



The Impact of COVID-19 on Radiological Science Students and Interns at King Saud bin Abdulaziz University for Health Sciences: Cross-Sectional Study

Reham Kaifi ¹⁻³, Ahmed Subahi^{2,4}, Salem Alqarni¹, Ahmed Jaddawi¹, Ahmed Alghamdi¹, Khalid M Alshamrani ¹⁻³

¹Department of Radiological Sciences, College of Applied Medical Sciences, King Saud bin Abdulaziz University for Health Sciences, Jeddah City, Saudi Arabia; ²King Abdullah International Medical Research Center, Jeddah City, Saudi Arabia; ³Medical Imaging Department, Ministry of the National Guard - Health Affairs, Jeddah City, Saudi Arabia; ⁴Department of Basic Sciences, College of Science and Health Professions, King Saud bin Abdulaziz University for Health Sciences, National Guard, Jeddah City, Saudi Arabia

Correspondence: Reham Kaifi, Email kaifir@ksau-hs.edu.sa

Introduction: The impact of the coronavirus disease (COVID-19) outbreak on many parts of our lives cannot be overstated. This study aimed to identify the psychological, physical activity, and educational effects of COVID-19 on radiological sciences students and interns at the three campuses of King Saud bin Abdulaziz University for Health Sciences (KSAU-HS), Riyadh, Jeddah, and Alahsa.

Methods: A cross-sectional study was conducted between November and December 2021 among Saudi-108 radiological sciences students and interns using non-probability convenient sampling at King Saud bin Abdul-Aziz University for Health Science (KSAU-HS), Riyadh, Jeddah, and Alahsa using a validated questionnaire. Statistical analyses were conducted using Excel and JMP statistical software.

Results: 102 out of 108 completed the questionnaire resulting in a 94.44% response rate. The percentage of the overall negative psychological impact was 62%. For the physical activity effects of COVID-19 among students and interns, 96% reported a decline in their physical activities. 77% of participants reported a fair impression that the students were able to achieve some of their academic goals and acquired new skills during the pandemic, and 20% reported a good impression. They achieved all their goals and developed new skills, whereas 3% reported bad impressions and needed to achieve their goals or improve their skills.

Conclusion: COVID-19 had a negative psychological and physical activity impact on RADs students and interns at the three KSAU-HS campuses in the Kingdom of Saudi Arabia. Despite technical difficulties, students and interns reported positive academic outcomes from COVID-19.

Keywords: COVID-19, radiological sciences students, interns, psychological effect, clinical skills, radiography education

Introduction

With the coronavirus pandemic 2019 (COVID-19), educational training institutions and health professions faced many challenges worldwide.^{1,2} Although many nations have embraced extreme measures to prevent the spread of the infection, such as social distancing, the consequences of COVID-19 led to several impacts on students, healthcare workers, and trainers.³⁻⁵ Many schools and colleges throughout the globe have been closed and stopped their instructional activities because of the pandemic, which has affected students' mental health.^{6,7} Even though the learning activities gradually shifted to electronic learning (eLearning), the main challenge was setting a schedule compatible with the pandemic, especially with training activities, as attendance was restricted and prohibited.^{8,9} Furthermore, with the pandemic, the reduction of patients in hospitals caused trainers to work with fewer cases, which led to the limitation of studying various diseases and X-ray procedures.⁶ Interruptions in educational delivery have been reported and are well-documented.¹⁰⁻¹² The pandemic has greatly affected teaching, research, and hands-on training in radiography at different universities.¹²⁻¹⁴

The College of Applied Medical Sciences (CoAMS) of King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) in Saudi Arabia (KSA) offers a high-quality undergraduate Radiological Sciences (RADS) program to maximize students' ability via intensive instruction and practice. It is a four-year tracks-based curriculum in three KSA cities/campuses with three specialized pathways: CT & MRI, VIR, and US. After two years of preprofessional science and health courses, students begin their professional studies in RADS's third and fourth years. RADS' curriculum includes interactive lectures, practical workshops, PBL and TBL, group discussions, and case studies. RADS programs also give hands-on instruction in the third and fourth years through field/clinical experiences. After the fourth year, students begin internships as interns, who enroll in the fifth year of clinical practice. All in-person teaching and learning activities were suspended following government directives during the pandemic. Gradually, the teaching activities transitioned to virtual classes using Blackboard Collaborate and Microsoft Teams. The field/clinical activities were restricted and transitioned to simulation using mannequins available in the university for students enrolled in blended courses that are theoretical and practical. In addition, field/clinical training was coordinated (in compliance with local COVID-19 protocols) for students enrolled in pure practical courses and for interns during their internship.

