The relationship between health-related quality of life of students at Tehran University of Medical Sciences and their knowledge, attitudes, and practices regarding COVID-19 in 2020

Reza Heidari-Soureshjani, Tayeb Mohammadi¹, Ali Hashemi-Shahraki², Roya Khorrami Estakhri³, Arezoo Rasti⁴

Abstract:
BACKGROUND: Present study attempts to investigate health-related quality of life (HRQoL) and its relation with knowledge, attitudes, and practices (KAP) of students of Tehran University of Medical Sciences (TUMS) during this pandemic.

MATERIALS AND METHODS: In this cross-sectional study which was conducted between 23 May to 21 June 2020, 470 students in different levels of TUMS were included to the study randomly. Participants completed validated, designed online questionnaire which assessed KAP towards coronavirus disease 2019 (COVID-19) and HRQoL. All statistical tests were applied, including Chi-square and Fisher’s exact test, Partial correlation, analysis of variance, multiple linear regression, multiple binary and multinomial logistic regression models ($P < 0.05$) and were performed in SPSS 16, R 4.0.2, and GraphPad Prism 6.0 softwares.

RESULTS: A total of 470 students were included in the study. The overall correct answer rate of the COVID-19 knowledge questionnaire was 74.43% and total score of the HRQoL was 72.50 (14.85). 61.7% of the students were agreed that COVID-19 will finally be successfully controlled, 44.3% had confidence that Iran can win the battle against the COVID-19, and 92.6% agreed that Quarantine will reduce the prevalence of COVID-19. Most of them adhered to health protocols and about a relation between HRQoL and knowledge we have a weak positive and unsignificant correlation between them ($r = 0.05$, $P = 0.27$).

CONCLUSIONS: TUMS students showed expected levels of knowledge, proper attitudes, and preemptive practices regarding COVID-19, whereas COVID-19 outbreak substantially affected the physical and mental health but, the students were in a way better physical health rather than mental. Therefore, motivational planning and other related intervention to improve mental health can be noticeable.

Keywords: Attitude, COVID-19, health, knowledge, quality of life

Introduction

In December 2019, an unidentified case of pneumonia was reported in Wuhan City, Hubei Province, China, which was very similar to viral pneumonia. This recently-detected virus was later named coronavirus disease 2019 (COVID-19) by
the World Health Organization (WHO). The virus has spread rapidly around the world as of 9:33 a.m. CET, January 10, 2021, there have been more than 88.1 million confirmed cases of COVID-19, including more than 1.9 million deaths reported to the WHO. Moreover, in Iran, more than 1.2 million people have been infected with this disease and almost 56 thousand of them have died until 10 January 2021. COVID-19 has clinical symptoms such as cough, fever, shortness of breath, fatigue, and loss of smell and taste, and also the resultant emotional and mental disorders. In this delicate situation, many universities around the world have canceled physical classes to prevent the spread of the COVID-19 infection. Furthermore, the students’ long stay at home would lead to the short and long-term adverse consequences for their physical and mental health. Previous studies have demonstrated that COVID-19 affected the health and quality of life (QoL) of the students and resulted in some students’ problems such as depression and anxiety. Previous research suggested that the mental and physical health of students should be monitored during epidemics due to their vital importance. Due to the influence of knowledge about COVID-19 on the students’ perceptions and health-related QoL (HRQoL) concerning their past experiences and beliefs, the status of knowledge, attitudes, and practices (KAP) of students becomes crucially important. 

To the best of researchers’ knowledge just one study has assessed only related knowledge, preventive behaviors, and risk perceptions of students concerning COVID-19 in Iran but not the HRQoL and its relation with KAP. Because of the probable effects of universities closure and the COVID-19 pandemic on the physical and mental health of students, this study was the first attempt to investigate HRQoL (mental and physical status) and its relation with KAP of students of Tehran University of Medical Sciences (TUMS) during COVID-19 pandemic. However, not enough researches focused on exploring the KAP towards COVID-19 among the medical students. Therefore, the results of this study can show the effectiveness of the efforts of relevant agencies (WHO and Ministry of Health and Medical Education) and additionally determine the gap for relevant interventions by demonstrating the status of KAP, mental and physical health.

Materials and Methods

Study design and setting
This cross-sectional study was conducted in TUMS from May 23 to June 21, 2020, to investigate TUMS students’ KAP of COVID-19 and its relation with HRQoL.

Study participants and sampling
The sample size calculated through using Cochran’s formula was 372 with a confidence level of 95% and 5% margin of error. Due to the TUMS closure and prevention recommendations caused by the outbreak, data was gathered using a designed online questionnaire through Telegram channels, WhatsApp, and the TUMS website. Inclusion and exclusion criteria in this study: Students entered into the study with personal consent and only TUMS students who had completed the electronic questionnaire were eligible for participation, without any age or gender restriction and finally we checked the students ID of all participants, and others were excluded from the study.

Measures
The online questionnaire consisted of three sections: Demographic data, KAP of COVID-19 and HRQoL. The demographic section included gender, marital status, age, region (village or city), history of COVID-19 infection, place of residency (dormitory or others), and academic degree (undergraduate or postgraduate).

Concerning the COVID-19 guidelines and announcement issued by WHO, the Ministry of Health and Medical Education of Iran, and a similar study conducted in China by Zhong 2020, a COVID-19 KAP questionnaire was developed by the authors of the current study.

