Knowledge, Attitude and Practice Associated with COVID-19 among University Students: a Cross-Sectional Survey in China

Yaling Peng1,3, Chenchen Pei2,3, Yan Zheng1,3, Juan Wang1, Kui Zhang1, Zhaohui Zheng1*, Ping Zhu1*

1Department of Clinical Immunology, PLA Specialized Research Institute of Rheumatology & Immunology, Xijing Hospital, Fourth Military Medical University, Xi’an, China

2Department of Dermatology, Xijing Hospital, Fourth Military Medical University, Xi’an, China.

3These authors contributed equally to the study.

*Corresponding authors: Ping Zhu and Zhaohui Zheng, Department of Clinical Immunology, PLA Specialized Research Institute of Rheumatology & Immunology, Xijing Hospital, Fourth Military Medical University; No. 127 Changle West Rd, Xi’an710032, Shaanxi, China; Tel: +86 29 84771581, +86 29 84775355; Email: zhuping@fmmu.edu.cn, zhengzh@fmmu.edu.cn

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Abstract

**Background:** The current COVID-19 pandemic is effectively constrained by intensified public health measures in China, among which ubiquitous education plays a vital part. **Objective:** This survey aims to understand the status quo acquisition of the ongoing public health education campaign among university students. **Methods:** We designed this cross-sectional survey to investigated the knowledge, attitude and practice (KAP) associated with COVID-19 among university students during their household isolation at the peak of this pandemic. 872 university undergraduates were recruited from 10 universities in Shaanxi Province, China, in a stratified cluster sampling method. A self-administered and close-ended questionnaire was answered by subjects online voluntarily and anonymously to collect their answers regarding their KAP associated with COVID-19. **Results:** Results showed that appropriate knowledge was acquired by 82.34% subjects, but the level was significantly higher in students from public universities and medical programs than in their counterparts ($P < 0.05$). 73.81% subjects reported positive attitude, with level significantly higher in females ($P < 0.01$). Proactive practice was found in 87.94% subjects. Taken together, the score of KAP was $4.12 \pm 0.749$, $8.54 \pm 1.201$, and $8.91 \pm 1.431$ respectively, suggesting a positive correlation between attitude and practice ($r=0.319$, $P<0.01$). Total KAP score was $21.57 \pm 2.291$, apparently correlated with gender ($r=0.096$, $P=0.005$) and major ($r=-0.081$, $P=0.017$). **Conclusions:** Most university students acquired necessary knowledge, positive attitude and proactive practice towards COVID-19, but their KAP score significantly varied by gender, major and school
Keywords: university students, COVID-19, knowledge, attitude and practice

1. Introduction

Since late December 2019, numerous viral pneumonia cases of unknown causes have been consecutively reported in Wuhan city, China. Then the pathogen was soon isolated, analyzed, performed viral genome sequencing and finally identified as a novel strain of coronavirus. Different from both MERS-CoV and SARS-CoV, this is identified as the seventh member of the coronaviruses family that infects human[1]. Increasing evidence shows that, COVID-19 is less lethal but more contagious than SARS-Cov and MERS-CoV[2][3][4]. The outbreak soon spread to the whole country, reached beyond the boarder and was declared as a Public Health Emergency of International Concern by World Health Organization in late January, 2020[5].

To curb the virus, China quickly announced first-level public health emergency response and adopted a series of extraordinary measures during the so called “massive isolation and disinfection” period in the extended Spring Festival holiday, ranging from the lockdown of epicenter city, ubiquitous public health education, massive disinfection, rigorous in-door quarantine and person-to-person health check-ups, as well as delayed school and workplace opening date, etc[6]. The outbreak impacted all stakeholders in education in an unprecedented way. Among them, university students represent a special group characterized by more autonomy and pressing need to live
independently, but lack of life experience. Thus their perceptions and behaviors are presumably more affected by this pandemic. Therefore, the authors conducted a cross-sectional investigation on the knowledge, attitude and practice (KAP) associated with COVID-19 among university students to assess their current acquisition of this public health education campaign, which reflects the response of young people in China to a certain degree. We hope our investigation will provide evidence to help health authorities improve COVID-19 education and preventative measures in university.

