Original Article

COVID-19 and Saudi medical students: A cross-sectional study on knowledge, preventive behaviors, and risk perception

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Abstract

Background: The knowledge, preventive behaviors, and risk perception of the COVID-19 pandemic among health care workers can affect virus transmission and control. As the primary individuals in contact with infected patients, health care workers risk infection. There are a few studies on the knowledge and self-practice prevention for COVID-19 among medical students. **Objectives:** This study evaluated the COVID-19-related knowledge, preventive behaviors, and risk perceptions among medical students and interns. **Methods:** This study used a quantitative cross-sectional evaluation of the Saudi Arabian medical students utilizing a previously published online survey in 2020. **Results:** The study questionnaire was completed by 474 respondents. The average knowledge and preventive behavior score was significantly lower in males. The reported source of information showed a statistically significant association with knowledge and was higher in the respondents who reported world health organization (WHO)/centers for disease control and prevention (CDC)/UpToDate as their main source of information. The National Guidelines of the Ministry of Health was the second source to be reported for seeking information. A statistically significant positive correlation was observed between the knowledge and preventive measures scores. The respondents who did not follow any information regarding COVID-19 had significantly lower knowledge and preventive behavior scores than those obtaining knowledge from sources. The preventive behavior score was not significantly different between clinical and pre-clinical students. **Conclusion:** This study assessed the knowledge, perceptions, and practices of COVID-19 following the onset of the pandemic in Saudi Arabia, indicating an acceptable level of undergraduate students' knowledge regarding the epidemic and its control measures.

Keywords: Behaviors, COVID-19, knowledge, medical students, prevention, risk

Introduction

Coronaviruses (CoV) are a broad family of viruses that are known to cause serious and fatal pulmonary diseases.[1] In 2003, severe acute respiratory syndrome coronavirus (SARS-CoV) was first identified as pneumonia in Guangdong, China, and then turned into a fatal respiratory failure. In December 2019, similar cases were reported in the Wuhan city of China.[1,2] The virus was identified by the World Health Organization (WHO) as a new form of coronavirus (novel coronavirus-2019). It was named COVID-19 and is considered one of the major global threats of the twenty-first century.[3]

Health care providers are at a high risk of becoming infected themselves, as they are the primary individuals in contact with infected patients.[4] Knowledge, attitude, and practices related to

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the COVID-19 pandemic among health care workers can affect virus transmission and control. They can influence the perceptions of the providers and their ability to participate in preventive strategies, including the acceptance of immunization.[5] Medical students are among the first individuals who may have close contact with the affected people.[6] Medical schools are known to have a stressful environment, which often leads to a negative effect on the students. Thus, constant high demand can lead to burnout and stress that may last throughout the training and beyond.[7]

Lack of knowledge in this population can make medical students overestimate the situation, increase their stress and anxiety levels, and may interrupt the appropriateness of their medical judgments.[8,9] Thus, a study on the medical students' knowledge of COVID-19 preventive behaviors and risk perception is necessary. To the best of our knowledge, there are no studies available yet to assess the medical students' COVID-19-related knowledge, preventive behaviors, and risk perception in Saudi Arabian medical schools. The aims of the study are (1) to assess the basic knowledge of the COVID-19 pandemic and (2) to analyze the current state of preventive behaviors and risk perception necessary for COVID-19 in medical students in Saudi Arabia. We hope to provide family physicians with this information regarding their students' knowledge, preventive behaviors, and risk perception so that they can develop new strategies, methods, and necessary protocols to protect medical students and trainees during their training in the COVID-19 pandemic.

Methods

A cross-sectional study on Saudi medical students from two large governmental medical schools in Riyadh, the capital and largest city in Saudi Arabia, was conducted to assess COVID-19-related knowledge, preventive behaviors, and risk perception. Pre-clinical years were defined as years 1, 2, and 3, while clinical years were defined as years 4, 5, and 6. The study was conducted using a previously published online questionnaire in the English language.[6] The online questionnaire was adopted to comply with the specific prevention measures recommended during the outbreak. The questionnaire consisted of four sections: demographic data, knowledge regarding COVID-19, preventive behaviors, and risk perception. Demographic information included gender, age, level of education, grade point average (GPA), and source of information regarding COVID-19. Knowledge regarding COVID-19 was assessed using 15 items. Three items were used to assess the basic knowledge regarding COVID-19 basic science and its etiology. Two items were used to test symptoms and incubation period; one item was used for diagnosis. Two and four items were used to test knowledge regarding transmission and public prevention. Three items were used to test the medical professionals' specific prevention, treatment, and referring of suspicious cases. The correct answer was assigned one point, and an incorrect answer was assigned no point. Nine items were used to assess preventive behavior. Five items were about reducing the use of public places in daily life. Three items were used to test preventive behavior during coughing and intensive hand washing and surface disinfection. The remaining item was used to assess talking with people nearby about prevention. The nine questions had two possible choices (yes and no), and the participant was assigned 1 point for each appropriate behavior and 0 points for inappropriate behaviors. The total score ranged from 0 to 9. Two items were used to assess the risk perception of COVID-19 among the participants. Responses were provided using a five-point Likert-type scale (one = not at all, five = absolutely yes).

