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# The impact of COVID-19 on surgical training, education and burnout among different surgical specialties in Qassim region, Saudi Arabia

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## ABSTRACT

*Background:* The loss of normalcy during the COVID-19 pandemic affected operation services in health facilities, leading to a reduction in the number of elective surgeries. The pandemic-related modifications in surgical residency programs gave rise to a chance to investigate effective learning strategies that help reduce burnout. *Objectives:* To investigate the effects of the COVID-19 epidemic on general surgeons' burnout, surgical education and training in the Qassim Region of Saudi Arabia. *Methods:* This cross-sectional study involved general surgery doctors in the hospitals of the Qassim region in Saudi Arabia. *Results:* The COVID-19 patient care had a detrimental effect on the role of examining patients on rounds among females (adjOR = 0.260, 95%CI: 0.084-0.809; $p$ = 0.020) and males (adjOR = 0.426, 95% CI: 0.232-0.780; $p$ = 0.006). COVID-19 patient care had a negative impact on the number of days off in a month among females (adjOR = 0.159, 95% CI: 0.029-0.875; $p$ = 0.035). Equally, COVID-19 patient care had a negative impact on meeting ACGME's minimum requirements (adjOR = 0.163, 95% CI: 0.042-0.634; $p$ = 0.009) as noted by the specialist. Lastly, COVID-19 patient care had a negative impact as expressed by the specialist who was concerned the pandemic had made one less prepared for the future (adjOR = 0.074, 95% CI: 0.007-0.739; $p$ = 0.027). *Conclusions:* COVID-19 patient care had a negative relationship with the operation volume on the role of examining patients on rounds, the likelihood of not meeting the ACGME's minimum requirements and burnout concerns. The specialist is more concerned with matters regarding meeting the ACGMEs and burnout concerns which would make the general surgery doctors less prepared for the future.

**Keywords:** Burnout, COVID-19, Clinical scheduling, Instructional programs, Operation volume, Saudi Arabia, Surgical training

## 1. INTRODUCTION

Coronaviruses (CoV) are positive-sense, non-segmented, single-strand ribonucleic acid genome viruses that belong to the Coronaviridae family (Fung & Liu, 2019). Despite being largely associated with enzootic illnesses, they have also developed over the past few decades to infect people (Schoeman & Fielding, 2019). Coronavirus infections can range in severity from the ordinary cold to more serious conditions like Middle East respiratory syndrome (MERS) and severe acute respiratory syndrome (SARS-CoV) (MERS-CoV) (Chan et al., 2015). The World Health Organization (WHO) classified the 2019 coronavirus illness (COVID-19), a public health emergency that originated in the Chinese city of Wuhan in 2019, to be a pandemic in March 2020 (Fung & Liu, 2019). Healthcare professionals are fighting the sickness that is easily spread by aerosols on the front lines. Due to both direct and indirect contact with COVID-19-positive people and the scarcity of personal protective equipment, they are especially at risk of contracting the disease (Chan et al., 2015; COVIDSurg et al., 2020). The disease's quick spread and the influx of patients made things busier and interfered with the surgical resident training programs. In addition to that, the World Health Organization declared in March 2020 that it was a global pandemic (Cucinotta & Vanelli, 2020).

Global healthcare delivery is facing huge obstacles as a result of the COVID-19 epidemic. A decrease in possibilities for surgical training runs parallel to this. The COVIDSurg research collaboration predicted that during the first wave of the pandemic in early 2020, over 28 million elective cases will be abandoned (COVIDSurg et al., 2020). Health services have experienced a return to restrictions on elective activity equal to those of the early 2020 as the globe fights new waves of illness and more aggressive strains of COVID-19. This creates challenges for the conventional surgical training program. The academic program that was created to improve surgical skills in dealing with a number of issues, including fewer team meetings and less time spent in clinical and hands-on settings to prevent physician-patient contacts and maintain the team's safety. The loss of normalcy and element of terror in one's professional and personal lives can cause a health care worker to become physically, mentally and emotionally exhausted and is linked to a number of psychiatric issues (Afifi et al., 2022). As a result, the demands placed on frontline healthcare workers have grown enormously as the number of cases rises day after day (Osama et al., 2020).