2. Methods

2.1 Sampling of subjects

This survey employed a stratified cluster sampling method, enrolling 872 university undergraduates from 10 universities in Shaanxi Province, China, during February 23 to 28, 2020 when they were isolated and observed at home. Data were collected using an online convenient questionnaire tool named WJX (https://www.wjx.cn/). All subjects were informed of the survey purpose and the option that they may withdraw from the study at any time. They all volunteered to participate and written informed consents were obtained from all adult subjects or if subjects were under 18, from a legal guardian for inclusion before they started. This study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of Xijing Hospital.”

2.2 Survey tool
The questionnaire was developed with questions adapted from *COVID-19 Diagnosis and Treatment Protocol (Tentative Version Six)* issued by National Health Commission of China[7]. The questionnaire included 6 demographic variables (age, name of university, grade, major, type of school, and birthplace), 7 variables about knowledge of COVID-19 (classification of infectious disease, major route of transmission, main clinical manifestation, incubation period, susceptible population, as detailed in Table 1), 5 variables about attitude towards COVID-19 (human-to-human transmission, wild animal consumption, endurance to emergency, impact on study, pandemic control measures, as detailed in Table 2) and 5 variables of practice related to COVID-19 (self-protection, help frontline rescue, meet cured patients, stay isolated, return to school, as detailed in Table 3).

Table 1 COVID-19 knowledge among university students

| Variable categories | Options                                      | Determination/ score | N (%)     |
|---------------------|----------------------------------------------|----------------------|-----------|
| **K1: What type of infectious disease is COVID-19?** | ● Bacterial.                                 | Incorrect/ 0         | 17 (1.95) |
|                     | ● Viral.                                     | Correct/ 1           | 848 (97.25) |
|                     | ● I don’t know.                              | Incorrect/ 0         | 7 (0.80)   |
| **K2: What is the main transmission route of COVID-19?** | ● Respiratory droplets and close contact.    | Correct/ 1           | 862 (98.85) |
|                     | ● Water.                                     | Incorrect/ 0         | 2 (0.23)   |
|                     | ● Food.                                      | Incorrect/ 0         | 5 (0.57)   |
|                     | ● I don’t know.                              | Incorrect/ 0         | 3 (0.35)   |
| **K3: How long is COVID-19 incubation period?** | ● 1~ 14 days.                                | Correct/ 1           | 579 (66.40) |
|                     | ● 3 ~ 7 days.                                | Incorrect/ 0         | 21 (2.41)  |
More than 14 days. Incorrect/0 265 (30.39)
I don’t know. Incorrect/0 7 (0.80)

K4: Who are susceptible to COVID-19?

The old and children. Incorrect/0 297 (34.06)
People are generally susceptible. Correct/1 441 (50.57)
Young adults. Incorrect/0 11 (1.26)
People with pre-existing diseases. Incorrect/0 117 (13.42)
I don’t know. Incorrect/0 6 (0.69)

K5: What are the main clinical manifestations of COVID-19?

Fever and dry cough. Correct/1 860 (98.63)
Fatigue. Incorrect/0 3 (0.34)
Stuffy and runny. Incorrect/0 1 (0.11)
Sore throat and myalgia. Incorrect/0 2 (0.23)
Diarrhea. Incorrect/0 0 (0)
I don’t know. Incorrect/0 6 (0.69)