Statistical analysis was performed using R version 3.6.3. The categorical variables were summarized using counts and percentages. The mean ± standard deviation was used to summarize the distribution of continuous normal variables, and the median and interquartile range (IQR) were used for non-normal variables. Pearson's correlation was used to assess the association between continuous variables. The reliability of the knowledge and preventive behavior scales was assessed using Cronbach's alpha with a lower acceptable value of 0.7. Hypothesis testing was performed at a 5% level of significance. The approval from the ethics committee was obtained (23/08/2021).

Results

The study questionnaire was completed by 474 respondents. The sociodemographic characteristics of the respondents are shown in Table 1. The males and females represented 65.6 and 34.4% of the study sample, respectively, with an average age of 22.4 ± 2.05 years. More than three-quarters of the respondents (~80%) reported a GPA >3.75, and only 3.8% reported a GPA <2.75. All but 10 respondents were single (97.9%), and 17.9% were interns. One-third of the respondents reported having a physician among first-degree family members. Only 6.96% did not follow any information related to COVID-19. Regarding the source of information, the WHO, CDC, and UpToDate were the main sources of information for 68.6% of the respondents. The average knowledge score was significantly higher in females than in males ($P = 0.021$) and was higher in students with low GPA (< 3.75) than those with a GPA ≥3.75 ($P = 0.009$). The source of information showed a statistically significant association with knowledge. The average knowledge score was lower in respondents who did not follow any information regarding COVID-19 ($P < 0.05$) and was higher in respondents who reported WHO/CDC/UpToDate as their main source of information ($P < 0.001$). The academic year was not significantly associated with the knowledge score ($P > 0.05$), although the average risk preventions score showed a declining linear trend ($P = 0.006$).

The average score for preventive measures was the highest in students in the pre-clinical stage than students in the clinical stage and was higher in both groups than interns. The average preventive measures score was significantly higher in females than in males ($P < 0.05$). The average preventive measures score was significantly lower in respondents who did not follow any information regarding COVID-19 ($P < 0.05$) and was significantly

Table 1: The sociodemographic characteristics of the respondents

	[ALL] *n*=474	Knowledge 0-15	*P*	Preventive measures 0-8	*P*	Risk perception 2-10	*P*
Gender			**0.021**		0.021		
Female	163 (34.4%)	12.9±1.26		12.8±1.26		4.66±2.05	
Male	311 (65.6%)	12.7±1.26		12.7±1.26		4.31±2.01	
Age	22.4 (2.05)	0.06¶	0.17¶	-0.08¶	0.07¶	0.01	0.87
GPA (out of 5)			**0.009**		0.177		**0.007**
2-2.74	18 (3.80%)	13.4±0.78		7.39±2		4.33±2.22	
2.75-3.74	81 (17.1%)	13.1±0.94		7.91±2.01		4.07±2.08	
3.75-4.49	189 (39.9%)	12.7±1.5		7.97±1.52		4.2±1.85	
4.50-5	186 (39.2%)	12.7±1.12		7.48±2.11		4.82±2.11	
Marital status			0.155		0.583		0.488
Single	464 (97.9%)	12.7±1.27		7.74±7.89		4.41±2.01	
Married	10 (2.11%)	13.2±0.92		8±1.41		5.1±3	
Academic year:			0.655		**0.018**		0.776
1st	41 (8.65%)	12.5±1.19		7.88±1.75		4.63±2.27	
2nd	46 (9.70%)	12.8±0.99		8.2±1.29		3.98±2.02	
3rd	78 (16.5%)	12.7±1.26		8.01±1.66		4.53±1.67	
4th	96 (20.3%)	12.8±1.41		7.43±2.14		4.39±2.02	
5th	72 (15.2%)	12.7±1.55		8.01±1.62		4.56±2.47	
6th	56 (11.8%)	12.9±1		7.89±1.73		4.36±1.96	
Intern	85 (17.9%)	12.8±1.14		7.24±2.25		4.46±1.89	
Academic year:			0.41		**0.006**		0.974
Pre-clinical	165 (34.8%)	12.6±1.17		8.03±1.58		4.43±2.15	
Clinical	224 (47.3%)	12.8±1.37		7.73±1.9		4.46±1.89	
Intern	85 (17.9%)	12.8±1.14		7.24±2.25		4.4±1.94	
Physician among first-degree family members			0.359		0.269		0.348
No	305 (64.3%)	12.8±1.09		7.82±1.82		4.36±2.02	
Yes	169 (35.7%)	12.7±1.53		7.62±1.98		4.54±2.05	
Source of information regarding COVID-19							
None	33 (6.96%)	12.2±1.69	**0.048**	6.42±2.41	**0.002**	4.42±1.95	0.995
National guidelines	261 (55.1%)	12.8±1.1	0.111	7.91±1.72	**0.038**	4.39±2	0.71
College	181 (38.2%)	12.9±1.07	0.14	8.07±1.55	**0.002**	4.3±2.02	0.281
WHO/CDC/UpToDate	325 (68.6%)	13.1±1.03	**<0.001**	7.93±1.84	**0.002**	4.45±2.13	0.698
Working in the hospital	86 (18.1%)	13±1.02	0.058	8.05±1.59	0.169	4.21±1.95	0.261
Other source	142 (30.0%)	13±1.2	**0.014**	8±1.8	**0.05**	4.09±1.95	**0.017**