Radiographers are first-line healthcare workers who play a crucial role in providing care during COVID-19. Maintaining workforce numbers, especially as health services recover from the first effects of COVID-19 and become ready for additional pandemic waves, depends heavily on the entry of fresh graduates into the profession. Different studies have measured burnout, anxiety, and depression among medical and non-medical students nationally and internationally during COVID-19.¹⁵⁻¹⁸ However, to our knowledge, no study has been done on the psychological, physical activity, and educational impacts of the first wave of COVID-19 on radiological sciences students and interns at the three campuses of KSAU-HS in the Kingdom of Saudi Arabia. Therefore, this study aimed to identify the psychological, physical activity, and educational impacts of COVID-19 on radiological sciences students and interns at the three campuses of King Saud bin Abdulaziz University for Health Sciences (KSAU-HS), Riyadh, Jeddah, and Alahsa.

Methodology

A cross-sectional study was conducted at King Saud bin Abdul-Aziz University for Health Sciences (KSAU-HS), Kingdom of Saudi Arabia, between November and December 2021. The study aimed to collect data from radiological sciences students (RADS) and interns enrolled in KSAU-HS, College of Applied Medical Sciences, at the three campuses, Riyadh, Jeddah, and Alahsa, during the pandemic of COVID-19. The exclusion criteria were students who had withdrawn from the program or had postponed the semester during the pandemic. Non-probability convenient sampling technique was used, and all participants (n= 108) were invited via email to complete an online survey.

A twenty questions survey was designed and validated by experts to determine how COVID-19 affected the radiological sciences students and interns during their clinical rotations. The questionnaire's content validity was determined by computing the index of Item Objective Congruence (IOC).¹⁹ Parameters of the index suggested that an IOC score of more than 0.6 indicated excellent content validity.¹⁹ The IOC scores for all items of the questionnaire were more than 0.6. Before collecting data, twenty copies of the questionnaire were pretested among selected RADs participants enrolled in KSAU-HS, Jeddah campus. Cronbach's alpha, a measure of internal consistency established before data collection, was 0.70. The survey has two sections, and it takes about ten minutes to be completed. Response choices were closed-ended, five-point Likert scale. The first section was designed for demographic data [ie, age, gender, academic level, and location of their campus at KSAU-HS] and participants' history of COVID-19. Section two was created to examine the psychological, physical activity, and academic challenges and issues faced by RADs students and interns during the first wave of COVID-19.

This study was approved by the Institutional Review Board (IRB) committee of King Abdullah International Medical Research Center (KAIMRC). Electronic consent was obtained from all participants before filling out the survey. Participants' confidentiality was maintained, and students' performance was kept confidential during the study analysis. The participant's information was held in a secure encrypted Excel file. All analyses were conducted using Excel version 16 and JMP statistical software version 16. The statistical analysis process involved three steps: descriptive statistics

(mean and standard deviation), Cronbach's alpha test was used to evaluate scale reliability, and Chi-Square Test for Association was used to determine if there is any association between two variables.

Results

The overall number of students who agreed to participate in this study was 102 out of 108, resulting in a 94.44% response rate [46 male (45%), 56 female (55%)]. The participants' age range was 19 to 24 years old, with an average age of 21.59 ± 1.25 years. A summary of the student's academic levels and campus locations is provided in [Table 1](#). Most of the participants among the three campuses were interns (n=36) then, fourth-year students (n=34) then, third-year students (n=32), with total percentages of 35.3%, 33.3%, and 31.4%, respectively. The participants who were from Riyadh were (n=37) 36.3%, Jeddah (n= 35) 34.3%, and Alahsa (n= 30) 29.4%. Participants were asked if they had been infected with COVID-19 since the pandemic started, and the results showed that 68% of the participants got infected. In comparison, 32% did not get infected ([Figure 1](#)). The survey's internal consistency (Cronbach's alpha) was good and acceptable ($\alpha = 0.701$).