The KAP questionnaire had 21 questions including 14 knowledge, 3 attitude, and 4 practice items. Knowledge questions had three response options of true, false, and I don’t know, in which the true answer was assigned 1 score and the false and I don’t know answer were assigned 0 point. With regard to the reliability of the modified version of Zhong’s knowledge questions, the Cronbach’s alpha coefficient was 0.82 in our sample, indicating an acceptable level of internal consistency.

SF-36 is a standardized and validated HRQoL questionnaire which was constructed to survey health status in the Medical Outcomes Study. It involved 36 questions with eight distinct health status concepts (physical functioning [PF], role-physical [RP], role-emotional [RE], vitality [VT], mental health [MH], social functioning [SF], bodily pain [BP] and general health [GH]) in order to assess HRQoL. Eight of the SF-36 scales contributed, with different degrees, to the physical component summary (PCS) and the mental component summary (MCS). PF, RP, BP and GH, contribute more significantly to the PCS, whereas VT, SF, RE, and MH, contribute more significantly to MCS to be precise.

Statistical analysis
We used mean ± standard deviation and frequency (percentage) indices to describe quantitative and qualitative variables, respectively. The univariate correlation of KAP regarding COVID-19 and HRQoL
with demographic characteristics was analyzed using independent t-test, one-way analysis of variance, and Chi-square test or Fisher’s exact test. Furthermore, multiple linear regression analysis was used to identify adjusted association of the demographic variables as independent variables and Knowledge, HRQoL, PCS, and MCS scores as the dependent variables. Partial correlation coefficients were used to assess the relationship between each of the subscales and knowledge score. Likewise, multiple binary and multinomial logistic regression models were used to identify factors associated with practices (a binary dependent variable) and attitudes (a nominal qualitative dependent variable with more than two levels), respectively. Odds ratios and their 95% confidence intervals were used to quantify the associations between the variables and KAP. Statistical analysis was performed in SPSS ver. 16 (IBM, Chicago, IL, USA) and the logistic package (for penalized binary logistic regression) in R software (version 4.0.2, R Foundation for Statistical Computing, Vienna, Austria). GraphPad Prism software (version 6.0, GraphPad, San Diego, CA, USA) was also used to draw the graphs. The level of significance selected for the statistical tests was 0.05.

**Ethical considerations**

The first page of the online questionnaire was related to the consent form which had to be approved before starting and detailed information about the study; therefore, all students were informed of the study’s goals and procedures. The study was conducted in accordance with the World Medical Association’s Helsinki Declaration for Human Studies and was approved at the ethics committee of TUMS (Approval ID: IR.TUMS. VCR.REC.1399.237).

**Results**

The online questionnaire was viewed 984 times, but only 499 (response rate: 64%) viewers completed it, and the average response time was 9 min and 46 s. About 94% of these questionnaires were completed by mobile device, 4% by personal computer, 2% by tablet phone, and the distribution networks included Telegram (41%), WhatsApp (2%), and others (57%). Among 499 respondents, only 470 included to the study because 29 of them were not the TUMS students. The mean age of students was 24.2 ± 6.84 years old (range: 17–60 years). With regard to gender, 287 of the participants (61.3%) were women and the rest of them were men. The overall correct answer rate of the COVID-19 knowledge questionnaire was 74.43% and total score of the COVID-19 knowledge and HRQoL were 10.42 (1.74) and 72.50 (14.85), respectively. Table 1 shows the COVID-19 knowledge and HRQoL scores based on the level of demographic characteristics.

HRQoL and knowledge scores showed no significant difference across demographic characteristics, but history of COVID-19 was associated with HRQoL [Table 2].

Concerning the attitudes, 61.7% of the students were agreed that COVID-19 will finally be successfully controlled (A1), 44.3% had confidence that Iran can win the battle against the COVID-19 (A2), and 92.6% agreed that quarantine will reduce the prevalence of COVID-19 (A3). The adjusted association between attitudes and demographic characteristics, knowledge, and HRQoL using multi-nominal logistic regression model are shown in Table 3 and unadjusted association is summarized in Supplementary Table S1.

The results of four questions about practices showed that 60.9% of the students did not go to crowded places in recent days (P1), 78.1% of them wore masks when leaving their houses (P2), 93.8% washed their hands when they returned home (P3) and 92.1% of the students avoided touching their eyes, their mouths and noses as far as possible (P4). The adjusted associations between practices and demographic characteristics, knowledge, and HRQoL conducted using multiple binary logistic regression are reported in Table 4 and unadjusted correlation is summarized in Supplementary Table S2.

The results showed a weak, positive, and insignificant correlation between HRQoL and knowledge ($r = 0.05$, $P = 0.27$). The results of subscales of the SF-36, showed that the mean scores of PCS and MCS were 78.21 (15.85) and 61.12 (20.89), respectively. The relationships between knowledge and two dimensions of HRQoL (PCS and MCS) regarding the students’ demographic characteristics are reported in the supplementary Table S3. Besides, the descriptive statistics and partial correlation coefficients between each of the subscales and knowledge (whilst controlling for the effect of the others) are shown in Figure 1.