Table 2 Attitude toward COVID-19 among university students

| Variable categories | Options | Determination/ score | N (%) |
|---------------------|---------|----------------------|-------|
| A1. Are you scared by human-to-person transmission of COVID-19? | Yes, but I’m rational and I can protect myself. | Positive/2 | 812 (93.10) |
| | I don’t care, I feel the same. | Neutral/1 | 32 (3.70) |
| | I’m panic and don’t know what to do. | Negative/0 | 28 (3.20) |
| A2. Do you hope the outbreak stop fast so you can return to school soon? | Yes. | Positive/2 | 673 (77.20) |
| | I don’t care. | Neutral/1 | 147 (16.90) |
| | No, I want to stay at home as long as possible. | Negative/0 | 52 (5.90) |
A3. What’s your attitude towards wild animal consumption?
- I don’t eat wild animals, and I will accuse consumers. Positive/2 689 (79.01)
- I don’t personally, but I won’t stop others Neutral/1 155 (17.78)
- I don’t mind to have a try. Negative/0 28 (3.21)

A4. Do you think you will be more capable to endurance such public health emergence?
- Yes, I’m more educated and thus more capable. Positive/2 740 (84.90)
- I will be the same Neutral/1 111 (12.70)
- No, I’m too scared to withstand it anymore. Negative/0 21 (2.40)

A5. Do you think this outbreak has impacted your study?
- Yes, it did have. Negative/0 568 (65.10)
- No, I’m self-disciplined and my study was not affected at home. Positive/2 304 (34.90)

Table 3 Practices related to COVID-19 among university students

| Variable categories | Options                                                                 | Determination/ score | N (%)   |
|---------------------|-------------------------------------------------------------------------|----------------------|---------|
| **P1:** What would you do if you had fever and dry cough? | I will analyze the situation rationally. Stay home for observation and quarantine or go to the hospital for treatment. | Proactive/2          | 817 (93.69) |
|                     | I want to go to the hospital, but I’m afraid to be infected.           | Neutral /1           | 39 (4.47) |
|                     | I feel panic. I don’t know what to do.                                  | Passive/0            | 16 (1.84) |
| **P2:** If the country needs you, are you willing to help the frontline rescue? | Yes, a country’s trouble is everyone’s responsibility.                  | Proactive/2          | 812 (93.12) |
|                     | I’m not sure and need suggestions from the family.                      | Neutral /1           | 45 (5.16) |
|                     | No, it’s too dangerous.                                                 | Passive/0            | 15 (1.72) |
2.3 Score grading

A common grading method was used for each variable in this KAP questionnaire as follows. 1 point was given to the correct option, and 0 for the incorrect answer in the Knowledge Section; 2 for positive, 1 for neutral and 0 for negative option in the Attitude Section; 2 for proactive, 1 for neutral and 0 for passive option in the Practice Section.

2.4 Data processing and analysis

Data were processed using SPSS 18.0 software. *T* test was used to compare mean values of variables. *Chi square* test was utilized to compare categorical variables and ratios. Spearman correlation analysis was employed to compare two variables; $\alpha=0.05$, $P<0.05$ was reckoned statistically significance in two-sided test.

| P3: What would you do if you had close contact with confirmed cases? |
|---------------------------------------------------------------|
| • Proactively report to the community and stay in quarantine as required. | Proactive/2 | 852 (97.71) |
| • Same as before. | Neutral /1 | 3 (0.34) |
| • I feel panic and don’t know what to do. | Passive/0 | 17 (1.95) |

| P4: What would you do if someone cured from COVID-19 wanted to meet you? |
|---------------------------------------------------------------------------|
| • I will meet them and show more kindness. | Proactive/2 | 697 (79.93) |
| • I will meet them just like before. | Neutral /1 | 40 (4.59) |
| • I’ll find excuse to keep away from them. | Passive/0 | 135 (15.48) |

| P5: What will be your top priority when the epidemic stops? |
|-------------------------------------------------------------|
| • I will go back to school and restart normal study. | Proactive/2 | 656 (75.23) |
| • Same as before. | Neutral /1 | 30.34) |
| • The outbreak is too scary. I need to enjoy my life as much as possible. | Passive/0 | 213 (24.43) |
3. Results

3.1 Demographical characteristics of subjects

All the subjects were recruited from ten regular universities in Xi’an, Shaanxi Province, including five public and five private schools. Among them, 534/872 (61.24%) were females and 338/872 (38.76%) were males; 430/872 (49.31%) were medical students and 442/872 (50.69%) were from non-medical majors; 453/872 (51.90%) attended public schools and 442/872 (50.69%) were from private schools. 580/872 (66.51%) were in their first year and the rest 292/872 (33.49%) were in other years. The subjects were between 17-25 years old, with the mean age 20.06±0.072. The hometown of student was reported as covering 28 provinces, autonomous regions and municipalities of China.