The participants were asked about their overall impression of COVID-19. The results showed that the overall impression of the effect of COVID-19 on students' study and clinical training was as follows: 77% of participants reported a fair impression, 20% reported a good impression, where the students were able to achieve their planned academic goals, ie, raising their cumulative GPA or maintaining their GPA from dropping down and developed new skills, and 3% of the students reported a bad impression where they did not achieve their academic goals or improve skills ([Figure 2](#)). The association between gender and the overall impression of the COVID-19 pandemic on participants' study and clinical training was evaluated using the Chi-square analysis test. The results showed no significant difference between males' and females' impressions, with a P value of 0.4256, as shown in ([Figure 2](#)). The participants were asked to select the most significant challenge they faced while studying during COVID-19. Our results showed that the top three challenges the radiological students and trainers faced in KSAU-HS were the fear of family members getting infected with COVID-19, social distancing and quarantine, and dealing with COVID patients during the clinical training ([Figure 3](#)). A summary of the rest of the survey's results is shown in [Table 2](#). The following sections will present combinations of the results Likert scales [strongly agree and agree] and [strongly disagree and disagree]. Our results showed that 42% of the students were able to access electronic learning (eLearning) during the pandemic, 29% were sometimes able to access eLearning, and 29% of the students were not able to access eLearning. Of those who could access the eLearning, 61% faced technical issues throughout the experience, 22% reported that they sometimes faced technical problems in the eLearning, and 17% of the students reported that they did not face any technical issues with the eLearning experience. In addition, our results showed that 55% of the students reported that their studying performance was negatively affected by COVID-19. In comparison, 26% of the students reported that their studying performance was sometimes negatively affected by COVID-19 for some courses, and 19% reported that their studying performance was not negatively affected by the pandemic. However, 62% of the students reported that their instructors and supervisor were cooperative during the eLearning sessions and were more lenient during the clinical training evaluation process, 16% reported that instructors and supervisors were sometimes cooperative and lenient, and 22% reported that instructors and supervisors were not cooperative nor lenient during the eLearning sessions and the clinical training evaluation process. Consequently, 55% of the students reported that studying during the pandemic was good for them academically, while

Table 1 Percentage of Students' Academic Levels Among the Three KSAU-HS Campuses

Academic Level	Alahsa n [%]	Jeddah n [%]	Riyadh n [%]	Total n [%]
3rd year	5 [4.9%]	9 [8.8%]	18 [17.7%]	32 [31.4%]
4th year	11 [10.8%]	15 [14.7%]	8 [7.8%]	34 [33.3%]
Internship	14 [13.7%]	11 [10.8%]	11 [10.8%]	36 [35.3%]
Total	30 [29.4%]	35 [34.3%]	37 [36.3%]	102 [100%]

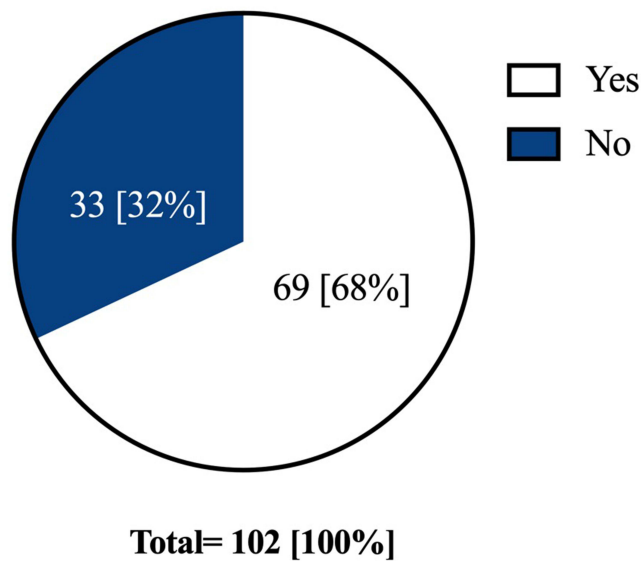


Figure 1 Percentage of students infected with COVID-19 during the pandemic.