![Figure 1: Result of descriptive statistics of the Subscales of the SF-36, and their relation to knowledge](image-url)
Due to the widespread prevalence of COVID-19, the subsequent quarantine and closure of universities, students’ physical and mental health has been exposed to danger. On the other hand, having enough knowledge, optimistic attitude and cautious practice about this disease could have a great impact on its prevention. Therefore, this study aimed to the investigation of such issues. According to the literature, this study was the first to investigate the impact of COVID-19 on HRQoL and its relationship with KAP among TUMS Students in 2020. The majority of the students scored more than 10 points, indicating their knowledgeability while only 0.6% showed limited (score <4 points) knowledge about COVID-19. Concerning HRQoL, about half of the students had an acceptable level of HRQoL (score more than 75) while 5.5% of them had very low level of HRQoL (score <45). The students had a relatively optimistic attitude towards COVID-19 pandemic: Most believed that social distancing (quarantine) would reduce the prevalence of COVID-19, 61.7% believed that COVID-19 would finally be successfully controlled and 44.3% believed that Iran could definitely win the
Table 3: Multi-nominal logistic regression analysis of factors associated with attitudes

| Variables                        | No versus yes | I don’t know versus yes |
|----------------------------------|---------------|-------------------------|
|                                  | A* | OR   | 95% CI | P   | OR   | 95% CI | P   |
| Gender (male versus female)      | A1 | 0.97 | 0.59-1.61 | 0.91 | 0.41 | 0.22-0.75 | 0.004 |
|                                  | A2 | 0.76 | 0.48-1.21 | 0.25 | 0.53 | 0.32-0.89 | 0.02 |
|                                  | A3 | 1.65 | 0.66-4.13 | 0.28 | 0.77 | 0.19-3.16 | 0.72 |
| Age                              | A1 | 1.004 | 0.95-1.06 | 0.89 | 1.02 | 0.97-1.08 | 0.37 |
|                                  | A2 | 1.01 | 0.96-1.06 | 0.75 | 1.02 | 0.97-1.07 | 0.53 |
|                                  | A3 | 0.85 | 0.72-1.00 | 0.052 | 1.03 | 0.92-1.16 | 0.58 |
| Marital status (married versus single) | A1 | 1.05 | 0.46-2.40 | 0.91 | 0.65 | 0.26-1.62 | 0.35 |
|                                  | A2 | 1.10 | 0.49-2.36 | 0.86 | 0.88 | 0.37-2.06 | 0.76 |
|                                  | A3 | *   | *   | *   | *   | *   | *   |
| Academic degree (postgraduate versus undergraduate) | A1 | 0.85 | 0.49-1.47 | 0.56 | 1.33 | 0.75-2.38 | 0.33 |
|                                  | A2 | 1.44 | 0.87-2.36 | 0.15 | 1.29 | 0.75-2.23 | 0.36 |
|                                  | A3 | 0.84 | 0.28-2.52 | 0.76 | 0.65 | 0.15-2.87 | 0.57 |
| Region (city versus village)     | A1 | 1.79 | 0.37-8.87 | 0.47 | 0.89 | 0.17-4.51 | 0.88 |
|                                  | A2 | *   | *   | *   | *   | *   | *   |
| Residence places (dormitory versus others) | A1 | 0.86 | 0.51-1.45 | 0.57 | 0.71 | 0.39-1.27 | 0.25 |
|                                  | A2 | 1.03 | 0.64-1.65 | 0.92 | 0.80 | 0.48-1.36 | 0.42 |
|                                  | A3 | 1.28 | 0.51-3.16 | 0.60 | 5.4  | 1.09-27.29 | 0.04 |
| History of COVID-19 (yes versus no) | A1 | 1.28 | 0.31-5.23 | 0.73 | 6.65 | 1.95-22.68 | 0.002 |
|                                  | A2 | 4.77 | 0.98-23.18 | 0.053 | 5.52 | 1.04-29.27 | 0.045 |
| Knowledge score                  | A1 | 0.98 | 0.86-1.13 | 0.81 | 0.95 | 0.81-1.12 | 0.54 |
|                                  | A2 | 0.93 | 0.81-1.06 | 0.25 | 0.91 | 0.79-1.05 | 0.19 |
|                                  | A3 | 0.70 | 0.56-0.88 | 0.003 | 0.52 | 0.37-0.71 | <0.001 |
| HRQoL score                      | A1 | 0.96 | 0.95-0.98 | <0.001 | 0.98 | 0.96-1.00 | 0.08 |
|                                  | A2 | 0.97 | 0.95-0.98 | <0.001 | 0.99 | 0.97-1.01 | 0.15 |
|                                  | A3 | 0.97 | 0.94-0.99 | 0.03 | 0.98 | 0.94-1.02 | 0.29 |

*Attitude, **Estimates do not converge because we have an empty cell. A1=Do you agree that COVID-19 will finally be successfully controlled?, A2=Do you have confidence that Iran can win the battle against the COVID-19?, A3=Do you agree that social distancing (quarantine) will reduce the prevalence of COVID-19?, COVID-19=Coronavirus disease-2019, HRQoL=Health-related Quality of Life, OR=Odds ratio, CI=Confidence interval