All variables were summarized using counts and percentages except age (mean and standard deviation). Statistical analysis was performed using unpaired t-test for two groups and one-way ANOVA for more than two groups. ¶Analysis was performed using Spearman's correlation

Table 2: Correlation between knowledge, preventive behaviors, and risk perception

	Knowledge score	Preventive measures	Risk perception
Knowledge score		0.252***	-0.038
Preventive measures	0.252***		-0.039
Risk perception	-0.038	-0.039	

Computed correlation used Spearman's method. *P<0.05, **P<0.01, ***P<0.001

higher in respondents who obtained information from all other sources except their work in the hospital. The GPA showed a statistically significant association with the risk perception score ($P < 0.05$). *Post hoc* pairwise comparisons showed that the average risk perception score was significantly higher in respondents with a GPA of 4.5–5 than in the remaining three groups. The average risk perception score was significantly lower in the respondents who obtained their information from sources other than the remaining sources ($P < 0.05$).

A statistically significant positive correlation was observed between the knowledge and preventive measures scores ($r = 0.252$, $P < 0.001$). No correlation was observed between the risk perception score and knowledge ($r = -0.038$, $P > 0.05$) or preventive measures ($r = -0.039$, $P > 0.05$) scores. The average percentage of correct answers was 85%. The percentage of correct answers was >90% for 10 questions. For preventive measures questions, the percentage of correct answers ranged from 77 to 94%, with an average of 86% [Table 2].

Linear regression was used to assess factors associated with knowledge, preventive behavior, and risk perception. The average knowledge score was significantly lower in males than females ($B = -0.36$, $P < 0.05$). Similarly, the average preventive behavior score ($B = -0.59$, $P = 0.001$) was significantly lower in males than females. Risk perception was not significantly different between males and females. The GPA showed a statistically significant association with knowledge ($B = -0.24$,

$P < 0.05$), preventive behavior ($B = -0.27$, $P < 0.05$), and risk perception ($B = 0.31$, $P < 0.05$), which indicates that knowledge and preventive behavior decrease with the increase in GPA, while the opposite was observed for risk perception. The preventive behavior score was significantly lower in interns than students in clinical years ($B = -0.6$, $P < 0.05$), while the preventive behavior was not significantly different between students in clinical and pre-clinical years ($B = 0.38$, $P > 0.05$). Respondents who did not follow any information regarding COVID-19 had significantly lower knowledge ($B = -0.57$, $P < 0.05$) and preventive behavior ($B = -1.43$, $P < 0.001$) scores than respondents who obtained knowledge from any other source [Table 3]. Responses to knowledge questions, responses to risk perception questions, and responses to preventive measures questions are shown in Tables 4 and 5 and Figure 1.