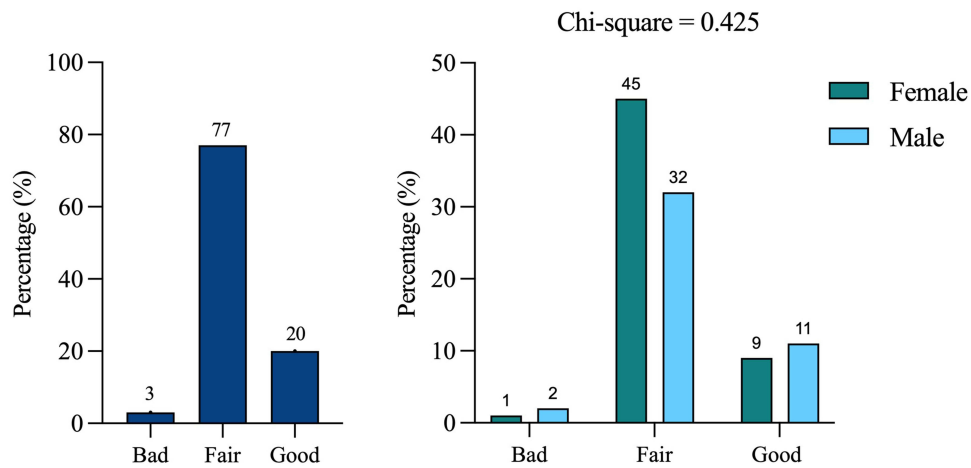


Figure 2 The overall impression of COVID-19 on participants' educational and clinical goals on the left and the Association between gender and overall impression of COVID-19 on the right.

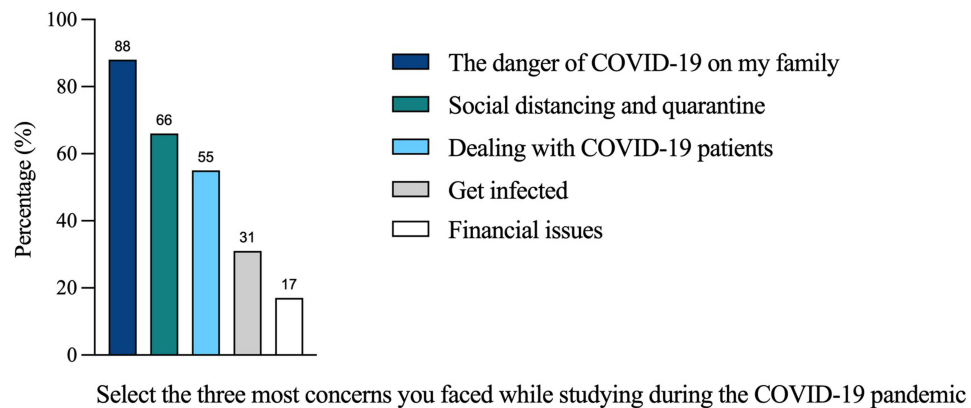
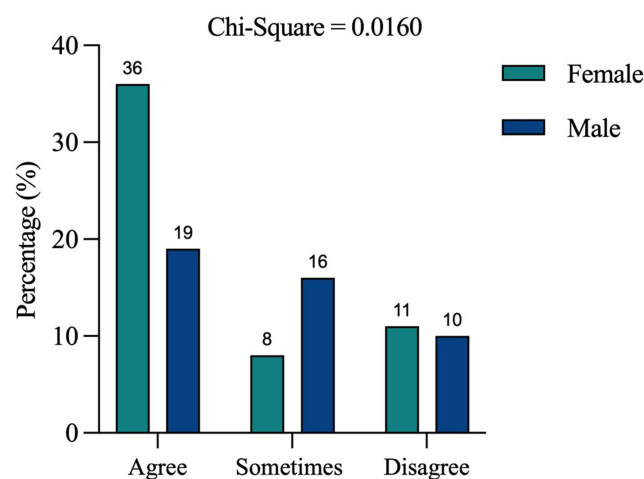


Figure 3 RADs students and interns' concerns faced while studying during the pandemic.