Operating rooms are especially affected by the COVID-19 virus, which causes significant problems for the healthcare system. As the number of elective surgeries were reduced during the pandemic. By restricting the operating rooms to emergency cases, surgical residents were able to focus more on these cases and provide essential care in other health services, including consulting services and acute care (Obaid et al., 2021). Consequently, work hours were reduced to minimize residents' exposure to COVID-19 cases. A study conducted in California found that most residents had more free time for self-learning and attending virtual sessions and nearly half had increased their research activity (Wise et al., 2021). In Singapore, the reduction of work hours ranged from 26 to 70%, while the reduction of consultations was up to 50%, which in fact resulted in fewer patients being seen by the residents. Furthermore, many meetings and conferences were cancelled and only a few societies used social media and virtual applications (Seow et al., 2022). Cases processed during the pandemic, in number was significantly down, according to research conducted in the United States that evaluated how the COVID-19 pandemic affected surgical residents' clinical schedules, operating volumes and educational curricula as well as resident burnout (Aziz et al., 2021).

Therefore, resident experience is further reduced when the number of surgeons in the OR is limited. As a result, residents become more concerned about their readiness for completing the program and taking on responsibilities. On the other hand, most inhabitants claimed to have spent more time studying than they had before the outbreak. In terms of burnout, the study shows PGY 1 class was more likely than other classes to have burnout during the peak of the pandemic, one of the factors driving that is the fear of spreading the virus to their friends and family (Aziz et al., 2021). The pandemic-related modifications in surgical residency programs, the circumstance has given rise to a chance to investigate effective learning strategies that help reduce burnout (Osama et al., 2020). In several recent studies conducted in Italy among general surgery residents and urology residents, it has been demonstrated that not only the patients were affected by COVID-19, but surgeons' perspectives of training have also been affected (Berger et al., 2020; Bernardi et al., 2020; COVIDSurg et al., 2020; Pertile et al., 2020). The Netherlands reported a study including cardiology residents that 41% of residents worked up to 3 months at a cohort unites of COVID-19 and holding up their training (Berger et al., 2020). Psychiatric symptoms were established in a recent study done in China among healthcare workers showing 8 to 35% of insomnia, anxiety, moderate to severe distress and depression which is considered an alarming prevalence (Lai et al., 2020).

Due to the pandemic, there were surgical residency program changes such as clinical exposure, hands-on and working hours. According to a study conducted in Pakistan, the pandemic adversely affected 86.6% of surgical residents in hands-on surgical duration, also affecting their clinical exposure (82.1%) (Osama et al., 2020). Also, evidence for the COVID-19 Pandemic's Effect on Surgical Residency Training The number of postgraduate programs at Nigerian colleges was decreased (164, 79.2 percent) or canceled (11, 5.3 percent), according to a cross-sectional survey (Adesunkanmi et al., 2021). Meetings with people who participated

in academic programs were always conducted virtually. The majority of responders (173, 83.6%) stated that they saw fewer patients in the outpatient clinics and that there were a fewer emergency and elective procedures (58.5 percent and 90.8 percent, respectively). 70 respondents, or 33.8 percent, stated they were considering leaving the country (Adesunkanmi et al., 2021). Impact of the COVID-19 epidemic on the professional and personal experiences of early-career surgeons and surgical trainees revealed a significant impact on their lives, including the mitigation of burnout and depression through increasing access to personal protective equipment and offering wellness programs, with a particular focus on high-risk groups (Coleman et al., 2021; ).