Table 4: Results of multiple binary logistic regression analysis on factors associated with practices of coronavirus disease-2019

| Variables                        | Practices, OR (95% CI) yes versus no |
|----------------------------------|-------------------------------------|
|                                  | P1                      | P2                      | P3                      | P4                      |
| Gender (male versus female)      | 1.74 (1.16-2.6)**        | 0.44 (0.28-0.71)**      | 0.50 (0.22-1.12)        | 0.62 (0.28-1.34)        |
| Marital status (married versus single) | 0.91 (0.45-1.81)        | 2.04 (0.76-5.49)        | 2.82 (0.63-17.84)       | 4.03 (0.86-26.94)       |
| Region (city versus village)     | 1.4 (0.43-4.4)           | 0.96 (0.28-3.38)        | 4.37 (0.95-16.99)       | 0.23 (0.002-1.99)       |
| History of COVID-19 (yes versus no) | 0.6 (0.21-1.72)        | 0.82 (0.26-2.62)        | 0.52 (0.13-2.94)        | 0.33 (0.1-1.24)*        |
| Residence places (dormitory versus others) | 1.1 (0.72-1.67)        | 0.66 (0.41-1.08)        | 1.1 (0.47-2.57)         | 0.41 (0.19-0.91)*       |
| Academic degree (postgraduate versus undergraduate) | 1.13 (0.73-1.75)        | 1.57 (0.91-2.69)        | 1.69 (0.69-4.68)        | 3.86 (1.49-12.03)**     |
| Age                              | 1.00 (0.96-1.04)        | 1.00 (0.95-1.06)        | 0.97 (0.90-1.05)        | 0.95 (0.89-1.03)        |
| Knowledge score                  | 0.97 (0.86-1.1)         | 1.09 (0.96-1.24)        | 1.28 (1.05-1.56)*       | 1.18 (0.99-1.44)        |
| HRQoL score                      | 0.99 (0.97-1)           | 1.01 (0.99-1.03)        | 1.02 (0.99-1.05)        | 1.05 (1.02-1.07)**      |

*P<0.05, **P<0.01, ***P<0.001. P1=Have you gone to any crowded place, in recent days?, P2=Have you worn a mask when leaving home, in recent days?, P3=In recent days, when you return home, have you washed your hands (for at least 20 s with soap and water) and disinfected your devices before entering into home?, P4=In recent days, do you avoid touching your eyes, mouth and nose as much as possible when leaving home?. COVID-19=Coronavirus disease-2019, HRQoL=Health-related Quality of Life, OR=Odds ratio, CI=Confidence interval

battle against the COVID-19. Although the results of the current study were consistent with the findings of some previous studies,[13,16,21] the measure values of previous research were much higher. For instance, in Zhong’s study, the mean score of COVID-19 knowledge was 10.8 and the overall correct answer rate of COVID-19 knowledge questionnaire was 90% while in the current study these measures were 10.4 and 74.43%, respectively. Moreover, Zhong’s study showed the better function of participants in the areas of “had not visited any...
crowded place” and “wore masks when going out” than the present study, which could be the probable reason of China successfulness in controlling the COVID-19 pandemic. In addition, this study evaluated other aspects of precautionary practices such as “avoid touching eyes, mouth and nose as far as possible when they leave home” and “washing hands when they return home” which are not mentioned in Zhang’s study.[15,16] Furthermore, this study unlike similar previous studies made use of a wider sample size (including different provinces of the country) and longer period of completion time.[13,15,22] Also, to identify factors associated with attitudes, instead of fitting two independent binary logistic regression models with a same reference category, this study used the multinomial logistic regression to predict the probability of category membership on given several independent variables. The used analysis approach was more powerful than previous approaches because it provided lower standard error than the separate binary logistic models.

The results expressed that knowledge score did not show any significant difference across gender, age, marital status, academic degree, region, place of residency, and history of COVID-19, which was similar to Zhong’s study.[15] However, HRQoL scores differed significantly only across history of COVID-19 and Marital status. To be exact, HRQoL of single students was higher than married students in MCS and PCS, which could be due to the economic problems and health-related concerns of families. It is worth noting that the married students less likely went to crowded places and more likely followed hygienic protocols such as masking, hand washing, and avoiding touching the face than the single students.

The students with a history of COVID-19 were more likely to choose “I don’t know” rather than “yes” to the item of “eventually COVID-19 will be controlled and Iran can win the battle against the COVID-19”, which could be due to the psychological burden of experiencing COVID-19 infection. To put differently, the history of COVID-19 infection reduced the HRQoL scores (MCS and PCS). Also, the more knowledge about COVID-19 the students acquired, the more PCS promotion they gained; however, their MSC did not considerably increase. The reason behind the relative stability of the MCS scores may be due to effect of the critical COVID-19 pandemic on the students’ mental health. In addition, the students with a history of COVID-19 less often went to the crowded places; however, they have less adhered to health prohibitive protocols (P1-P4), especially regarding avoiding touching the face when leaving home, which could be a factor in the growth of prevalence of the disease.

Those students living in the dormitory were more likely to say “I don’t know” than “yes” to the item of “Belief of quarantine is effective in preventing COVID-19;” however, they had better attitudes towards A1 and A2. Moreover, they wore less masks when they went out, which could be due to the less rigorous and voluntary measures at the time of the study.

It is worth mentioning that male students less likely opted to say “I don’t know” than “yes” to the item of “eventually COVID-19 will be controlled and Iran can win the battle against the COVID-19” and they were more likely (74%) to go to crowded place. Whereas a vast majority of the students held an optimistic attitude towards the effectiveness of quarantine but men were less agreed to quarantine than women and men were more likely to go to crowded places. Although the male students more likely believed that COVID-19 would finally be successfully controlled, they less frequently adhered to health protocols than women, especially wearing a mask when leaving home.

