worry about their families and this disease, had lower depression scores. In this outbreak, the generation of rumors and their influence cannot be overlooked [48]. The negative and false contents of the epidemic information have a great deal of psychological impact [49] on the students because receiving a lot of negative information could make them feel negative and require the companionship of family and friends at this time, but the biggest problem is that most of the students studying abroad are alone because the countries' banning on transportation and migration. Thus, more social and school support is needed to help them turn into a positive mindset. At the same time, government departments should release fair information in time to reduce the spread of discriminatory information, and schools should give students more caring.

#### 4.2. Implications

Both government departments and universities should provide and ensure the dissemination of fair information, and carry out a variety of effective health education and health activities according to the

characteristics of the two students groups in time so that university students could understand the more comprehensive information of COVID-19 and implement the relevant preventive measures better. Moreover, psychological consultation and help to reduce the negative effects on university students brought by the outbreak are also needed.

#### 4.3. Limitation and Future Research

This study has several limitations. Owing to the restrictions of various activities and methods limitations during the COVID-19 pandemic, first, a web-based questionnaire was adopted in this study, which may have some shortcomings. One example is that self-assessed levels of physical condition and depression scores may not always be aligned with assessment by their real situation because of the “socially desirable response”. Second, the survey method employed was a Snowball sampling method and therefore may not be possible to make statistical inferences from the sample to the population on account of the absence of random selection of samples. Third, the case that the severity of the epidemic varies from region to region, and the effects on depression of these university students may be also different. Therefore, we need further study on their depression status, we are planning to conduct a prospective study on a comparable group. Notwithstanding the above limitations, this study provides invaluable information on the Knowledge, Preventative practice, and Depressive symptoms from Chinese students in two countries (China and South Korea) that had suffered the big outbreak of COVID-19 at that time. Our results could be used as a valuable reference for further psychological interventions for college students in different areas during public health events.

## 5. Conclusions

The present study investigates the knowledge, preventative practices, and depression status of Chinese university students living in South Korea and Mainland China during the COVID-19 outbreak, and furtherly explore the determinants of depression among these 2 groups' students. The results showed that the majority of these 2 groups' respondents had a satisfactory level of knowledge of COVID-19. The “International Group” students did better than the “Mainland Group” students regarding preventative practices, but the percentage of mild depression was higher in the “International Group”. Highly concerned about family members, highly concerned about getting COVID-19, and having a suspicion of contact with patients increased the depression state among the respondents. Meanwhile, taking preventative behaviors more comprehensively can decrease the depression state of both groups.

## Declarations

***Ethics approval and consent to participate:*** All respondents gave their informed consent for inclusion before they participated in the study. This study was approved by Yonsei University Institutional Review Committee (IRB) before the data collection (Task No. 1041849-202005 - SB-054-01)

***Consent of publication:*** Not applicable.

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## Tables

Table 1. Demographic and general characteristics of the participants.

Variables	International Group (n = 171)	Mainland Group (n = 249)	Total (n = 420); n(%)	t/ $\chi^2$ (Pearson)	P
Gender					
Male	57 (33.33)	76 (30.52)	133 (31.67)	0.370	0.543
Female	114 (66.67)	173 (69.48)	287 (68.33)		
Age					
Mean $\pm$ S.D.	24.08 $\pm$ 4.14	22.12 $\pm$ 2.28	22.90 $\pm$ 3.30	5.427 <sup>a</sup>	<0.001
Educational Level					
Undergraduate	98 (57.31)	177 (71.08)	275 (65.48)	8.509	0.004
Graduate	73 (42.69)	72 (28.92)	145 (34.52)		
Marital Status					
Single	159 (92.98)	242 (97.19)	401 (95.48)	4.153	0.042
Married	12 (7.02)	7 (2.81)	19 (4.52)		
Family Size					
1 member	9 (5.26)	1 (0.40)	10 (2.38)	32.126	<0.001
2 members	24 (14.04)	8 (3.21)	32 (7.62)		
3-5 members	134 (78.36)	221 (88.76)	355 (84.52)		
6 members or more	4 (2.34)	19 (7.63)	23 (5.48)		
Medical Insurance					
No	28(16.37)	16(6.43)	44(10.48)	10.699	0.001
Yes	143(83.63)	233(93.57)	376(89.52)		
Chronic illness					
No	159 (92.98)	232 (93.17)	391 (93.10)	0.006	0.940
Yes	12 (7.02)	17 (6.83)	29 (6.90)		
Traveled abroad					
No	166 (97.08)	244 (97.99)	410 (97.62)	0.366	0.545
Yes	5 (2.92)	5 (2.01)	10 (2.38)		
Self-quarantined					
No	29 (16.96)	119 (47.79)	148 (35.24)	42.230	<0.001
Yes	142(83.04)	130 (52.21)	272 (64.76)		
Self-assessed physical condition					
Above good	153 (89.47)	227 (91.16)	380 (90.48)	1.206	0.752
Below fair	18 (10.53)	22 (8.84)	40 (9.52)		