In the psychological part, a cross-sectional study revealed a significant correlation was found between anxiety and male gender ($p = 0.055$), level of training ($p = 0.002$), deployment to cover ICUs ($p = 0.050$), testing positive for COVID-19 ($p = 0.054$) and having an infected family member ($p = 0.004$) in studies to assess the effects of the coronavirus-19 (COVID-19) pandemic and its effects on general surgery residents in the Kingdom of Saudi Arabia and the Kingdom of Bahrain (Aljehani et al., 2020). According to the report, the coronavirus-19 pandemic has a negative impact on all healthcare professionals and surgical residents have undergone significant stress (Aljehani et al., 2020; Alsafran et al., 2022). According to the survey conducted by the Saudi Commission for Health Specialties, almost all of the trainees (93%) agreed about the distraction from daily routine practice and the negativity the COVID-19 brought. Also, only 9% applied for psychological support (Alsaywid et al., 2020).

The purpose of this study is to study the positive and negative outcomes of the COVID-19 pandemic on surgical training, education and burnout among general surgeons in the Qassim Region, Saudi Arabia. As well as the residents' professional and personal lives. We believe it will give us the information we need to foresee issues in the work force and residency programs in the future (Osama et al., 2020). The global COVID-19 epidemic has had an impact on millions of people. Despite the fact that it is still unclear how this outbreak would affect surgical training specifically. In order to determine how COVID-19 has affected surgical training, education and burnout, we set out to conduct a country wide survey of general surgery trainees in the Qassim region, Saudi Arabia as there is a lack of information regarding this point.

As the pandemic of COVID-19 has many consequences on health care dimensions, it is crucial to comprehend how COVID-19 affected general surgeons and how the pandemic period affected their access to training and education in surgery programs in the Qassim region of Saudi Arabia. Therefore, the aim of this study will be:

To evaluate how the COVID-19 epidemic has affected the clinical scheduling, operation volume and instructional programs of general surgeons in the Qassim Region.

To assess the impact of COVID-19 on surgical training, education and burnout in the Qassim Region

## 2. METHODS AND MATERIALS

A cross-sectional study was carried out from 1st of June 2022 to 1st of December 2022 with a validated online questionnaire conducted electronically by using social network apps among general surgery doctors at the hospitals of the Qassim region in Saudi Arabia. The Study sample is all general surgeons with speciality of; GS, ENT, Urology, Orthopaedics, Ophthalmology, Obstetrics and Gynaecology, Neurosurgery and Paediatric Surgery in all hospital of Qassim regions; King Fahd Specialist Hospital, Buraidah Central Hospital, King Saud Hospital, Al Mithnab Hospital, Al Rass General Hospital, Bukayriyah General Hospital and Maternity and Children Hospital. The total population for the general surgeons doctors at the hospitals of Qassim regions was 135. All were given equal chance to participate in the study. However, using convenience sampling, a total of 111 general surgery doctors voluntarily agreed to participate in the study which achieve a precision of ±5% with a 95% confidence interval according to this formula:

$$n = \frac{z^2 \times p(1-p)}{d^2}$$

Where:

$n$: Calculated sample size

$z$: The z-value for the selected level of confidence = is 1.96.

$p$: 50%, for maximum sample size calculation

$q$: $(1 - p) = 50\%$.

$d$: The margin of error = 0.05.

The link to the online Google forms was distributed to all the participants irrespective of their gender. The questionnaire was adapted from research conducted in the United States (Aziz et al., 2021) with some modifications on it according to recent literature. Questions include open-ended, closed-ended and multiple-choice response questions. The questionnaire consisted of 23 questions, including 2 items of personal questions and 21 items of self-administered questions regarding their duties before and during the

COVID-19 pandemic and how the pandemic has affected their anxiety, burden and well-being, how the COVID-19 epidemic has affected the clinical scheduling Q4, operation volume Q5-12 and instructional programs of general surgeons in the Qassim Region Q13-14. Also, to assess the impact of COVID-19 on surgical training Q15, education Q16-17 and burnout in the Qassim Region Q18-23. The dependent variable is according to direct care for COVID-19-positive patients Q3 and the covariate variables are gender and level of the study Q1-2. The given questions were confirmed with the general surgery department from the college of medicine at Qassim University and re-confirmed that the questionnaire and its contents were clear.

