



Knowledge, Attitudes, and Practices Regarding Ocular Manifestations of COVID 19 among Students in a Medical College in Saudi Arabia- A Cross Sectional Study

**Bayan S. Alshuhayb^a, Abdullah F. Alwadani^a, Kaberi Biswas^{b*},
Aqeel Y. Alhumaid^c, Norah S. Alshuhayb^c and Ali R. Bushajea^c**

^a King Faisal University, College of Medicine, Al Ahsa, Saudi Arabia.

^b Department of Ophthalmology, Al Azhar College of Medicine, Thodupuzha, Kerala, India.

^c Ministry of Health, Al Ahsa, Saudi Arabia.

Authors' contributions

This work was carried out in collaboration among all authors. Author KB conceptualized and designed the study, writing the discussion, critically revised the manuscript for key intellectual content, and approved the final version to be submitted. Author BA carried out the literature review, contributed to the study design and methodology, drafted the manuscript, carried out the data acquisition, analysis, and interpretation, and manuscript publication. Author AA was responsible for IRB approval, data collection, and reviewing the article. Authors AA, NA, and AB were responsible for data collection, criticizing and reviewing the article. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JPRI/2022/v34i32A36106

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here:

<https://www.sdiarticle5.com/review-history/86218>

Original Research Article

Received 07 March 2022

Accepted 14 April 2022

Published 19 April 2022

ABSTRACT

Background: The coronavirus pandemic has forced governments of different countries to implement measures to control the spread of the virus and improve health awareness. Medical students are thought to have a significant role in public health promotion. Although there are studies assessing the level of knowledge of COVID-19 among medical students, there are very few assessing the level of knowledge about the ocular manifestations of COVID-19. Therefore, this study aims to assess the level of knowledge, attitudes, and practices regarding the ocular manifestations of COVID-19 among medical students a medical college in Saudi Arabia.

Methods: An online, questionnaire based cross sectional study was conducted to assess the

knowledge, attitudes, and practices regarding the ocular manifestations of COVID 19 among medical students.

Results: The level of knowledge about COVID-19 was adequate. However, there was a deficient knowledge regarding some aspects of ophthalmological involvement in coronavirus disease. Female students and those of higher academic years demonstrated significantly higher knowledge. Attitudes and practices regarding prevention of infection and personal protective measures were satisfactory. The main source of information about COVID-19 was social media and internet.

Conclusions: This is probably the first study investigating the ophthalmological knowledge of COVID-19 among medical students in this region. The level of knowledge about COVID-19 was adequate but knowledge about some ophthalmological aspects was insufficient. Students had adequate knowledge about COVID prevention and personal protective measures. It is suggested to include knowledge of COVID-19 in the curriculum to fill gaps in the knowledge, especially in the preclinical years. Seminars and training programmes could also add to the same.

Keywords: COVID-19; SARSCoV2; ophthalmology; medical students; Saudi Arabia.

1. INTRODUCTION

The corona virus pandemic and its consequences represent one of the most important medical events in recent times. The novel corona virus, severe acute respiratory syndrome (SARS CoV2) causing Coronavirus disease 2019 (COVID-19), was first identified in Wuhan, the capital city of Hubei province in China [1,2]. To date, there are almost 490,853,129 confirmed cases of COVID-19, including 6,155,344 deaths, reported to WHO [3]. Although the first cases presented as pneumonia of unknown origin, the disease has wide ranging manifestations, the spectrum of which can extend from being completely asymptomatic to acute respiratory distress and multiorgan dysfunction. Ocular signs and symptoms have also been reported in COVID-19 patients and there is increasing recognition of conjunctivitis as a prodromal symptom of this disease [4]. Over the past couple of months, more and more studies are emerging that prove that the virus can also affect structures like the cornea, uvea, retina and the optic nerve. This disease, was noted to be very infectious, highly contagious and spread across the globe very fast [5] This in combination with the ubiquitous clinical manifestations and a mortality rate of 2-3%, has prompted health authorities in many countries, including Saudi Arabia, to impose lockdowns and restrict free movement to contain the pandemic [6-11]. As with all public health programmes, success depends on the government intent being supported by strong compliance from an aware and knowledgeable population. Studies conducted in Saudi Arabia have found varying levels of awareness of COVID-19 disease and its prevention, ranging from good level of awareness to less than desired level [11-13].

Medical students are thought to have a significant role in public health promotion [14]. An aware and knowledgeable medical student would be not just a good role model and health educator for his family, but also to the community he belongs. In fact, during the COVID pandemic in USA, year 3 medical students participated in telehealth clinics under supervision, which not only exposed them to an important health care delivery modality but also allowed them to actively participate in and deliver tele health care [15]. For a medical student to serve as an health promoter and a health educator, he/she has to have a basic knowledge about the COVID-19 virus, disease manifestations and preventive strategies. There are many studies assessing the level of knowledge of COVID-19 among medical students, but very few assessing the level of knowledge about the ocular manifestations of COVID-19, especially in the Kingdom of Saudi Arabia. The present study was conducted to assess the level of knowledge, attitudes, and practices regarding the ocular manifestations of COVID 19 among medical students in Saudi Arabia.