As mentioned in the previous parts, the student’s practice and attitude were at an appropriate level during the study time, which is consistent with Khasawneh and Zhong’s study.[15,16] Therefore, timely, proportional, and accurate reports and guidelines issued by WHO and Ministry of Health and Medical Education of Iran play an important role in tackling the COVID-19 pandemic.

The findings suggested that HRQoL and knowledge might have an influence on attitudes and practices since the students with higher knowledge score were more likely to wash their hands when they returned home and also those students with higher HRQoL score were more likely to avoid touching eyes, mouth and nose as far as possible when they were outside. Besides, the students with higher knowledge score were less likely to say “I don’t know” and “No” than “yes” to the item of “Belief of quarantine is in reduction of the prevalence of COVID-19”. Also, the students with higher HRQoL score were less likely to say “I don’t know” than “yes” to the two items of “eventually COVID-19 will be controlled, Iran can win the battle against the COVID-19” and “quarantine is effective in reduction of the prevalence of COVID-19”. The negative attitude of the students towards Iran’s success in overcoming COVID-19 could be due to the fact that Iran is a developing country and also dealing with an unfavorable economic situation due to imposed sanctions.

Regarding the students’ PCS and MCS in this study, which was measured by the SF-36 questionnaire, the students were in a way better physical rather than mental condition because their scores in PCS were higher than their scores in MCS. Although there was no significant correlation between HRQoL and knowledge, there was a significant positive correlation between
PCS and knowledge. Therefore, it could be implied that knowledge was a prerequisite to a decent high QoL in which the increase in knowledge score resulted in the increases in PCS score. The results suggested that the COVID-19 outbreak radically affected the physical and mental health of the TUMS students, which is line with some studies that suggested the need for measures to strengthen the physical and mental health during the epidemic.[23–26]

Limitations and recommendation
Regarding the limitations, first, the sample included those medical students who had access to the internet. Second, this study used the SF-36 questionnaire to assess HRQoL which was not a specialized questionnaire of the pandemic condition like COVID-19 so future research needs to be aimed at developing a COVID-19-specialized questionnaire for HRQoL assessment. Third, various dimensions of physical and mental health such as depression and stress that could affect the QoL were not investigated in this study. Therefore, future longitudinal studies are needed to analyze the long-term impact of COVID-19 pandemic on the health state and QoL of TUMS students to reach a conclusion on the causative relationships among the involved variables.

We recommend that improving the quality of educational programs for students during this pandemic can reduce students’ mental stress and assist those for effective learning.

Conclusions
Overall, the TUMS students showed expected levels of knowledge, appropriate attitudes, and precautionary practices regarding COVID-19. Whereas no significant evidence observed between HRQoL and knowledge and a significant positive correlation was detected between PCS and knowledge. In other words, an increase in the knowledge score resulted in an increase in the PCS score, which somehow indicated the effectiveness of knowledge in the QoL. Furthermore, the results suggested that the COVID-19 outbreak substantially affected the physical and mental health of medical students. Additionally, it was indicated that those students with higher HRQoL and knowledge scores had relatively better attitudes and preventive practices regarding COVID-19. It is worthwhile noting that the precautionary practices of the Iranian medical students have been lower than other countries, which was a reason behind the growth of COVID-19 prevalence in Iran. This issue emphasizes the fact that COVID-19 announcement and prohibitive education in Iran require necessary further modifications. These results could be used by the researchers as a scientific basis for future research in this area. Moreover, this study proves useful for the Ministry of Health and Medical Education of Iran in proposing the right policy measures.

Acknowledgments
We would also like to thank Students’ Scientific Research Center of TUMS for their support and Porsline Team for their assistance in providing a prime and quality questionnaire as well as Ali Banisharif for his tremendous help in the language-related writing processes of this study. Hereby, we gratefully thank the nurses all around the world for their considerable efforts and extreme diligence during COVID-19 pandemic.

Financial support and sponsorship
This article was obtained from a research project approved and registered at the Students’ Scientific Research Center of TUMS (no. 47515).

Conflicts of interest
There are no conflicts of interest.