3.2 Knowledge of COVID-19

COVID-19 related knowledge was assessed by 5 items. Each question and its options were described with graded scores in Table 1. Among the total 4,360 answers, 3,590 (82.34%) indicated correct knowledge. To further analyze, the female had significantly higher score for K5 than the male; public school students had significantly higher score for K1 and K4 than private school students. Other items were found with no statistically significant difference between groups (Table 4).
Table 4 Comparison of COVID-19 knowledge between different groups

| Variables* | Gender (n, %) | Major (n, %) | Grade (n, %) | Type of school (n, %) |
|------------|--------------|--------------|--------------|----------------------|
|            | Male | Female | χ²  | P   | Medical | Non-medical | χ²  | P   | First year | Other grades | χ²  | P   | Public | Private | χ²  | P   |
| K1-correct |     |       |     |     |         |             |     |     |            |              |     |     |        |         |     |     |
|            | 2.467 | 0.116 | 0.233 | 0.63 |         |             |     |     | 0.798 | 0.372 |         |             |     |     | 7.181 | 0.007 |
|            | 325 (97.04) | 523 (97.94) | 417 (96.98) | 431 (97.51) | 562 (96.7) | 286 (97.95) | 447 (98.68) | 401 (95.7) |     |     |            |              |     |     |        |         |     |     |
| K2-correct | 0.007 | 0.936 | 1.509 | 0.219 |         |             | 0.193 | 0.661 |         |             |     |     | 0.579 | 0.447 |
|            | 334 (98.82) | 528 (98.88) | 427 (99.3) | 435 (98.42) | 574 (98.97) | 288 (98.63) | 449 (99.12) | 413 (98.57) |     |     |            |              |     |     |        |         |     |     |
| K3-correct | 1.925 | 0.165 | 3.205 | 0.073 | 1.435 | 0.231 |         |             |     |     | 0.101 | 0.751 |
|            | 215 (63.61) | 364 (68.16) | 298 (69.3) | 281 (63.57) | 393 (67.76) | 186 (63.7) | 303 (66.89) | 276 (65.87) |     |     |            |              |     |     |        |         |     |     |
| K4-correct | 0.000 | 0.993 | 1.669 | 0.196 |         |             | 0.002 | 0.963 |         |             |     |     | 7.28  | 0.007 |
|            | 171 (50.59) | 270 (50.56) | 227 (52.79) | 214 (48.42) | 293 (50.52) | 148 (50.68) | 249 (54.97) | 192 (45.82) |     |     |            |              |     |     |        |         |     |     |
| K5-correct | 3.992 | 0.046 | 1.243 | 0.265 |         |             | 0.366 | 0.545 |         |             |     |     | 0.199 | 0.656 |
|            | 330 (97.63) | 530 (99.25) | 426 (99.07) | 434 (98.19) | 573 (98.79) | 287 (98.29) | 446 (98.45) | 414 (98.81) |     |     |            |              |     |     |        |         |     |     |

* The questions and correct option of each variable is described in Table 1.
3.3 Attitude toward COVID-19