2. MATERIAL AND METHODS

A cross sectional study was conducted to assess the level of knowledge, attitudes, and practices regarding the ocular manifestations of COVID 19 among medical students. Knowledge was compared across years of study, gender and other variables.

This online, questionnaire-based study was conducted in a medical college in the Eastern province of Saudi Arabia. Saudi medical students of all years from the university were included in this research. The College of Medicine students

have preclinical years which include the preparatory year and years 1-3. Clinical years, in which the students have small group teaching in the clinics include 4 and 5 years.

The online Google form questionnaire was distributed through social media including Whatsapp, Facebook and e-mail. Participation was voluntary and informed and participants were assured about confidentiality. The participants were provided with a brief information about the research at the beginning of the questionnaire and asked to proceed only if they wanted to. Individual consent was taken by clicking on the 'agree' button on a question asking about their willingness to participate in the study. Students were requested to answer the questions to the best of their knowledge without any assistance. The study commenced after obtaining appropriate permission from the College of Medicine IRB.

The online questionnaire had a total of 27 questions divided into 3 sections. Section A had 7 questions assessing demographic information and information about eye diseases, glass and contact lenses use and a history of COVID-19 infection among the student or family members. Section B had 12 questions assessing knowledge of general and ocular manifestations of COVID-19. Students who answered 6 or less questions correctly were said to have less than adequate level of knowledge. Attitudes and

practices regarding COVID-19, especially ophthalmological, were assessed through 8 questions in section C. The questionnaire was designed by an ophthalmologist and validated by another faculty member. This was followed by pilot testing, after which, it was disseminated to the medical students.

The results obtained from the google form questionnaire were analysed by using the SPSS software version 22. The data was analysed using percentages and means and chi square test for comparison between groups. A P-value of less than 0.05 was considered significant.

3. RESULTS

A total of 359 medical students participated in the study, of which 188 were female and 171 were male students. The participants were from different academic years in which 43.1% were in the clinical years, and 56.8% pre-clinical. The characteristics of the participants are presented in (Table 1).

Enquiry about the medical background revealed that nearly half of the participants themselves or their family members had COVID-19 infection in the past 6 months. Majority of the participants (82.7%) had no chronic eye problems, however, 41.2% of the participants were contact lens wearers. The medical background of the participants is presented in (Table 2).

Table 1. General characteristics of study participants (N:359)

	Gender		Total		
	Female	Male			
Academic Year	Pre-clinical	Prep year	35	25	60 (16.7%)
		1st year	17	15	32 (8.9%)
		2nd year	28	27	55 (15.3%)
	Clinical	3rd year	26	31	57 (15.9%)
		4th year	50	27	77 (21.4%)
5th year		32	46	78 (21.7%)	
Total		188 (52.4%)	171 (47.6%)	359 (100%)	

Table 2. Medical background of study participants (N:359)

Have you or any family member tested positive for COVID 19 in the past 6 months?	No	183	51.0%
	Yes	176	49.0%
Do you have any eye problem which needs regular follow up?	No	297	82.7%
	Yes	62	17.3%
Do you wear glasses/ contact lenses?	No	211	58.8%
	Yes	148	41.2%
Have you done any refractive surgeries?	No	334	93.0%
	Yes	25	7.0%

Table 3. Knowledge about COVID-19 and its ocular manifestation (N:359)

K1- COVID 19 is an RNA virus.	Correct	220 (61.3%)
	Incorrect/ Didn't know	139 (38.7%)
K2- The incubation period of the COVID 19 virus is 2-14 days.	Correct	333 (92.8%)
	Incorrect/ Didn't know	26 (7.2%)
K3- The main clinical presentation of COVID 19 infection in symptomatic patients is cough and fever.	Correct	316 (88.0%)
	Incorrect/ Didn't know	43 (12.0%)
K4- Regular hand washing is an effective preventive method.	Correct	342 (95.3%)
	Incorrect/ Didn't know	17 (4.7%)
K5- Wearing mask is an effective preventive method.	Correct	350 (97.5%)
	Incorrect/ Didn't know	9 (2.5%)
K6- The eye can be involved in COVID 19 infections.	Correct	222 (61.8%)
	Incorrect/ Didn't know	137 (38.2%)
K7- The most common ocular manifestation of COVID 19 is conjunctivitis.	Correct	130 (36.2%)
	Incorrect/ Didn't know	229 (63.8%)
K8- The COVID-19 virus never affects the retina.	Correct	51 (14.2%)
	Incorrect/ Didn't know	308 (85.8%)
K9- Sore eye is the most common ocular symptom seen in COVID 19 patients.	Correct	103 (28.7%)
	Incorrect/ Didn't know	256 (71.3%)
K10- The tears may contain the virus in COVID positive patients.	Correct	97 (27.0%)
	Incorrect/ Didn't know	262 (73.0%)
K11- The COVID-19 virus does not affect vision.	Correct	61 (17.0%)
	Incorrect/ Didn't know	298 (83.0%)
K12- Hand eye contact is an important factor in the pathogenesis of conjunctivitis in COVID 19.	Correct	223 (62.1%)
	Incorrect/ Didn't know	136 (37.9%)