References
1. Xu X, Chen P, Wang J, Feng J, Zhou H, Li X, et al. Evolution of the novel coronavirus from the ongoing Wuhan outbreak and modeling of its spike protein for risk of human transmission. Sci China Life Sci 2020;63:457–60.
2. Ganji A, Mosayebi G, Khaki M, Ghazavi A. Review on immunopathogenesis, molecular biology and clinical aspects of the 2019 novel coronavirus (COVID-19). Arak Univ Med Sci 2020;23:8-21.
3. World Health Organization (WHO). Dashboard, WHO Coronavirus Disease (COVID-19). Available from: https://covid19.who.int/.[Last accessed on 2021 Jan 10].
4. Jiao WY, Wang LN, Liu J, Fang SF, Jiao FY, Pettoello-Mantovani M, et al. Behavioral and emotional disorders in children during the COVID-19 epidemic. J Pediatr 2020;221:e264-6.e1.
5. Adil MT, Rahman R, Whitelaw D, Jain V, Al-Taan O, Rashid F, et al. SARS-CoV-2 and the pandemic of COVID-19. Postgraduate Medical Journal 2021;97:110-6.
6. Rosário R. COVID-19 and schools closure: Implications for school nurses. J Sch Nurs 2020;36:241-2.
7. Pfeiferbaum B, North CS. Mental Health and the COVID-19 Pandemic. N Engl J Med 2020;383:510-2.
8. Heidari-Soureshjani R, Abdolahi G. Journal FT-GM, 2020 Undefined. Nursing Students’ Education during COVID-19 Pandemic. Available from: https://gmj.ir/index.php/gmj/article/view/2033.[Last accessed on 2021 Jan 10].
9. Cao W, Fang Z, Hou G, Han M, Xu X, Dong J, et al. The psychological impact of the COVID-19 epidemic on college students in China. Psychiatry Res 2020;287:112934.
10. Odriozola-González P, Planchuelo-Gómez Á, Irurtia MJ, de Luis-García R. Psychological effects of the COVID-19 outbreak and lockdown among students and workers of a Spanish university. Psychiatry Res 2020;290:113108.
11. Sahu P. Closure of universities due to coronavirus disease 2019 (COVID-19): Impact on education and mental health of students and academic staff. Cureus 2020;12:e7541.
12. Bhagavathula AS, Aldhalee WA, Rahmani J, Mahabadi MA, Bandari DK. Knowledge and perceptions of COVID-19 among health care workers: Cross-sectional study. JMIR Public Health Surveill 2020;6:e19160.
13. Taghrir MH, Borazjani R, Shiraly R. COVID-19 and Iranian medical students: a survey on their related-knowledge, preventive behaviors and risk perception. Arch Iran Med 2020;23:249-54.
14. Geldsetzer P. Knowledge and Perceptions of COVID-19 among the general public in the United States and the united kingdom: A cross-sectional online survey. Ann Intern Med 2020;173:157-60.
15. Khasawneh AI, Humeidan AA, Alsulaiman JW, Bloukh S, Ramadan M, Al-Shatanawi TN, et al. Medical students and COVID-19: Knowledge, attitudes, and precautionary measures. A descriptive study from Jordan. Front Public Health 2020;8:253.
16. Zhong BL, Luo W, Li HM, Zhang QQ, Liu XG, Li WT, et al. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: A quick online cross-sectional survey. Int J Biol Sci 2020;16:1745-52.
17. Ministry of Health and Medical Education of Iran. COVID-19 Epidemiological Committee. Available from: http://corona.behdasht.gov.ir/. [Last accessed on 2020 Aug 16].
18. Taber KS. The use of Cronbach’s alpha when developing and reporting research instruments in science education. Res Sci Educ 2018;48:1273-96.
19. Ware JE, Kosinski MA, Keller SD. SF-36 Physical and Mental Health Summary Scales. Boston, MA: The Health Institute, New England Medical Center. Health Assessment Lab.; 1994.
20. Ware JE Jr., Sherbourne CD. The MOS 36-item short-form health survey (SF-36): I. Conceptual framework and item selection. Med Care 1992;30:473-83.
21. Peng Y, Pei C, Zheng Y, Wang J, Zhang K, Zheng Z, et al. A cross-sectional survey of knowledge, attitude and practice associated with COVID-19 among undergraduate students in China. BMC Public Health 2020;20:1292.
22. Qi M, Li P, Moyle W, Weeks B, Jones C. Physical activity, health-related quality of life, and stress among the chinese adult population during the COVID-19 pandemic. Int J Environ Res Public Health 2020;17:1-10.
23. Chi X, Becker B, Yu Q, Willeit P, Jiao C, Huang L, et al. Prevalence and psychosocial correlates of mental health outcomes among chinese college students during the coronavirus disease (COVID-19) pandemic. Front Psychiatry 2020;11:1.
24. Wu S, Li Z, Li Z, Xiang W, Yuan Y, Liu Y, et al. The mental state and risk factors of Chinese medical staff and medical students in early stages of the COVID-19 epidemic. Compr Psychiatry 2020;102:152202.
25. Shaukat N, Ali DM, Razzak J. Physical and mental health impacts of COVID-19 on healthcare workers: A scoping review. Int J Emerg Med 2020;13:1-8.
26. Guo J, Fu M, Liu D, Zhang B, Wang X, van IJzendoorn MH. Is the psychological impact of exposure to COVID-19 stronger in adolescents with pre-pandemic maltreatment experiences? A survey of rural Chinese adolescents. Child Abus Negl 2020;110:104667.
Table S1: The students’ coronavirus disease-2019-related attitudes regarding demographic characteristics, knowledge, and health-related Quality of Life