Note: 'International Group' means the Chinese college students who studying in South Korea; 'Mainland Group' means the Chinese college students who studying in Mainland China. a: t-test

Table 2. Difference in knowledge about COVID-19.

Variables	International Group (N = 171)	Mainland Group (N = 249)	Total (N = 420); n(%)	t/ $\chi^2$ (Pearson)	P
Route of transmission					
Droplets (agree)	171 (100)	248 (99.60)	419 (99.76)	0.688	0.407
Objects (agree)	145 (84.80)	228 (91.57)	373 (88.81)	6.213	0.045
Air (agree)	116 (67.84)	165 (66.27)	281 (66.90)	1.037	0.595
Updated information					
Infected cases (yes)	168 (98.25)	249 (100)	417 (99.29)	4.400	0.036
Death cases (yes)	169 (98.93)	247 (99.20)	416 (99.05)	0.144	0.704
Recovered cases (yes)	163 (95.32)	245 (98.39)	408 (97.14)	3.447	0.063
Number of information source					
1~3	161 (94.15)	226 (90.76)	387 (92.14)	1.608	0.205
4~6	10 (5.85)	23 (9.24)	33 (7.86)		
Information satisfaction					
Above Satisfied	157 (91.81)	239 (95.98)	396 (94.3)	3.274	0.070
Below dissatisfied	14 (8.19)	10 (4.02)	24 (5.7)		
Confidence about diagnose					
Highly confident	101 (59.06)	192 (77.11)	293 (69.76)	15.647	<0.001
Lowly confident	70 (40.93)	57 (22.89)	127 (30.24)		
Concern about this disease					
Highly	123 (61.93)	155 (62.25)	278 (66.19)	4.246	0.039
Lowly	48 (38.07)	94 (37.75)	142 (33.81)		
Perceived probability					
Get infected (high)	59 (34.50)	48 (19.28)	107 (25.48)	12.379	<0.001
Survive after infection (high)	157 (91.81)	216 (86.74)	373 (88.81)	2.618	0.106
Concern about family members					
Highly	139 (81.29)	192 (77.11)	331 (78.81)	1.060	0.303
Lowly	32 (18.71)	57 (22.89)	89 (21.19)		
Knowledge score					
Mean $\pm$ S.D	13.95 $\pm$ 1.88	13.99 $\pm$ 1.92	13.97 $\pm$ 1.90	-0.184 <sup>a</sup>	0.854

a: t-test

Table 3. Preventative practice against COVID-19 taken by Chinese students in the two countries.

Mean  $\pm$  S.D



Variables(Score: 1-5)	International Group (n = 171)	Mainland Group (n = 249)	Total (n = 420)	t
wearing mask regardless of the presence or absence of symptoms	4.32 ± 0.79	4.27 ± 0.89	4.30 ± 0.86	0.52
wearing mouth when coughing and sneezing	4.67 ± 0.80	4.36 ± 1.02	4.49 ± 0.95	3.28 ***
washing hands with soap and water	4.84 ± 0.44	4.62 ± 0.66	4.71 ± 0.59	2.83 ***
washing hands immediately after coughing, washing nose or sneezing	4.18 ± 1.05	3.98 ± 1.13	4.06 ± 1.10	1.76*
washing hands after touching contaminated objects	4.93 ± 0.38	4.47 ± 0.78	4.66 ± 0.69	7.11 ***
avoiding public transportation	4.73 ± 0.66	4.58 ± 0.72	4.65 ± 0.70	2.23 *
avoiding elevators	3.44 ± 1.40	4.18 ± 1.19	3.88 ± 1.33	-5.81 ***
sitting in one row while having a meal	2.80 ± 1.70	4.22 ± 1.18	3.64 ± 1.57	-10.13 ***
avoiding meeting more than 10 people	4.74 ± 0.89	4.76 ± 0.62	4.75 ± 0.74	-0.22

\* $p < 0.05$  \*\* $p < 0.01$  \*\*\* $p < 0.001$ .