Table 2 Psychological, Physical Activity, and Educational Effects of COVID-19 on Radiological Sciences Students and Interns at KSAU-HS

Questions	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree	Total n [%]
I was able to access eLearning (Electronic learning) during the COVID-19 pandemic.	18 [18%]	25 [24%]	30 [29%]	20 [20%]	9 [9%]	102 [100%]
I faced technical problems when I accessed eLearning	23 [23%]	39 [38%]	23 [22%]	12 [12%]	5 [5%]	102 [100%]
During the COVID-19 pandemic, my studying performance was negatively affected.	19 [19%]	37 [36%]	27 [26%]	14 [14%]	5 [5%]	102 [100%]
My instructors and supervisors cooperated during the pandemic's eLearning and were more lenient during the clinical training evaluation process.	30 [29%]	34 [33%]	16 [16%]	16 [16%]	6 [6%]	102 [100%]
Overall, my academic performance was good during the pandemic. (Improvement in grades)	22 [22%]	34 [33%]	25 [24%]	14 [14%]	7 [7%]	102 [100%]
Communication with colleagues was difficult during the pandemic.	25 [24%]	38 [37%]	18 [18%]	14 [14%]	7 [7%]	102 [100%]
The pandemic has had a negative psychological impact on me.	27 [27%]	36 [35%]	29 [28%]	5 [5%]	5 [5%]	102 [100%]
My education and clinical training during the COVID-19 pandemic stressed and overwhelmed me.	12 [12%]	28 [27%]	30 [29%]	20 [20%]	12 [12%]	102 [100%]
I was worried about my health during my clinical training; by getting infected by COVID-19.	13 [13%]	35 [34%]	37 [36%]	11 [11%]	6 [6%]	102 [100%]
Overall, the pandemic caused a negative impact on me physically, ie, a reduction in physical activities.	43 [42%]	39 [38%]	16 [16%]	4 [4%]	0 [0%]	102 [100%]

21% reported that studying during the pandemic was not good for them academically. The association between gender and academic performance improvement of participants was evaluated using the Chi-square analysis test. Our findings revealed a statistically significant association between academic performance improvement and gender ($P = 0.0160$), where 36% of female students reported good academic performance. In comparison, only 19% of males reported good academic performance during the pandemic (Figure 4).

**Figure 4** Association between gender and self-reported improvement of academic performance grades during the pandemic.

In addition, our results showed difficulties in communication between peers 61% reported it was difficult to communicate during the pandemic, 18% reported sometimes having difficulties communicating, and 21% had no issue communicating during the pandemic. Regarding the psychological impact, 62% of the students had a negative effect, 28% of the students sometimes had a negative impact, and 10% of the students did not have a bad psychological impact. Our study showed that 39% of the students were stressed and overwhelmed with their education and clinical training during the COVID-19 pandemic, 29% of the students sometimes were stressed with their education and clinical training, and 32% of the students were not stressed with their education and clinical training. In addition, our results showed that 47% of the students worried about their health during their clinical rotation, 36% were sometimes concerned about their health during their clinical rotation, and 17% did not worry about their health during the clinical rotation. Regarding the physical activity impact, 96% of the students reported a negative physical effect, whether during the whole pandemic or sometimes during the pandemic. In contrast, 4% of the students reported they had no negative impact on their physical activities during the pandemic.

Discussion

Our study revealed a snapshot of the psychological, physical activity, and educational impact of the first wave of COVID-19 among RADs students and interns at the three campuses of King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) Riyadh, Jeddah, and Alahsa. A dominance was noted in Riyadh's response rate among the other campuses [Table 1](#). This could be explained by the variation in the students' number enrolled among the three campuses due to the location and capacity of these three campuses. The Riyadh campus is the main campus with seven colleges and is in the capital city of Saudi Arabia. Jeddah campus has four colleges and is located in the second largest city in Saudi Arabia. Finally, the campus in Alahsa, the fifth largest city in Saudi Arabia, has three colleges in the university. In addition, the response rate was highest among the interns involved in clinical field internships; this may help explain why 68% of the participants had been infected with COVID, as shown in [Figure 1](#). On the other hand, when participants ranked their top three concerns, fear of family members being infected by COVID-19 was the top concern, with 88%. Quarantine and social distancing were ranked as a second concern with 66%, then dealing with COVID patients during the clinical training with 55%. Similarly, a Canadian study revealed that their participants were more concerned about family members and loved ones from getting severely sick or dying, with a percentage of 59%, then passing the virus to someone else if got infected with 53%, and finally becoming ill by the virus with 48%.¹⁴ The reason for this could be that participants were aware that people over the age of 65 account for 80% of hospitalizations and have a death risk that is 23 times higher than the risk faced by those younger than 65.²⁰