Items about COVID-19 attitude including 5 single choice questions. Each question and its options were described with graded scores in Table 2. Among all 4,360 answers, 3,218 (73.81%) indicated positive attitude. The female had scored significantly higher for A1 and A3 than the male. Students from public schools scored significantly higher for A2, A3 and A5 than those from private schools (Table 5).
| Variables* | Gender (n, %) | Major (n, %) | Grade (n, %) | Type of school (n, %) |
|------------|--------------|--------------|--------------|-----------------------|
|            | Male         | Female       | Medical      | Non-medical           | χ² | P   | Medical | Non-medical | χ² | P   | Medical | Non-medical | χ² | P   |
| A1-positive| 7.911        | 0.019        | 0.601        | 0.74                | 0.841 | 0.657 | 0.579   | 0.749       |
|            | 307 (90.83)  | 505 (94.57)  | 401 (93.26)  | 411 (92.99)         |      |      |         |             |
| A2-positive| 5.312        | 0.070        | 5.347        | 0.069               | 5.415 | 0.067 | 6.49    | 0.039       |
|            | 255 (75.44)  | 418 (78.28)  | 334 (77.67)  | 339 (76.7)          |      |      |         |             |
| A3-positive| 36.562       | 0.000        | 5.101        | 0.078               | 5.044 | 0.08  | 8.819   | 0.012       |
|            | 233 (68.93)  | 456 (85.39)  | 353 (82.09)  | 336 (76.02)         |      |      |         |             |
| A4-positive| 4.593        | 0.101        | 0.978        | 0.613               | 0.248 | 0.883 | 3.319   | 0.19        |
|            | 276 (81.66)  | 464 (86.89)  | 369 (85.81)  | 371 (83.94)         |      |      |         |             |
| A5-positive| 0.313        | 0.576        | 1.264        | 0.261               | 0.232 | 0.630 | 5.897   | 0.015       |
|            | 114 (33.72)  | 190 (35.58)  | 142 (33.02)  | 162 (36.65)         |      |      |         |             |

* The questions and positive option of each variable is described in Table 2.
3.4 Practice related to COVID-19

Practice related to COVID-19 was assessed by 5 single-choice questions. Each question and its options were described with graded scores in Table 3. Among the 4,360 answers collected, 3,834 (87.94%) indicated proactive practice. The female had significantly higher score for variables P2-P5, except P1. Students in higher graders had significantly higher score for P5 than freshmen (Table 6).
Table 6 Comparison of COVID-19 practice between different groups

| Variables* | Gender (n, %) | Major (n, %) | Grade (n, %) | Type of school (n, %) |
|------------|---------------|--------------|--------------|----------------------|
|            | Male | Female | χ²   | P   | Medical | Non-medical | χ²   | P   | First year | Others | χ²   | P   | Public | Private | χ² | P |
| P1-proactive | 3.126 | 0.210 | 5.219 | 0.074 | 3.985 | 0.136 | 2.295 | 0.318 |
|             | 311 (92.01) | 506 (94.76) | 411 (95.58) | 406 (91.86) | 550 (94.83) | 267 (91.44) | 419 (92.49) | 398 (94.99) |
| P2- proactive | 24.885 | 0.000 | 4.196 | 0.123 | 1.191 | 0.551 | 1.331 | 0.514 |
|             | 297 (87.87) | 515 (96.44) | 407 (94.65) | 405 (91.63) | 542 (93.45) | 270 (92.47) | 420 (92.72) | 392 (93.56) |
| P3- proactive | 3.89 | 0.049 | 0.152 | 0.696 | 0.662 | 0.416 | 0.031 | 0.860 |
|             | 326 (96.45) | 526 (98.5) | 421 (97.9) | 431 (97.51) | 565 (97.41) | 287 (98.29) | 443 (97.79) | 409 (97.61) |
| P4- proactive | 9.294 | 0.010 | 1.903 | 0.386 | 1.504 | 0.471 | 0.747 | 0.688 |
|             | 273 (80.77) | 424 (79.4) | 348 (80.93) | 349 (78.96) | 470 (81.03) | 227 (77.74) | 367 (81.02) | 330 (78.76) |
| P5- proactive | 6.411 | 0.011 | 0.006 | 0.936 | 6.494 | 0.011 | 0.192 | 0.661 |
|             | 270 (79.88) | 386 (72.28) | 324 (75.35) | 332 (75.11) | 421 (72.59) | 235 (80.48) | 338 (74.61) | 318 (75.89) |