| Characteristics          | A1                          | A2                          | A3                          |
|--------------------------|-----------------------------|-----------------------------|-----------------------------|
|                          | Yes | No | I don't know | P  | Yes | No | I don't know | P  | Yes | No | I don't know | P  |
| Gender                   |     |    |              |    |     |    |              |    |     |    |              |    |
| Male                     | 121 (66.9) | 41 (22.7) | 19 (10.5) | 0.006 | 90 (49.7) | 58 (32) | 33 (18.2) | 0.056 | 163 (90.1) | 13 (7.2) | 5 (2.8) | 0.171 |
| Female                   | 168 (58.5) | 56 (19.5) | 63 (22) | 117 (40.8) | 92 (32.1) | 78 (27.2) | 0.006 | 271 (94.4) | 10 (3.5) | 6 (2.1) | 0.258 |
| Marital status           |     |    |              |    |     |    |              |    |     |    |              |    |
| Married                  | 46 (59) | 17 (21.8) | 15 (19.2) | 0.858 | 30 (38.5) | 28 (35.9) | 20 (25.6) | 0.54 | 76 (97.4) | 1 (1.3) | 1 (1.3) | 0.258 |
| Single                   | 242 (62.2) | 80 (20.6) | 67 (17.2) | 176 (45.2) | 122 (31.4) | 91 (23.4) | 0.006 | 357 (91.8) | 22 (5.7) | 10 (2.6) | 0.258 |
| Age (years)              |     |    |              |    |     |    |              |    |     |    |              |    |
| <22                      | 130 (62.5) | 45 (21.6) | 33 (15.9) | 0.674 | 101 (48.6) | 60 (28.8) | 47 (22.6) | 0.207 | 186 (89.4) | 17 (8.2) | 5 (2.4) | 0.029 |
| ≥22                      | 158 (61) | 52 (20.1) | 49 (18.9) | 105 (40.5) | 90 (34.7) | 64 (24.7) | 0.006 | 246 (95) | 7 (2.7) | 6 (2.3) | 0.029 |
| Region                   |     |    |              |    |     |    |              |    |     |    |              |    |
| Village                  | 10 (71.4) | 2 (14.3) | 2 (14.3) | 0.926 | 10 (71.4) | 3 (21.4) | 1 (7.1) | 0.133 | 13 (92.9) | 0 | 1 (7.1) | 0.402 |
| City                     | 280 (61.4) | 96 (21.1) | 80 (17.5) | 198 (43.4) | 148 (32.5) | 110 (24.1) | 0.006 | 422 (92.5) | 24 (5.3) | 10 (2.2) | 0.402 |
| History of COVID-19      |     |    |              |    |     |    |              |    |     |    |              |    |
| No                       | 283 (63) | 94 (20.9) | 72 (16) | 0.002 | 205 (47.7) | 139 (31) | 105 (23.4) | 0.011 | 416 (92.7) | 23 (5.1) | 10 (2.2) | 0.452 |
| Yes                      | 7 (33.3) | 4 (19) | 10 (47.6) | 3 (14.3) | 12 (57.1) | 6 (28.6) | 0.006 | 19 (90.5) | 1 (4.8) | 1 (4.8) | 0.452 |
| Residence place          |     |    |              |    |     |    |              |    |     |    |              |    |
| Others                   | 151 (57.9) | 58 (22.2) | 52 (19.9) | 0.133 | 110 (42.1) | 83 (31.8) | 68 (26.1) | 0.303 | 246 (94.3) | 12 (4.6) | 3 (1.1) | 0.088 |
| Dormitory                | 129 (66.5) | 38 (19.6) | 27 (13.9) | 92 (47.4) | 63 (32.5) | 39 (20.1) | 0.006 | 174 (89.7) | 12 (6.2) | 8 (4.1) | 0.088 |
| Academic degree          |     |    |              |    |     |    |              |    |     |    |              |    |
| Undergraduate            | 192 (62.1) | 70 (22.7) | 47 (15.2) | 0.327 | 146 (47.2) | 94 (30.4) | 69 (22.3) | 0.231 | 284 (91.9) | 18 (5.8) | 7 (2.3) | 0.525 |
| Postgraduate             | 89 (60.5) | 28 (19) | 30 (20.4) | 57 (38.8) | 53 (36.1) | 37 (25.2) | 0.006 | 138 (93.9) | 5 (3.4) | 4 (2.7) | 0.525 |
| Knowledge score          | 10.24 (1.68) | 10.32 (1.93) | 10.4 (1.73) | 0.78 | 10.53 (1.62) | 10.28 (1.84) | 10.41 (1.83) | 0.40 | 10.54 (1.61) | 9.38 (2.41) | 7.82 (2.27) | <0.001 |
| HRQoL score              | 74.86 (13.71) | 67.68 (17.09) | 69.93 (14.17) | <0.001 | 75.52 (13.21) | 68.44 (16.74) | 72.36 (13.76) | <0.001 | 72.95 (14.48) | 67.99 (18.11) | 64.68 (19.05) | 0.059 |

COVID-19=Coronavirus disease-2019, SD=Standard deviation, HRQoL=Health-related Quality of Life
## Table S2: The students’ coronavirus disease-2019-related practices of regarding demographic characteristics, knowledge, and health-related Quality of Life