Regarding the psychological impact, several studies in several countries have measured burnout, anxiety, and depression among college students during COVID-19.^{15–18} A previous national study has reported the burnout rate among Saudi radiological sciences students enrolled in the College of applied medical sciences (CoAMS) at the three campuses of KSAU-HS during the COVID-19 pandemic as moderate to high burnout rates. The study reported that burnout increased as students advanced to the fourth year.²¹ Similarly, our findings revealed that 39% of the RADs students and interns felt stressed and overwhelmed during their study. The percentage increased to 47% during their clinical training, mainly during the fourth year of their study and the internship. Our findings revealed that 62% of the students reported a negative psychological impact of COVID-19 during their study. There is evidence from multiple international studies that physical activity can significantly reduce the psychological impact of lockdown during the pandemic.^{22–25}

On the other hand, different studies reported a general decline in physical activity levels among university students because of social distancing.²⁶ Nine studies found a statistically significant decline in participants' physical activity levels. Five studies showed a reduction in light/mild physical activity (walking) of 32.5% to 64.5% compared to pre-lockdown rates. Seven studies showed a reduction in high/vigorous physical activity of 2.9% to 52.8%. Across the board, university students' levels of walking, moderate, strong, and total physical activity decreased during the COVID-19 pandemic confinements.²⁶ Our findings showed comparable results of 96% of the students and interns reporting a decline in their physical activities, negatively affecting them.

Regarding the educational impact, like previous studies,^{13,14} online learning was utilized in KSAU-HS instead of regular face-to-face teaching instructions. Two indicators were used to evaluate participants' learning performance: (a) improvement

in perceived learning (ie, students' self-evaluation of their academic studying performance during the lockdown period relative to the period before the lockdown); (b) improvement in grades (self-reported differences in student grades between the lockdown period and the period before the lockdown). Our results revealed 55% of participants reported a negative studying performance, while 55% reported improvements in their grades. In addition, our study provided evidence of the gender gap in favor of females in learning outcomes, especially when it comes to grades ($P = 0.0160$). A study conducted in Mexico revealed similar results that females had a higher academic average than males.²⁷ The study concluded that gender was a factor associated with academic performance during the quarantine period due to the COVID-19 pandemic.²⁷

On the other hand, the education system faced many challenges globally due to the COVID-19 pandemic.^{8,9} A study conducted in Ghana reported that 64.5% of radiography students found the online system as not user-friendly due to no prior experience/training in online education and lack of access to internet services.¹² Similarly, our research showed that only 42% of students had access to their eLearning and 61% of those who did report experiencing technical difficulties. Even though online learning lacks the engaging qualities of face-to-face learning, online learning has advantages (ie, flexibility, availability of learning materials such as audio and video whenever needed, less commuting costs, etc).^{28,29} Moreover, our study showed that 62% of participants reported that supervisors demonstrated a positive attitude toward collaboration and flexibility During the eLearning classes and the clinical training evaluation procedures, which eventually benefitted the students' overall impression of COVID-19 with 97% fair to good impression, where the students were able to achieve their planned academic goals, ie, raising their cumulative GPA or maintaining their GPA from dropping down and developed new skills.

Limitations

The major limitation of this study is that we did not capture the impact of the pandemic on RADs students' research activity. In addition, this study was mainly focused on one university that offers a Radiological science program in Saudi Arabia.

Conclusion

Our study showed the psychological, physical activity, and educational impact of the first wave of COVID-19 among RADs students and interns at the three campuses of King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) Riyadh, Jeddah, and Alahsa. Our study showed that 68% of the participants had been infected with COVID-19, and the participants reported a negative impact on them psychologically. In addition, due to the lockdown, participants reported a negative impact on their physical activities. On the other hand, RADs students and interns reported good academic impacts of COVID-19 regardless of the technical issues associated with eLearning. A future qualitative study could look at the experiences of 68% of participants who got infected with COVID-19 during their study. In addition, future research would be to conduct a study to evaluate the impact of the COVID-19 pandemic on RADs students' research activity. Also, further research is recommended to compare the effects of COVID-19 among different universities in the Kingdom of Saudi Arabia that provide radiological sciences programs.