Discussion

This study assessed the knowledge, perceptions, and practices related to COVID-19 following the onset of the pandemic in Saudi Arabia. In the past two decades, Saudi Arabia faced challenges of major infectious disease epidemics, including

Table 3: Factors associated with knowledge, preventive behaviors, and risk perception

Predictors	Knowledge			Preventive behavior			Risk perception		
	B	CI	*P*	*B*	CI	*P*	*B*	CI	*P*
Academic year									
Clinical years	Ref			Ref			Ref		
Intern	0.06	-0.32-0.43	0.772	-0.60	-1.14--0.05	0.032	0.01	-0.60-0.62	0.967
Pre-clinical	-0.17	-0.50-0.17	0.330	0.38	-0.10-0.87	0.124	-0.10	-0.65-0.44	0.710
Age	-0.02	-0.12-0.07	0.627	0.02	-0.12-0.16	0.792	0.02	-0.14-0.18	0.837
Gender									
Female	Ref			Ref			Ref		
Male	-0.36	-0.60--0.12	0.004	-0.59	-0.94--0.24	0.001	-0.26	-0.65-0.14	0.200
GPA	-0.24	-0.39--0.08	0.003	-0.27	-0.49--0.05	0.018	0.31	0.06-0.57	0.014
Marital status									
Single	Ref			Ref			Ref		
Married	0.43	-0.36-1.23	0.287	0.56	-0.60-1.72	0.343	0.54	-0.76-1.84	0.411
Physician in family									
No	Ref			Ref			Ref		
Yes	-0.13	-0.37-0.11	0.282	-0.15	-0.50-0.20	0.406	0.09	-0.30-0.48	0.643
Information source									
Another source	Ref			Ref			Ref		
No source	-0.57	-1.01--0.13	0.012	-1.43	-2.08--0.79	<0.001	0.06	-0.67-0.78	0.878
R^2/R^2 adjusted		0.056/0.040			0.096/0.080			0.025/0.008	

CI: 95% confidence interval, *B*: Linear regression estimate

Table 4: Responses to knowledge questions

	[ALL] *n*=474
1. COVID-19 is a respiratory infection caused by a new species of coronavirus family.	459 (96.8%)
2. The first case of COVID-19 was diagnosed in Wuhan, China.	470 (99.2%)
3. The origin of COVID-19 is not clear but it seems that it has been transmitted to humans by sea foods, snakes, or bats.	416 (87.8%)
4. Its common symptoms are fever, cough, and shortness of breath but nausea and diarrhea were reported rarely.	434 (91.6%)
5. Its incubation period is up to 14 days with a mean of 5 days.	452 (95.4%)
6. It can be diagnosed by PCR test on samples collected from nasopharyngeal and oropharyngeal discharge or from sputum and bronchial washing.	455 (96.0%)
7. It is transmitted through respiratory droplets such as cough and sneeze.	462 (97.5%)
8. It is transmitted through close contact with an infected case (especially in family, crowded places, and health centers).	464 (97.9%)
9. The disease can be prevented through hand washing and personal hygiene.	450 (94.9%)
10. A medical mask is useful to prevent the spread of respiratory droplets during coughing.	461 (97.3%)
11. The disease can be prevented through no close contacts such as handshakes or kissing, not attending meetings, and frequent hand disinfection.	451 (95.1%)
12. All people in the society should wear masks.	45 (9.49%)
13. Only during intubation, suction, bronchoscopy, and cardiopulmonary resuscitation, you have to wear an N95 mask.	323 (68.1%)
14. The disease can be treated by the usual antiviral drugs.	307 (64.8%)
15. If the symptoms appear within 14 days from direct contact with a suspected case, the person should inquire at a nearby public health center.	396 (83.5%)
Average	85%

Table 5: Responses to preventive measures questions

	ALL (*n*=474)
1. I canceled or postponed meetings with friends, eating out, and sports events.	380 (80.2%)
2. I reduced the use of public transportation.	401 (84.6%)
3. I went shopping less frequently.	398 (84.0%)
4. I reduced the use of closed spaces, such as libraries, theaters, and cinemas.	366 (77.2%)
5. I avoided coughing around people as much as possible.	445 (93.9%)
6. I avoided places where many people gathered.	417 (88.0%)
7. I increased the frequency of cleaning and disinfecting items that can be easily touched with hands (i.e., door handles and surfaces)	394 (83.1%)
8. I washed my hands more often than usual.	430 (90.7%)
9. I discussed COVID-19 prevention with my family and friends.	441 (93.0%)
Average	86.1%