| Characteristics       | P1    | P2    | P3    | P4    |
|-----------------------|-------|-------|-------|-------|
|                       | Yes   | No    | P     | Yes   | No    | P     | Yes   | No    | P     | Yes   | No    | P     |       |
| Gender                |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Male                  | 85 (47) | 96 (53) | 0.005 | 123 (68) | 58 (32) | <0.001 | 163 (90.1) | 18 (9.9) | 0.008 | 162 (89.5) | 19 (10.5) | 0.099 |
| Female                | 97 (33.8) | 190 (66.2) | 242 (84.3) | 45 (15.7) | 276 (96.2) | 11 (3.8) | 269 (93.7) | 18 (6.3) |       |
| Marital status        |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Married               | 31 (39.7) | 47 (60.3) | 0.946 | 70 (89.7) | 8 (10.3) | 0.006 | 76 (97.4) | 2 (2.6) | 0.199 | 75 (96.2) | 3 (3.8) | 0.144 |
| Single                | 153 (39.3) | 236 (60.7) | 294 (75.6) | 95 (24.4) | 362 (93.1) | 27 (6.9) | 355 (91.3) | 34 (8.7) |       |
| Age (years)           |       |       |       |       |       |       |       |       |       |       |       |       |       |
| <22                   | 75 (36.1) | 133 (63.9) | 0.185 | 153 (73.6) | 55 (26.4) | 0.04 | 194 (93.3) | 14 (6.7) | 0.68 | 186 (89.4) | 22 (10.6) | 0.06 |
| ≥22                   | 109 (42.1) | 150 (57.9) | 211 (81.5) | 48 (18.5) | 244 (94.2) | 15 (5.8) | 244 (94.2) | 15 (5.8) |       |
| Region                |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Village               | 5 (35.7) | 9 (67.3) | 0.79 | 10 (71.4) | 4 (28.6) | 0.52 | 11 (78.6) | 3 (26) | 0.49 | 14 (100) | 0 (0) | 0.62 |
| City                  | 179 (39.3) | 277 (60.7) | 357 (78.3) | 99 (21.7) | 430 (94.3) | 26 (5.7) | 419 (91.9) | 37 (8.1) |       |
| History of COVID-19   |       |       |       |       |       |       |       |       |       |       |       |       |       |
| No                    | 177 (39.4) | 272 (60.6) | 0.58 | 351 (78.2) | 98 (21.8) | 0.79 | 422 (94) | 27 (6) | 0.38 | 418 (93.1) | 31 (6.9) | 0.004 |
| Yes                   | 7 (33.3) | 14 (66.7) | 16 (76.2) | 5 (23.8) | 19 (90.5) | 2 (9.5) | 15 (71.4) | 6 (28.6) |       |
| Residence places      |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Others                | 97 (37.2) | 164 (62.8) | 0.44 | 213 (81.6) | 48 (18.4) | 0.023 | 246 (94.3) | 15 (5.7) | 0.53 | 245 (93.9) | 16 (6.1) | 0.102 |
| Dormitory             | 79 (40.7) | 115 (59.3) | 141 (72.7) | 53 (27.3) | 180 (92.8) | 14 (7.2) | 174 (89.7) | 20 (10.3) |       |
| Academic degree       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Undergraduate         | 117 (37.9) | 192 (62.1) | 0.55 | 233 (75.4) | 76 (24.6) | 0.07 | 287 (92.9) | 22 (7.1) | 0.21 | 279 (90.3) | 30 (9.7) | 0.04 |
| Postgraduate          | 60 (40.8) | 87 (59.2) | 122 (83) | 25 (17) | 141 (95.9) | 6 (4.1) | 141 (95.9) | 6 (4.1) |       |
| Knowledge score       | 10.33 (1.94) | 10.48 (1.59) | 0.40 | 10.51 (1.63) | 10.10 (2.1) | 0.033 | 10.47 (1.66) | 9.59 (2.61) | 0.08 | 10.47 (1.67) | 9.81 (2.36) | 0.103 |
| HRQoL score           | 71.12 (14.05) | 73.33 (15.31) | 0.13 | 72.80 (14.87) | 71.43 (14.79) | 0.41 | 72.95 (14.67) | 65.63 (16.06) | 0.01 | 73.52 (14.05) | 60.54 (18.53) | <0.001 |

COVID-19=Coronavirus disease-2019, SD=Standard deviation, HRQoL=Health-related Quality of Life
Table S3: The results of multiple linear regression on factors associated with physical and mental component summary

| Independent | Dependent   | Coefficient | SE  | P     | 95% CI (lower-upper) |
|-------------|-------------|-------------|-----|-------|-----------------------|
| Gender (male versus female) | PCS | −0.38 | 1.50 | 0.80 | −3.33-2.58 |
|             | MCS | −0.14 | 2.06 | 0.95 | −4.19-3.91 |
| Age         | PCS | −0.23 | 0.15 | 0.11 | −0.52-0.06 |
|             | MCS | 0.19  | 0.20 | 0.34 | −0.20-0.59 |
| Marital status (married versus single) | PCS | −3.26 | 2.52 | 0.19 | −8.21-1.69 |
|             | MCS | −1.69 | 3.45 | 0.63 | −8.47-5.09 |
| Academic degree (postgraduate versus undergraduate) | PCS | −0.06 | 1.61 | 0.97 | −3.23-3.10 |
|             | MCS | −2.56 | 2.21 | 0.25 | −6.89-1.78 |
| Region (city versus village) | PCS | 3.35  | 4.22 | 0.43 | −4.96-11.65 |
|             | MCS | 5.01  | 5.79 | 0.39 | −6.37-16.39 |
| Residence places (dormitory versus others) | PCS | 0.97  | 1.56 | 0.53 | −2.10-4.05 |
|             | MCS | 2.39  | 2.14 | 0.26 | −1.82-6.61 |
| History of COVID-19 (yes versus no) | PCS | −20.49 | 3.68 | <0.001 | −27.72-−13.27 |
|             | MCS | −17.81 | 5.04 | <0.001 | −27.71-−7.90 |
| Knowledge score | PCS | 1.03  | 0.42 | 0.01 | 0.21-1.84 |
|             | MCS | 0.44  | 0.57 | 0.44 | −0.67-1.56 |

SE=Standard error, CI=Confidence interval, PCS=Physical component summary, MCS=Mental component summary, COVID-19=Coronavirus disease-2019