Table 4. Study participants attitudes toward the ocular manifestations of COVID 19

		Frequency & percentage
During these times, any patient presenting with ocular irritation, watering, redness and photophobia should be suspected to be COVID positive.	Agree	68 (18.9%)
	Disagree	105 (29.2%)
	Neutral	152 (42.3%)
	Strongly agree	15 (4.2%)
	Strongly Disagree	19 (5.3%)
Any person presenting with ocular irritation, watering, redness and photophobia during the time of the pandemic should be advised COVID 19 testing.	Agree	135 (37.6%)
	Disagree	62 (17.3%)
	Neutral	112 (31.2%)
	Strongly agree	34 (9.5%)
	Strongly Disagree	16 (4.5%)
Hand hygiene is important to prevent spread of COVID 19 including eye involvement.	Agree	92 (25.6%)
	Disagree	7 (1.9%)
	Neutral	30 (8.4%)
	Strongly agree	221 (61.6%)
	Strongly Disagree	9 (2.5%)
Protective face shield and goggles should be worn on examining any patient with red eye.	Agree	124 (34.5%)
	Disagree	35 (9.7%)
	Neutral	91 (25.3%)
	Strongly agree	107 (29.8%)
	Strongly Disagree	2 (0.6%)
COVID 19 patients should be discouraged from touching the eyes to avoid eye involvement.	Agree	103 (28.7%)
	Disagree	36 (10.0%)
	Neutral	88 (24.5%)
	Strongly agree	128 (35.7%)
	Strongly disagree	4 (1.1%)

Table 5. Factors associated with knowledge level of COVID-19 ocular manifestations

		Good knowledge	Poor knowledge	Total no: of students
Academic Year	Prep year	23 (6.4%)	37 (10.3%)	60 (16.7%)
	1st year	16 (4.5%)	16 (4.5%)	32 (8.9%)
	2nd year	18 (5.0%)	37 (10.3%)	55 (15.3%)
	3rd year	21 (5.8%)	36 (0.0)	57 (15.9%)
	4th year	43 (12.0%)	34 (9.5%)	77 (21.4%)
	5th year	63 (17.5%)	15 (4.2%)	78 (21.7%)
	P value	<0.001*		
Gender	Female	111 (30.9%)	77 (21.4%)	188 (52.4%)
	Male	73 (20.3%)	98 (27.3%)	171 (47.6%)
	P value	0.002*		
Do you have any eye problem which needs regular follow up	No	164 (40.7%)	151 (50.8%)	297 (82.7%)
	Yes	38 (10.6%)	24 (6.7%)	62 (17.3%)
	P value	0.082		
Do you wear glasses/ contact lenses?	No	108 (30.1%)	103 (28.7%)	211 (58.8%)
	Yes	76 (21.2%)	72 (20.2%)	148 (41.2%)
	P value	0.975		
Have you done any refractive surgeries?	No	169 (47.1%)	165 (46.0%)	338 (93%)
	Yes	15 (4.2%)	10 (2.8%)	25 (7.0%)
	P value	0.364		
Have you or any family member tested positive for COVID 19 in the past 6 months?	No	88 (24.5%)	95 (26.5%)	183 (51.0%)
	Yes	96 (26.7%)	80 (22.3%)	176 (49.0%)
	P value	0.221		

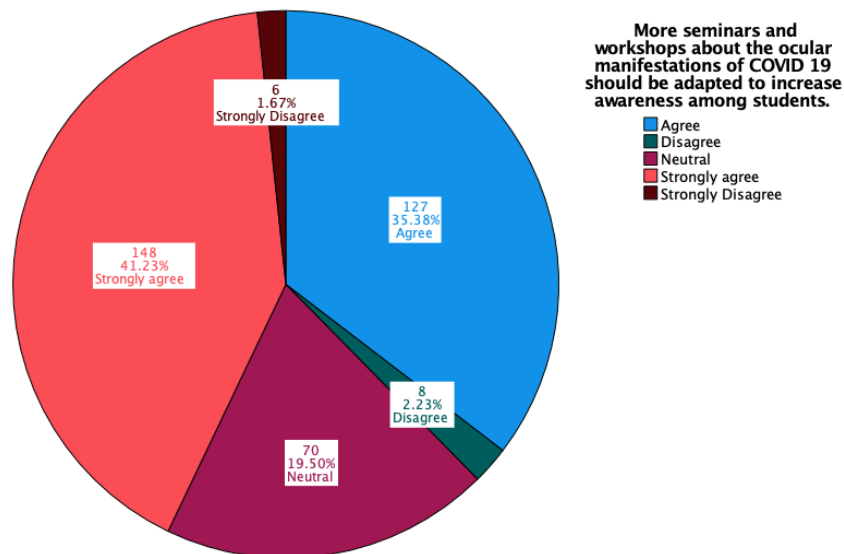


Fig 1. Suggestions of students to improve COVID knowledge

Concerning the knowledge about COVID-19, majority answered the general COVID-19 questions correctly (K1-K5). Over half of the students had more than adequate knowledge of COVID-19(51.3%). However, the majority of the

questions regarding the ocular manifestations were scored incorrectly as shown in (Table 3).