Abbreviations

COVID-19, Coronavirus Disease 2019; RADS, Radiological Sciences; CoAMS, College of Applied Medical Sciences; KSAU-HS, King Saud bin Abdulaziz University for Health Sciences; KSA, Kingdom of Saudi Arabia; eLearning, electronic learning; CT & MRI, Computed Tomography and Magnetic Resonance Imaging; VIR, Vascular and Interventional Radiology; US, Ultrasound; PBL, Problem-Based Learning; TBL, Team-Based Learning; IOC, Item Objective Congruence.

Ethics Statement

We confirm that participants were informed about the purpose of the survey, that electronic consent was obtained from the study participants, and that the guidelines outlined in the Declaration of Helsinki were followed.

Acknowledgments

King Abdullah International Medical Research Center ethics committee approved this study (Study Number: SP21J/070/03)". This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Disclosure

The authors report no conflicts of interest in this work.

References

1. Rainford LA, Zanardo M, Buissink C, et al. The impact of COVID-19 upon student radiographers and clinical training. *Radiography*. 2021;27(2):464–474. doi:10.1016/j.radi.2020.10.015
2. Robbins JB, England E, Patel MD, et al. COVID-19 impact on well-being and education in radiology residencies: a survey of the association of program directors in radiology. *Acad Radiol*. 2020;27(8):1162–1172. doi:10.1016/j.acra.2020.06.002
3. Tay YX, Cai S, Chow HC, Lai C. The needs and concerns of clinical educators in radiography education in the face of COVID-19 pandemic. *J Med Imaging Radiat Sci*. 2021;52(1):3–8. doi:10.1016/j.jmir.2020.10.004
4. Lim EC, Oh VM, Koh D-R, Seet RC. The challenges of ‘continuing medical education’ in a pandemic era. *Ann Acad Med Singapore*. 2009;38(8):724–726. doi:10.47102/annals-acadmedsg.V38N8p724
5. Rabe A, Sy M, Cheung WYW, Lucero-Priso DE. COVID-19 and health professions education: a 360 view of the impact of a global health emergency. *MedEdPublish*. 2020;9(148):148. doi:10.15694/mep.2020.000148.1
6. Edigin E, Eseaton PO, Shaka H, Ojemolon PE, Asemota IR, Akuna E. Impact of COVID-19 pandemic on medical postgraduate training in the United States. *Med Educ Online*. 2020;25(1):1774318. doi:10.1080/10872981.2020.1774318
7. Rose S. Medical student education in the time of COVID-19. *JAMA*. 2020;323(21):2131–2132. doi:10.1001/jama.2020.5227
8. Mishra L, Gupta T, Shree A. Online teaching-learning in higher education during lockdown period of COVID-19 pandemic. *Int J Educ Res Open*. 2020;1:100012. doi:10.1016/j.ijedro.2020.100012
9. He W, Wei G. Higher education in China, a paradigm shift from conventional to online teaching. *Higher Educ Stud*. 2021;11(2):30–41. doi:10.5539/hes.v11n2p30
10. Cushen-Brewster N, Strudwick RM, Doolan C, Driscoll–Evans P. An evaluation of the experiences of radiography students working on the temporary HCPC register during the COVID-19 pandemic. *Radiography*. 2021;27(4):1000–1005. doi:10.1016/j.radi.2021.03.003
11. Tay YX, Sng LH, Chow HC, Zainuddin MR. Clinical placements for undergraduate diagnostic radiography students amidst the COVID-19 pandemic in Singapore: preparation, challenges and strategies for safe resumption. *J Med Imaging Radiat Sci*. 2020;51(4):560–566. doi:10.1016/j.jmir.2020.08.012
12. Ofori-Manteaw BB, Dzirzornu E, Akudjedu TN. Impact of the COVID-19 pandemic on clinical radiography education: perspective of students and educators from a low resource setting. *J Med Imaging Radiat Sci*. 2022;53(1):51–57. doi:10.1016/j.jmir.2021.11.002
13. Ogolodom MP, Mbaba AN, Nwodo VK, et al. The impact of Covid-19 pandemic on academic and professional development programmes organized by the Radiographers Registration Board of Nigeria. *J Biomedical Sci*. 2021;10(1): 47.
14. Gadermann AC, Thomson KC, Richardson CG, et al. Examining the impacts of the COVID-19 pandemic on family mental health in Canada: findings from a national cross-sectional study. *BMJ Open*. 2021;11(1):e042871. doi:10.1136/bmjopen-2020-042871
15. Garcia-Reyna B, Castillo-Garcia GD, Barbosa-Camacho FJ, et al. Anxiety and COVID-19: Coronavirus Anxiety Scale scores in medical and non-medical personnel in urban hospitals in Guadalajara. A cross-sectional survey study. *Death Stud*. 2022;46(3):581–589. doi:10.1080/07481187.2021.1936297
16. Maciaszek J, Ciulkowicz M, Misiak B, et al. Mental health of medical and non-medical professionals during the peak of the COVID-19 pandemic: a cross-sectional nationwide study. *J Clin Med*. 2020;9(8):2527. doi:10.3390/jcm9082527
17. Mion G, Hamann P, Saleten M, Plaud B, Baillard C. Psychological impact of the COVID-19 pandemic and burnout severity in French residents: a national study. *Eur J Psychiatry*. 2021;35(3):173–180. doi:10.1016/j.ejpsy.2021.03.005
18. Alkureishi ML, Jaishankar D, Dave S, et al. Impact of the early phase of the COVID-19 pandemic on medical student well-being: a multisite survey. *J Gen Intern Med*. 2022;37(9):2156–2164. doi:10.1007/s11606-022-07497-2
19. Turner RC, Carlson L. Indexes of item-objective congruence for multidimensional items. *Int J Test*. 2009;3(2):163–171. doi:10.1207/S15327574IJT0302_5
20. Mueller AL, Mcnamara MS, Sinclair DA. Why does COVID-19 disproportionately affect older people? *Aging*. 2020;12(10):9959–9981. doi:10.18632/AGING.103344
21. Alshamrani KM, Alkenawi AA, Kaifi R, et al. Burnout among Saudi radiological sciences undergraduate students during COVID-19 pandemic: a cross-sectional study. *Psychol Res Behav Manag*. 2022;15:1637. doi:10.2147/PRBM.S372251
22. Lesser IA, Nienhuis CP. The impact of COVID-19 on physical activity behavior and well-being of Canadians. *Int J Environ Res Public Health*. 2020;17(11):3899. doi:10.3390/ijerph17113899
23. Maugeri G, Castrogiovanni P, Battaglia G, et al. The impact of physical activity on psychological health during Covid-19 pandemic in Italy. *Heliyon*. 2020;6(6):e04315. doi:10.1016/j.heliyon.2020.e04315
24. Scully D, Kremer J, Meade MM, Graham R, Dudgeon K. Physical exercise and psychological well being: a critical review. *Br J Sports Med*. 1998;32(2):111–120. doi:10.1136/bjism.32.2.111
25. Fox KR. The influence of physical activity on mental well-being. In: *Public Health Nutrition*. CAB International; 1999:411–418. doi:10.1017/S1368980099000567
26. López-Valenciano A, Suárez-Iglesias D, Sanchez-Lastra MA, Ayán C. Impact of COVID-19 pandemic on university students’ physical activity levels: an early systematic review. *Front Psychol*. 2021;11. doi:10.3389/fpsyg.2020.624567