A pilot study was conducted to ensure that the questionnaire was clear and able to identify any gaps in the project plan. However, the results of the pilot research are not included in the project's final analysis. The study was voluntary and the participants were assured of the privacy of their personal information. The study's cover letter firstly obtained from the Qassim University then the ethical approval obtained from Qassim Regional Research Ethics Committee, registered at National Committee of Bio & Med. Ethics (NCBI) Registration No. H-04-Q-001 and involved participants' written consent was obtained before the start of the study.

## 3. RESULTS

**Descriptive statistics**

The collected data were first checked for entry errors or missing data, before getting analysed using IBM SPSS Statistics Version 26. Binary logistic regression was the main multivariate analytical method performed in the current study. The descriptive statistics has been summarised in Table 1. The data collected had 111 participants where males represented 68.5% and females 31.5%. Based on the level of study the study participants were categorised into three groups: Consultants 24.3%, residents 34.2% and specialist 41.4%.

**Table 1** Descriptive statistics of covariate variables

| Items | Characteristics | Frequency |
|---|---|---|
| 1. Gender | Female | 35 (31.5%) |
| | Male | 76 (68.5%) |
| 2. Level of study | Consultant | 27 (24.3%) |
| | Resident | 38 (34.2%) |
| | Specialist | 46 (41.4%) |
| 3. Direct care for COVID-19-positive patients | Unsure | 18 (16.2%) |
| | No | 24 (21.6%) |
| | Yes | 69 (62.2%) |

**Inferential statistic**

***Clinical scheduling***

On matters clinical scheduling, 62.2% stated their roles in examining patients on rounds had changed among those who care of COVID-19 patients. Further analysis shows the most affected by the change in roles were males 68.5% against 31.5% females (Table 2).

**Table 2** Compared to before, during the COVID-19 pandemic, how has your role in examining patients on rounds changed?

| | COVID-19 Patientcare | | |
|---|---|---|---|
| Roles changed | No | Yes | *p*-value |
| No change | 15 (13.5%) | 45 (40.5%) | $\chi^2$ (2) = 15.13; $p$ = 0.001 |
| Less frequently | 9 (8.1%) | 16 (14.4%) | |
| More frequently | 18 (16.2%) | 8 (7.2%) | |
| Total | 42 (37.8%) | 69 (62.2%) | |
| | Gender | | |
| Roles changed | Female | Male | |
| No change | 25 (22.5%) | 35 (31.5%) | $\chi^2$ (2) = 7.53; $p$ = 0.023 |

| | | | |
|---|---|---|---|
| Less frequently | 3 (2.7%) | 22 (19.8%) | |
| More frequently | 7 (6.3%) | 19 (17.1%) | |
| Total | 35 (31.5%) | 76 (268.5%) | |

***Operational volumes***

Twenty-eight percent of the males stated that they only got less than 4 days off in month compared with 6.3% females. However, it is worth noting that 16.2% males had more than 8 days off in a month compared with 4.5% of females (Table 3).

**Table 3** During the COVID-19 epidemic, how many days off do you generally get every month?

| | Gender | | |
|---|---|---|---|
| Days off/month | Females | Males | |
| Less than 4 days | 7 (6.3%) | 31 (27.9%) | $\chi^2$ (2) = 8.90; $p$ = 0.012 |
| Between 5-7 days | 23 (20.7%) | 27 (24.3%) | |
| More than 8 days | 5 (4.5%) | 18 (16.2%) | |
| Total | 35 (31.5%) | 76 (68.5%) | |

Working hours increased during the pandemic as shown in Table 4. Thirty-four-point two percent of the general surgery doctors who took care of the COVID-19 patient acknowledge that they had worked past the allotted 80 hours of duty each week compared with 37.8% who did not take care of the COVID-10 patients.