In the attitude part of the study, 23.1% of the participants strongly agreed/agreed that any

patient presenting with ocular irritation, watering, redness, and photophobia in these times should be suspected to be COVID positive while 47.1% of the participants strongly agreed/agreed that they should be just advised to do COVID-19 testing. 64.4% students said that COVID 19 patients should be discouraged from touching the eyes to avoid eye involvement. 87.2% participants strongly agreed/agreed that hand hygiene is important to prevent spread of COVID 19 including eye involvement and 64.3% strongly agreed/agreed that protective face shield and goggles should be worn on examining any patient with red eye. The results are presented in (Table 4).

Concerning the protective measures to be adopted by the participants during the ophthalmology clinical rotation, the most common measures adopted were wearing mask (n=309), using disinfectant/hand sanitizer (n=304), maintaining reasonable distance from the patients (n=273), and wearing face shields/goggles (n=223). When the participants were asked about what actions they would take in case they develop eye irritation, watering, redness or photophobia, the majority (n=303) reported that they would consult an ophthalmologist followed by strictly observing hand hygiene(n= 134) and doing COVID 19 test (n= 117). 76.61% of the students strongly agreed/agreed that conducting more seminars and workshops about the ocular manifestations of COVID 19 would be effective in increasing awareness among students.

The most common source of information about COVID-19 was reported to be social media and internet(n=326), followed by medical journals and websites(n=202).

Chi-square test showed no significant relationship between the knowledge level and a past history of positive COVID 19 within the participants of their families, or a history of any eye problems or using glasses/ contact lenses. However, a statistically significant relationship was noted between participants' knowledge level and their gender and academic year with a p value less than 0.05 as shown in (Table 5).

4. DISCUSSION

A total of 359 students participated in this study, of which there was almost equal participation by males and females. The highest participation

was by the 4th (21.4%) and 5th (21.7%) year students.

Over half of the students in this study had a more than adequate level of knowledge about COVID-19. This is similar to studies conducted among medical students in other countries like India, Jordan, Turkey, Pakistan etc [16-21]. Medical students are expected to be abreast of the latest developments in the health field. However, some of the questions about ophthalmological knowledge did not receive as many correct responses. The questions with maximum correct responses were those about eye involvement and role of hand eye contact in the pathogenesis of COVID-19 conjunctivitis. A large volume of available researches about COVID-19 conjunctivitis and the role of hand eye contact in the pathogenesis of the same could be behind more accurate responses to questions regarding them.

Public health messages stressing the importance of hand hygiene in the prevention of coronavirus infection could also have played a role in reinforcing the role of hand eye contact in the causation of COVID-19 conjunctivitis. The questions with the least correct responses were those about visual impairment and retinal involvement in COVID-19. The last few months have shown increasing reports of posterior segment involvement in COVID-19 infection. The incidence of retinal involvement ranged from 7% to almost 55% in various studies [22-24]. There are also case reports of COVID-19 infection affecting visual acuity.²⁵⁻³⁰ Although conjunctivitis and sore eyes have been known to be associated with COVID-19 disease for many months, increasing information about retinal and optic nerve involvement is relatively recent. This could probably explain the reason for the relatively poor responses to questions regarding the same.

On analysis of the level of knowledge, female medical students had more knowledge regarding the ocular manifestations of COVID 19 than male students and this was found to be statistically significant. (p=0.002). A similar trend was noted regarding the level of COVID-19 knowledge among Saudi nursing students ,in which female students showed better knowledge, and also among medical students and dental students in Pakistan as well [20,31,32. It has been noted that female students in medical schools outperform male students in academic tests and OSCE exams and they showed certain personality traits that could be responsible for the success in

assignments and exams [33,34]. Probably the more accurate responses from the female students are a reflection of the same.

Fourth and fifth-year students (clinical years) demonstrated significantly higher knowledge scores than the other groups ($p < 0.0001$). The results were found to be similar to two studies among medical students from Pakistan, and even among nursing students in Saudi Arabia, all of which showed a positive correlation between level of knowledge and years of study [20,21,32]. On the contrary, Khasawneh Al et al noted similar knowledge between preclinical and clinical years of medical students [35]. It is expected that levels of knowledge would be higher in the advanced years of the medical course. Clinical exposure probably makes the senior students more aware and knowledgeable about COVID-19 and sensitizes them to methods of prevention and personal protection. Progress testing in Saudi University students has shown a gain in clinical knowledge in the senior years of medical schools [36]. Besides the students of year 4 and 5 have ophthalmology clinical rotations and year 5 students are expected to have knowledge of ocular involvement in systemic diseases and infections in their curriculum. All these could explain the higher knowledge scores in clinical years.