27. Vargas-Ramos JC, Lerma C, Guzmán-Saldaña RME, Lerma A, Bosques-Brugada LE, González-Fragoso CM. Academic performance during the COVID-19 pandemic and its relationship with demographic factors and alcohol consumption in college students. *Int J Environ Res Public Health*. 2022;19(1). doi:10.3390/ijerph19010365
28. Gherheș V, Stoian CE, Fărcașiu MA, Stanici M. E-learning vs. face-to-face learning: analyzing students' preferences and behaviors. *Sustainability*. 2021;13(8):4381. doi:10.3390/su13084381
29. Currie G, Hewis J, Nelson T, et al. COVID-19 impact on undergraduate teaching: medical radiation science teaching team experience. *J Med Imaging Radiat Sci*. 2020;51(4):518–527. doi:10.1016/j.jmir.2020.09.002

Advances in Medical Education and Practice

Dovepress

Publish your work in this journal

Advances in Medical Education and Practice is an international, peer-reviewed, open access journal that aims to present and publish research on Medical Education covering medical, dental, nursing and allied health care professional education. The journal covers undergraduate education, postgraduate training and continuing medical education including emerging trends and innovative models linking education, research, and health care services. The manuscript management system is completely online and includes a very quick and fair peer-review system. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <http://www.dovepress.com/advances-in-medical-education-and-practice-journal>