Table 4. Difference in depressive states of the students in the two countries.

		Mean ± SD		
PHQ-9		International Group (n = 171)	Mainland Group (n = 249)	Total (n = 420); n(%)
Scores		7.20 ± 0.41	6.20 ± 0.31	6.60 ± 5.14
Cut-off score: 10 points	minimal-to-mild moderate-to-severe	122 (71.35) 49 (28.65)	202 (81.12) 47 (18.88)	324 (77.14) 96 (22.86)

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\*  $p < 0.001$

Table 5. Stepwise regression analysis on related factors of depression due to COVID-19

Dependent Variable	Independent Variables	$\beta$	Std. Error	$\beta'$	t	p	[95% Conf. Interval]	
PHQ-9 Scores	Constant	13.793	3.186		4.329	0.000	7.501	20.084
	Concern on family members	1.069	0.386	0.205	2.772	0.006	0.308	1.890
	Patients contact history	0.574	0.231	0.185	2.489	0.014	0.119	1.030
	Information Satisfaction	-1.351	0.671	-0.148	-2.013	0.046	-2.676	-0.026
	Self-assessed physical condition	-1.491	0.594	-0.179	-2.509	0.050	-2.388	-0.002

Table 6. Hierarchical regression analysis on determinants of depression using PHQ-9 during COVID-19 (n = 420).

Variables	Model 1		PHQ-9. Model 2		Model 3		Model 4	
	$\beta$	t(p)	$\beta$	t(p)	$\beta$	t(p)	$\beta$	t(p)
Constant	12.122	3.439***	13.137	3.713***	11.586	3.296***	10.264	2.936**
Preventative practice score	-0.165	-3.221***	-0.155	-3.027**	-0.139	-2.745**	-0.138	-2.749**
Age	0.199	1.691	0.214	1.823	0.213	1.842	0.225	1.966*
Gender								
Male	(ref)		(ref)		(ref)		(ref)	
Female	-0.145	-0.547	-0.097	-0.178	-0.020	-0.037	-0.231	-0.431
Educational level								
Undergraduates	(ref)		(ref)		(ref)		(ref)	
Graduates	-0.401	-0.531	-0.466	-0.620	-0.609	-0.820	-0.706	-0.963
Marital status								
Single	(ref)		(ref)		(ref)		(ref)	
Married	-0.990	-0.742	-1.186	-0.892	-0.938	-0.714	-0.898	-0.693
Knowledge belief score	-0.142	-1.025	-0.149	-1.081	-0.109	-0.836	-0.165	-1.279
Information satisfaction								
Lowly	(ref)		(ref)		(ref)		(ref)	
Highly	-1.517	-1.415	-1.486	-1.392	-1.316	-1.249	-1.486	-1.426
Self-assessed physical condition								
Below fair			(ref)		(ref)		(ref)	
Above good			-1.865	-2.208*	-1.702	-2.040*	-1.501	-1.820
Contact patients history								
No					(ref)		(ref)	
Yes					-2.842	-0.983	-2.900	-1.015
Not sure					4.413	3.539***	4.069	3.287***
Concern on family members								
Lowly							(ref)	
Highly							1.580	2.624**
Concern on this disease								
Lowly							(ref)	
Highly							1.098	2.081*
F	2.778**		3.063**		3.875***		4.456***	
R <sup>2</sup>	0.045		0.056		0.087		0.116	
Adjusted R <sup>2</sup>	0.029		0.038		0.064		0.090	
Durbin-Watson				1.972				

\* $p < 0.05$  \*\* $p < 0.01$  \*\*\* $p < 0.001$

## Supplementary Files

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