Analysis of the attitude part of the questionnaire showed that only 23% students felt that COVID should be considered in any patient presenting with ocular irritation, watering, redness and photophobia during these times. Conjunctivitis is reported to be the commonest ocular manifestations of COVID-19 and there are even reports of keratoconjunctivitis in COVID-19 infection [37-41]. This is one aspect which need more awareness. Similar to other studies, most of the students opined that wearing a mask was an effective measure to prevent spread of COVID-19 [19-21]. Majority of the students mentioned that face shield and goggles should be used when examining a patient with red eye. This is in concurrence with the guidelines of the American Academy of Ophthalmology which recommends the use of eye protection like masks and face shields/goggles during ophthalmological examination [42]. 87.2% participants strongly agreed/agreed that hand hygiene is important to prevent spread of COVID-19 including eye involvement and 64.4% students said that COVID 19 patients should be discouraged from touching the eyes to avoid eye involvement. Conjunctivitis has been reported to

be seen more often in COVID patients with history of hand eye contact [37]. Thus, hand hygiene and frequent handwashing could represent one method to reduce the occurrence of COVID related conjunctivitis and the students seem to be well aware of the same.

Regarding the practices part of the survey, majority of the participants said that they would use mask, protective face shield and goggles and practice hand hygiene during the ophthalmology rotation. More than 90% of medical students used mask and practiced hand hygiene in studies from India and Pakistan, and the results of this study parallel the same. A large number of students said that they would consult an ophthalmologist if they developed eye irritation, watering, redness or photophobia in these times. This suggests that they would probably avoid self-medication in COVID times.

The most common source of information for the medical students was social media and internet. This was similar to researches among the general population and among nursing students in Saudi Arabia [32,43]. Social media was also found to be the most common source of information for medical students in other countries like India, Jordan, Turkey, Pakistan etc [16-21,31]. A study among Pakistani medical students assessing the level of knowledge of COVID-19 symptoms noted that students erred in questions about symptoms which were not mentioned in social media and internet [21]. Although the social media represents an easily accessible source of information, unsafe social media content may be detrimental [44]. Al Suraihi et al suggests that authentic social media pages can supply medical students with reliable information [45]. The social media has been found to have a significant impact in affecting the public perception during the COVID-19 pandemic and studies found a significant correlation between social media and spreading panic about COVID-19 in Saudi Arabia and in another location [46,47]. Medical students should be aware of the risks associated with social media and familiarize themselves with trustworthy platforms to ensure access to accurate and reliable information [48]. Supplementing knowledge obtained from the social media channels with traditional sources of information like indexed journals could go a long way in helping a medical student be up to date with the latest medical information. Students in the present study also felt that conducting more seminars and workshops about the ocular

manifestations of COVID-19 could help increase knowledge and awareness about the same.

5. CONCLUSION

The COVID-19 pandemic represents a huge public health challenge and medical students are thought to play a vital role in the war against the virus by serving as health educators, volunteers and even as clinical assistants. In this study, the knowledge about the general aspects of COVID-19 was satisfactory, but knowledge about some ophthalmological aspects was deficient. However, the students had adequate knowledge about COVID prevention and personal protective measures against the same and majority of the students in the clinical years were following the same. Social media and the internet were the commonest sources of information about COVID-19. Considering the comparatively lower level of knowledge among the preclinical years and the public health importance of COVID-19, it is suggested to include knowledge of COVID-19 in the curriculum of the preclinical years. This could be supplemented by seminars and training programmes. Judicious use of the internet bolstered by information from traditional sources like indexed journals could also help in improving knowledge and inculcating positive attitudes and practices among the medical students, thus making them effective warriors in the war against the SARS CoV2 virus.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

The study was approved by the irb committee at king faisal university, al ahsa. All participants were volunteers and asked to do their best. All data were kept confidential and used only for research purposes.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. World Health Organisation. Available: [https://www.who.int/emergencies/diseases/novel-coronavirus-](https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it)

2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it. Accessed 06 april 2022.

2. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in wuhan, China. *Lancet*. 2020;395:497-506
3. World health organisation. Available: <https://covid19.who.int/>. Accessed 25 february 2022.
4. Inomata T, Kitazawa K, Kuno T, Sung J, Nakamura M, Iwagami M et al; Clinical and Prodromal Ocular Symptoms in Coronavirus Disease: a systematic review and meta-analysis. *Invest. Ophthalmol. Vis. Sci*. 2020;61(10):29. Available: <https://doi.org/10.1167/iops.61.10.29>
5. Amawi H, Abu Deiab GI, A Aljabali AA, Dua K, Tambuwala MM. Covid-19 pandemic: an overview of epidemiology, pathogenesis, diagnostics and potential vaccines and therapeutics. *Ther Deliv*. 2020;11(4):245-268. DOI:10.4155/tde-2020-0035
6. Sahu KK, Mishra AK, Lal A. Covid-2019: update on epidemiology, disease spread and management. *Monaldi Arch Chest Dis*. 2020;90(1): DOI:10.4081/monaldi.2020.1292. Published 2020 Apr 16. DOI:10.4081/monaldi.2020.1292
7. Inomata T, Kitazawa K, Kuno T, Sung J, Nakamura M, Iwagami M et al; Clinical and Prodromal Ocular Symptoms in Coronavirus Disease: a systematic review and meta-analysis. *Invest. Ophthalmol. Vis. Sci*. 2020;61(10):29. Available: <https://doi.org/10.1167/iops.61.10.29>
8. García-ayuso D, Escámez-torrecilla M, Galindo-romero C, et al. Influence of the covid-19 pandemic on contact lens wear in spain [published online ahead of print, 2020 jul 17]. *Cont Lens Anterior Eye*. 2020;s1367-0484(20)30135-1. DOI:10.1016/j.clae.2020.07.002
9. Fitzgerald Da, Nunn K, Isaacs D. Consequences of physical distancing emanating from the covid-19 pandemic: an australian perspective. *Paediatr Respir Rev*. 2020;35:25-30. DOI:10.1016/j.prrv.2020.06.005
10. Yezli S, Khan A. COVID-19 social distancing in the kingdom of saudi arabia: bold measures in the face of political,

- economic, social and religious challenges. *Travel Med Infect Dis.* 2020;37:101692. DOI:10.1016/j.tmaid.2020.101692
11. Alyami MH, Alyami HS, Warraich A. Middle east respiratory syndrome (mers) and novel coronavirus disease-2019 (covid-19): from causes to preventions in saudi arabia. *Saudi Pharm J.* 2020;28(11):1481-1491. DOI: 10.1016/j.jsps.2020.09.014. Epub 2020 sep 24. Pmid: 32994704; pmcid: pmc7513931.
 12. Al-hanawi Mk, Angawi K, Alshareef N, Qattan AMN, Helmy HZ, Abudawood Y et al. Knowledge, attitude and practice toward covid-19 among the public in the kingdom of saudi arabia: a cross-sectional study. *Front Public Health.* 2020;8:217. DOI: 10.3389/fpubh.2020.00217. Pmid: 32574300; pmcid: pmc7266869.
 13. Alyami Hs, Orabi MAA, Aldhabbah FM, Alturki HN, Aburas WI, Alfayez AI, Alharbi AS, Almasuood RA, Alsuhaibani NA. Knowledge about covid-19 and beliefs about and use of herbal products during the covid-19 pandemic: a cross-sectional study in saudi arabia. *Saudi Pharm J.* 2020;28(11):1326-1332. DOI: 10.1016/j.jsps.2020.08.023. Epub 2020 sep 1. Pmid: 32904846; pmcid: pmc7462475.
 14. Sehgal A. What role do medical students have in shaping the future of the national health service? *Med Teach.* 2018;40(1):101-102. DOI: 10.1080/0142159x.2017.1319917. Epub 2017 may 4. Pmid: 28471276.
 15. Abraham HN, Opara IN, Dwaihy RL, Acuff C, Brauer B, Nabaty R, Levine DL. Engaging third-year medical students on their internal medicine clerkship in telehealth during covid-19. *Cureus.* 2020;12(6):e8791. DOI:10.7759/cureus.8791.Pmid: 32724740; pmcid: pmc7381847..
 16. Gohel KH, Patel PB, Shah PM, Patel JR, Pandit N, Raut A. Knowledge and perceptions about covid-19 among the medical and allied health science students in india: an online cross-sectional survey. *Clin Epidemiol Glob Health.* 2021;9:104-109. DOI: 10.1016/j.cegh.2020.07.008. Epub 2020 aug 12. Pmid: 32838066; pmcid: pmc7420087.
 17. Mishra A, Sharma D, Derashri G, Mishra A, Tripathi GM. Journal of Clinical and Diagnostic Research. 2020;14(10):lc01-lc05
 18. Torun F, Torun SD. The psychological impact of the covid-19 pandemic on medical students in turkey. *Pak J Med Sci.* 2020;36(6):1355-1359. DOI: 10.12669/pjms.36.6.2985. Pmid: 32968408; pmcid: pmc7501012.
 19. Khan H, Sadiq T, Khan R, Kamal D, Ali S, Yasmeen R. Measuring preparedness of mbbs students to the clinical exposure during covid-19 pandemic. *Pafmj.* 2020;70(2):s546-51.
 20. Noreen K, Rubab ZE, Umar M, Rehman R, Baig M, Baig F. Knowledge, attitudes, and practices against the growing threat of covid-19 among medical students of pakistan. *Plos One.* 2020;15(12):e0243696. DOI: 10.1371/journal.pone.0243696. Pmid: 33306712; pmcid: pmc7732088.
 21. Ikhlaq a, bint-e-riaz h, bashir i, ijaz f. Awareness and attitude of undergraduate medical students towards 2019-novel corona virus. *Pak j med sci.* 2020 may;36(covid19-s4):s32-s36. DOI: 10.12669/pjms.36.covid19-s4.2636. Pmid: 32582311; pmcid: pmc7306955.
 22. Pereira LA, Soares LCM, Nascimento PA, et al. Retinal findings in hospitalised patients with severe covid-19. *british journal of ophthalmology published Online First;* 2020. DOI: 10.1136/bjophthalmol-2020-31757
 23. Invernizzi A, Torre A, Parrulli S, Zicarelli F, Schiuma M, Colombo V et al. Retinal findings in patients with covid-19: results from the serpico-19 study. *Eclinicalmedicine.* 2020;27:100550. DOI: 10.1016/j.eclinm.2020.100550. Epub 2020 sep 20. Pmid: 32984785; pmcid: pmc7502280.
 24. Landecho MF, Yuste JR, Gándara E, Sunsundegui P, Quiroga J, Alcaide Ab et al. Covid-19 retinal microangiopathy as an in vivo biomarker of systemic vascular disease? *J Intern Med;* 2020. DOI: 10.1111/joim.13156. Epub ahead of print. Pmid: 32729633.
 25. Insausti-garcía A, Reche-Sainz JA, Ruiz-Arranz C, López Vázquez Á, Ferro-Osuna M. Papillophlebitis in a covid-19 patient: inflammation and hypercoagulable state. *Eur J Ophthalmol.* 2020;1120672120947-591.