* The questions and proactive option of each variable is described in Table 3.
3.5 Comparison of COVID-19 related KAP scores between different groups

KAP score related to COVID-19 was 4.12±0.749, 8.54±1.201, and 8.91±1.431 respectively. Knowledge level was significantly higher in students from public schools and medical programs than their counterparts from private schools and non-medical majors ($P<0.05$); attitude level was significantly higher in females ($P<0.01$); practice level was found with no statistically significant difference between groups by gender, grade, major or school style (Table 7).
Table 7 Comparison of COVID-19 related KAP scores between different groups

| Variables    | (n) | Knowledge | Attitude | Practice |
|--------------|-----|-----------|----------|----------|
|              |     | $\bar{x} \pm s$ | $t$ | $P$ | $\bar{x} \pm s$ | $t$ | $P$ | $\bar{x} \pm s$ | $t$ | $P$ |
| Gender       |     |             |         |          |             |         |          |             |         |          |
| Male         | 338 | 4.07±0.777 | -1.537  | 0.125    | 8.30±1.332  | -4.706  | 0.000    | 8.92±1.463 | 0.176    | 0.860    |
| Female       | 534 | 4.15±0.729 | -1.537  | 0.125    | 8.69±1.085  | -4.706  | 0.000    | 8.90±1.412 | 0.176    | 0.860    |
| Major        |     |             |         |          |             |         |          |             |         |          |
| Medical      | 430 | 4.17±0.713 | 2.240   | 0.025    | 8.59±1.159  | 1.058   | 0.290    | 9.00±1.366 | 1.751    | 0.080    |
| Non-medical  | 442 | 4.06±0.779 | -2.240  | 0.025    | 8.50±1.240  | -1.058  | 0.290    | 8.83±1.489 | 1.751    | 0.080    |
| Grade        |     |             |         |          |             |         |          |             |         |          |
| First year   | 580 | 4.13±0.733 | 0.686   | 0.493    | 8.59±1.155  | 1.758   | 0.079    | 8.89±1.432 | -0.474   | 0.636    |
| Others       | 292 | 4.09±0.779 | -0.686  | 0.493    | 8.44±1.284  | -1.758  | 0.079    | 8.94±1.431 | -0.474   | 0.636    |
| School type  |     |             |         |          |             |         |          |             |         |          |
| Public       | 453 | 4.18±0.748 | 2.636   | 0.009    | 8.52±1.251  | -0.548  | 0.584    | 8.89±1.505 | -0.472   | 0.637    |
| Private      | 419 | 4.05±0.743 | -0.548  | 0.584    | 8.57±1.146  | 8.89±1.505 | 8.93±1.349 |
3.6 Total KAP score related to COVID-19 among university students

Total KAP score was 21.57 ± 2.291 among the subjects, in which a positive correlation was observed between the attitude and practice (r=0.319, P<0.01). Total KAP score was notably correlated to gender (r=0.096, P=0.005) and major (r=-0.081, P=0.017).

4. Discussion

Since its outbreak in December 2019, COVID-19 has become the center of global concern. The strong affinity of SARS-CoV-2 to receptors in respiratory system [8] imposes a critical threat to global public health. As of March 14, 2020, 142,539 confirmed cases and 5,393 deaths occurred globally, among which 61,518/142,539 (43.16%) confirmed cases and 2,199/5393 (40.78%) deaths were outside China. As of March 14, 18 confirmed cases, 17 suspected cases and 14 deaths newly occurred, and 27 regions were reported with 0 confirmed cases/ suspected cases deaths in China in the last 24 hours [9], indicating the outbreak is effectively controlled in China. Public health education is recognized as an effective measure to prevent and control public health emergency by preparing the public against such situation. It may affect people’s KAP by spreading appropriate knowledge, mitigating panic and encouraging positive attitude, and as well as keep people comply with aligned and desired practice. All these KAP elements are crucial to ensure effective prevention and control of the emergency.