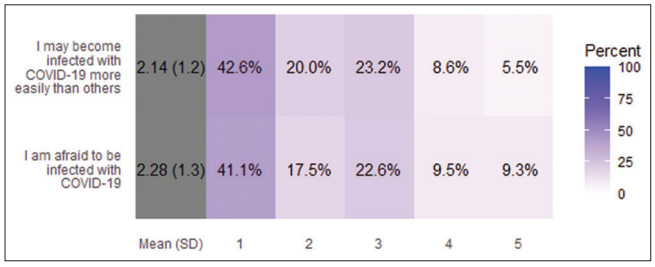

Figure 1: Responses to risk perception questions

SARS-CoV-1, swine flu (H1N1), Middle East respiratory syndrome coronavirus (MERS-CoV), and the recent worldwide SARS-CoV-2 pandemic.[10] COVID-19 has been recognized as one of the most critical pandemics and disastrous diseases that have occurred in human history. It is different from its ancestors in that it is highly transmissible and contagious. The virus spreads mainly from human to human via respiratory droplets of an infected person or direct contact, and it is rated to be two times more contagious than seasonal influenza.[11]

During this pandemic, health care organizations are supposed to have the main role, as health care practitioners and medical students posted in the wards are at extreme risk of exposure and infection.[12] Medical universities all over the world have rapidly decided to develop new strategies to establish innovative experiences for students who were suspended from their clinical rotations and to shift many of their educational activities from face-to-face mode to an online one. However, with the pandemic status rising, many medical students are shifted to work in close contact with the infected people and persons who may have been infected.[12,13] Studies on the undergraduate medical students during different pandemics have stated that they experienced high levels of burnout and anxiety.[13,14]

Regarding the knowledge in this study, the average knowledge score was significantly higher in females; WHO, CDC, and UpToDate were the main sources of information, and the source of information showed a statistically significant association with knowledge; the academic year was not significantly associated with the knowledge score, and a statistically significant positive correlation was observed between knowledge and preventive measures scores. These results are in accordance with those found among Turkish and Egyptian students, where the WHO website was the prevalent source of information.[15,16] The National Guidelines of the Ministry of Health was the second source to be reported for seeking information in our study; this was one of the lowest in other studies.[15-17]

In a study on the attitude of health care workers in Saudi Arabia about COVID-19, most of the participants did not feel safe at work using the standard precautions available.[18] In our medical students, the average preventive measures score was significantly lower in the respondents who did not follow any information regarding COVID-19, and a statistically significant positive correlation was observed between knowledge and preventive measures scores. In a study, most students found worrisome the possibility of getting infected with COVID-19 during their medical rotations and thought their institute-associated hospital would not be able to handle the situation in case of an uncontrolled outbreak.[12] Furthermore, the female gender was positively associated with a better knowledge of the disease and preventive measures. This may be due to multiple reports that women suffered burnout and stress more than men.[7]

In this study sample, a statistically significant positive correlation was observed between knowledge and preventive measures scores; the average preventive measures score was significantly lower in the respondents who did not follow any information regarding COVID-19, and the average risk perception score was significantly higher in the respondents with high GPA. These findings are supported in the literature, with studies reporting that when the level of knowledge increases, favorable practices increase as well.[16,18,19]

We hope that the information gained from this study helps family physicians develop their students' knowledge, preventive behaviors, and risk perception in the training of medical trainees and students in future pandemic crises such as the current COVID-19 pandemic.

The authors are aware of some limitations of the study. Because this study had a cross-sectional design, relationships between the variables can only be considered as general associations, rather

than relationships. Longitudinal studies are needed to find a correlation. The study was conducted in only two governmental medical schools in Riyadh, Saudi Arabia, despite a good response rate. Further research should use a national approach. A non-response bias is another limitation.

Conclusion

This study assessed the knowledge, perceptions, and practices related to COVID-19 following the onset of the pandemic in Saudi Arabia. A statistically significant positive correlation was observed between knowledge and preventive measures scores. Regarding the source of information, WHO, CDC, and UpToDate were the main sources of information, and the source of information showed a statistically significant association with knowledge. The respondents who did not follow any information regarding COVID-19 had significantly lower knowledge and preventive behavior scores than the respondents who obtained knowledge from any other source.

To our knowledge, we are from the fewest researchers to discuss the knowledge, preventive behaviors, and risk perception among medical trainees and students in Saudi Arabia. The findings of this article may influence the procedures and methods to protect medical students and trainees during COVID-19 and future pandemic crises.

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Conflicts of interest

There are no conflicts of interest.

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