- DOI: 10.1177/1120672120947591. Epub ahead of print. Pmid: 32735134; pmcid: pmc7399568
26. Invernizzi A, Pellegrini M, Messenio D, Cereda M, Olivieri P, Brambilla AM, Staurengi G. Impending central retinal vein occlusion in a patient with coronavirus disease 2019 (covid-19). *Ocul immunol inflamm.* 2020;28(8):1290-1292. DOI: 10.1080/09273948.2020.1807023. Epub 2020 sep 25. Pmid: 32976055.
 27. Sheth JU, Narayanan R, Goyal J, Goyal V. Retinal vein occlusion in covid-19: a novel entity. *Indian j ophthalmol.* 2020;68(10):2291-2293. DOI: 10.4103/ijo.ijo_2380_20. Pmid: 32971697.
 28. Walinjkar ja, makhija sc, sharma hr, morekar sr, natarajan s. Central retinal vein occlusion with covid-19 infection as the presumptive etiology. *Indian j ophthalmol.* 2020;68(11):2572-2574. DOI: 10.4103/ijo.ijo_2575_20. Pmid: 33120696.
 29. Ortiz-seller A, Martínez Costa L, Hernández-Pons A, Vallis Pascual E, Solves Alemany A, Albert-fort M. Ophthalmic and neuro-ophthalmic manifestations of coronavirus disease 2019 (covid-19). *Ocul immunol inflamm.* 2020;28(8):1285-1289. DOI: 10.1080/09273948.2020.1817497. Epub 2020 oct 6. Pmid: 33021422
 30. Benito-pascual B, Gegúndez JA, Díaz-Valle D, et al. Panuveitis and optic neuritis as a possible initial presentation of the novel coronavirus disease 2019 (covid-19). *Ocul Immunol Inflamm.* 2020;28(6):922-925. DOI:10.1080/09273948.2020.1792512
 31. Ali S, Alam BF, Farooqi F, Almas K, Noreen S. Dental and medical students' knowledge and attitude toward covid-19: a cross-sectional study from pakistan. *Eur J Dent.* 2020;14(s 01):s97-s104. DOI: 10.1055/s-0040-1719219. Epub 2020 dec 7. Pmid: 33285569
 32. Albaqawi HM, Alquwez N, Balay-Odao E, Bajet JB, Alabdulaziz H, Alsolami F et al. Nursing students' perceptions, knowledge, and preventive behaviors toward covid-19: a multi-university study. *Front public health.* 2020;8:573390. DOI: 10.3389/fpubh.2020.573390. Pmid: 33425830; pmcid: pmc7786242
 33. Wu h, li s, zheng j, guo j. Medical students' motivation and academic performance: the mediating roles of self-efficacy and learning engagement. *Med educ online.* 2020;25(1):1742964. DOI: 10.1080/10872981.2020.1742964. Pmid: 32180537; pmcid: pmc7144307.
 34. Graf j, smolka r, simoes e, zipfel s, junne f, holderried f, wosnik a, doherty am, menzel k, herrmann-werner a. Communication skills of medical students during the osce: gender-specific differences in a longitudinal trend study. *BMC Med Educ.* 2017;17(1):75. DOI: 10.1186/s12909-017-0913-4. Pmid: 28464857; pmcid: pmc5414383.
 35. 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. DOI: 10.3389/fpubh.2020.00253. Pmid: 32574313; pmcid: pmc7274076.
 36. Al alwan I, Al-Moamary M, Al-Attas N, Al Kushi A, Albanyan E, Zamakhshary M, Al Kadri HM, Tamim H, Magzoub M, Hajeer A, Schmidt H. The progress test as a diagnostic tool for a new pbl curriculum. *Educ health (abingdon).* 2011;24(3):493. Epub 2011 dec 15. Pmid: 22267346.
 37. Chen I, Deng C, Chen X, Zhang X, Chen B, Yu H, Qin Y, Xiao K, Zhang H, Sun X. Ocular manifestations and clinical characteristics of 535 cases of covid-19 in wuhan, china: a cross-sectional study. *Acta Ophthalmol.* 2020;98(8):e951-e959. DOI: 10.1111/aos.14472. Epub 2020 may 18. Pmid: 32421258; pmcid: pmc7276826.
 38. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He Jx et al.china medical treatment expert group for covid-19. Clinical characteristics of coronavirus disease 2019 in china. *N Engl J. Med.* 2020; 382(18):1708-1720. DOI: 10.1056/nejmoa2002032. Epub 2020 feb 28. Pmid: 32109013; pmcid: pmc7092819.
 39. Güemes-villahoz N, Burgos-Blasco B, García-Feijóo J, Sáenz-Francés F, Arriola-Villalobos P, Martínez-De-La-Casa JM, Benítez-Del-Castillo Jm, Herrera De La Muela M. Conjunctivitis in covid-19 patients: frequency and clinical presentation. *Graefes Arch Clin Exp Ophthalmol.* 2020;258(11):2501-2507. DOI: 10.1007/s00417-020-04916-0. Epub 2020 aug 29. Pmid: 32860573; pmcid: pmc7455778