This cross-sectional survey on 872 university undergraduates found that most students were well informed with COVID-19 related knowledge, showed positive attitude and proactive practice against the outbreak, indicating that effective health
education has been delivered by the administration through the massive public education campaign (especially via Internet), which consists with the results of investigations on H1N1 related KAP among university students in South Korea, UK and Hong Kong [10][11][12]. This investigation also revealed that the female had significantly higher score on item “clinical manifestations of COVID-19”, which consists with the result of a Saudi Arabian investigation on MERS[13]. We also found the female had a significantly higher score on attitude score and KAP total score. A few other study also reported that women was superior to men in terms of the knowledge and practice (hand hygiene, wearing a mask) related to infectious diseases (eg: H1N1, SARS, and MERS, etc)[12][13][14][15][16]. Our survey also revealed that, facing the risky human-to-human transmission, more females reported they will keep rational and can protect themselves. Besides, females showed more aversion to wild animal consumption and alleged they will accuse those eaters.

Moreover, the significantly higher score for COVID-19 related knowledge gained by subjects from public schools and medical programs may be explained by the characteristic educational situation in China that compared to private schools, public universities are innately superior in their numbers and scales, quantity and quality of students and teachers, as well as supports from the authorities, etc [18]. The significantly higher scores of knowledge gained by medical students can be further explained by their trainings in clinical medicine and public health. Their sense of duty and responsibility as a candidate medical professional may also drive them to present more positive attitude and proactive practice during this public health emergency [19].

This investigation has some notable limitations. First, the convenient sampling method, as opposed to random sampling, may not avoid subjective selection bias and thus diminishes the internal validity. Second, the nature of cross-sectional study
design was not able to determine causality between the variables. At last, our subjects
were enrolled from ten universities from a single locality, though they were staying at
hometown in twenty-eight provinces and regions at the time of survey. Still, they may
not reflect the whole picture of Chinese university students at large.

Despite these limitations, to our knowledge this study is the first investigation on
the current KAP related to COVID-19 among Chinese university students, thus it
provides invaluable insights and evidence to public health education and preventative
measures at large in Chinese universities during the COVID-19 pandemic. Results
revealed that the overwhelming majority of Chinese undergraduates had the basic
knowledge of COVID-19, but their performance varied by school type and major.
Attitude towards COVID-19 was significantly different between genders. Taken
together, these results suggest that gender, major and school style potentially affect
student’s response to COVID-19 outbreak and acquisition of public health education,
which should be noticed by education and health authorities. These factors should
also be considered when they formulate contingency plan or train the students against
similar public health emergencies.

5. Conclusion

Most Chinese university students were informed of basic information, possessed
positive attitude and proactive practice towards COVID-19, indicating the efficacy of
present public health campaign. However, results also revealed that gender, major and
school type should be taken into consideration when health and education authorities
formulate tailored public health trainings and improve their preventative measures
against the epidemic.

Declarations
**Ethics approval and consent to participate**

All subjects were informed of the survey purpose and the option that they may withdraw from the study at any time. They all volunteered to participate and written informed consents were obtained from all adult subjects or if subjects were under 18, from a legal guardian for inclusion before they started. This study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of Xijing Hospital.

**Consent for publication**

Not applicable.

**Availability of data and materials**

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

**Competing interests**

The authors declare that they have no competing interests.

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**Authors' contributions**

YL Peng conceptualized the study, designed survey and interpreted data; CC Pei drafted the manuscript; Y Zheng performed literature review and data analysis; J
Wang performed the survey; K Zhang critically reviewed and improved the manuscript; ZH Z and P Zhu improved data interpretation and revised the manuscript. All authors substantially contributed to the study and approved its submission.

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