40. Guo D, Xia J, Wang Y, Zhang X, Shen Y, Tong JP. Relapsing viral keratoconjunctivitis in covid-19: a case report. *Viol J.* 2020;17(1):97. DOI: 10.1186/s12985-020-01370-6. Pmid: 32641169; pmcid: pmc7341713
41. Cheema m, aghazadeh h, nazarali s, et al. Keratoconjunctivitis as the initial medical presentation of the novel coronavirus disease 2019 (covid-19). *Can J Ophthalmol.* 2020;55(4):e125-e129. DOI:10.1016/j.jcjo.2020.03.003
42. American Academy of Ophthalmology. important coronavirus updates for ophthalmologists. *Am acad ophthalmol;* 2020. Available: <https://www.aao.org/headline/alert-important-coronavirus-context>.
43. Baig M, Jameel T, Alzahrani SH, Mirza AA, Gazzaz ZJ, Ahmad T et al. Predictors of misconceptions, knowledge, attitudes, and practices of covid-19 pandemic among a sample of Saudi Population. *Plos One.* 2020;15(12):e0243526. DOI: 10.1371/journal.pone.0243526. Pmid: 33296420; pmcid: pmc7725365.
44. Lau AY, Gabarron E, Fernandez-Luque L, Armayones M. Social media in health--what are the safety concerns for health consumers? *Health inf manag.* 2012;41(2):30-5. DOI:10.1177/183335831204100204. Pmid: 23705132.
45. Alsuraihi AK, Almaqati AS, Abughanim SA, Jastaniah NA. Use of social media in education among medical students in saudi arabia. *Korean J Med Educ.* 2016;28(4):343-354. DOI: 10.3946/kjme.2016.40. Epub 2016 dec 1. Pmid: 27907981; pmcid: pmc5138570.
46. Alenazi TH, Bindhim NF, Alenazi MH, Tamim H, Almagrabi RS, Aljohani SM et al. Prevalence and predictors of anxiety among healthcare workers in saudi arabia During the covid-19 pandemic. *J infect public health.* 2020;13(11):1645-1651. DOI: 10.1016/j.jiph.2020.09.001. Epub 2020 oct 5. Pmid: 33032969; pmcid: pmc7535800.
47. Radwan E, Radwan A, Radwan W. The role of social media in spreading panic among primary and secondary school students during the covid-19 pandemic: an online questionnaire study from the gaza strip, palestine. *Heliyon.* 2020;6(12):e05807. DOI: 10.1016/j.heliyon.2020.e05807. Pmid: 33376831; pmcid: pmc7758520.
48. Ta aq, tang cg. Social media among medical students and personnel here to stay. *Otolaryngol head neck surg.* 2018;158(6):972-973. DOI: 10.1177/0194599818756286. Epub 2018 feb 6. Pmid: 29405835.
49. Chen I, deng c, chen x, et al. Ocular manifestations and clinical characteristics of 535 cases of covid-19 in wuhan, china: a cross-sectional study [published online ahead of print, 2020 may 18]. *Acta Ophthalmol.* 2020;10.1111/aos.14472. DOI:10.1111/aos.14472

© 2022 Alshuhayb et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/86218>