**Table 4** During the COVID-19 epidemic, have you gone above the allotted 80 hours of duty each week?

| | COVID-19 Patientcare | | |
|---|---|---|---|
| Allotted 80 hours/week | No | Yes | |
| No | 28 (25.2%) | 31 (27.9%) | $\chi^2$ (2) = 4.96; $p$ = 0.026 |
| Yes | 14 (12.6%) | 38 (34.2%) | |
| Total | 42 (37.8%) | 69 (62.2%) | |

***Instructional programs***

Fears on the likelihood of not meeting the ACGME's minimum requirements as a result of the effect of COVID-19 pandemic were mostly reported by the specialists (20.7%), followed by the consultants 19.8%) and lastly the residents (17.1%) (Table 5). As shown in Table 6, the specialist (18.9%) felt comfortable graduating with fewer cases, followed by the residents (18%) and then the consultants (16.2%).

**Table 5** If the COVID-19 pandemic continues to affect the training year, how likely do you think that you will not be able to meet the ACGME's minimum case requirements?

| | Level of study | | | |
|---|---|---|---|---|
| Meet ACGME's | Consultants | Residents | Specialists | |
| Unlikely | 5 (4.5%) | 19 (17.1%) | 23 (20.7%) | $\chi^2$ (2) = 8.30; $p$ = 0.016 |
| Likely | 22 (19.8%) | 19 (17.1%) | 23 (20.7%) | |
| Total | 27 (24.3%) | 38 (34.2%) | 46 (41.4%) | |

**Table 6** Even if you achieved the new accommodated standards, would you feel comfortable graduating with fewer cases than the previous number needed by the ACGME?

| | Level of study | | | |
|---|---|---|---|---|
| Comfortable graduating | Consultant | Resident | Specialist | |
| No | 24 (21.6%) | 18 (16.2%) | 25 (22.5%) | $\chi^2$ (2) = 12.56; $p$ = 0.002 |
| Yes | 3 (2.7%) | 20 (18%) | 21 (18.9%) | |

| | | | | |
|---|---|---|---|---|
| Total | 27 (24.3%) | 38 (34.2%) | 46 (41.4%) | |

***Surgical training and education***

More educational didactic was experienced by males (22.5%) compared with females (5.4%). It is worth noting that more males compared with females were either unsure of educational didactic or did not experience any changes in didactics (Table 7). Less educational didactics (35.1%) was experienced those who took care of the COVID-19 patients, although a few participants (7.2%) did state that there were no changes in their education didactics (Table 7).

**Table 7** Has the COVID-19 epidemic had any impact on the volume of educational didactic offered by your program (such as lectures, conferences, etc.)?

| | Gender | | |
|---|---|---|---|
| Educational didactic | Female | Male | |
| Unsure | 2 (1.8%) | 14 (12.6%) | $\chi^2$ (3) = 11.33; $p$ = 0.010 |
| No change in didactics | 5 (4.5%) | 14 (12.6%) | |
| Less didactics | 22 (19.8%) | 23 (20.7%) | |
| More didactics | 6 (5.4%) | 25 (22.5%) | |
| Total | 35 (31.5%) | 76 (68.5%) | |
| | COVID-19 Patientcare | | |
| Educational didactic | No | Yes | |
| Unsure | 7 (6.3%) | 9 (8.1%) | $\chi^2$ (3) = 20.37; $p$ < 0.001 |
| No change in didactics | 11 (9.9%) | 8 (7.2%) | |
| Less didactics | 6 (5.4%) | 39 (35.1%) | |
| More didactics | 18 (16.2%) | 13 (11.7%) | |
| Total | 42 (37.8%) | 69 (62.2%) | |

***Burnout***

More males felt are burned out (31.5%) during the pandemic compared with females (22.5%), although also more males (18%) compared with females (5.4%) did not feel any burn out (Table 8).

**Table 8** Compared to before, during the COVID-19 pandemic I feel:

| | Gender | | |
|---|---|---|---|
| Burnout | Female | Male | |
| No burnout | 6 (5.4%) | 20 (18%) | $\chi^2$ (2) = 6.51; $p$ = 0.039 |
| Less burned out | 4 (3.6%) | 21 (18.9%) | |
| More burned out | 25 (22.5%) | 35 (31.5%) | |
| Total | 35 (31.5%) | 76 (68.5%) | |

Regarding the level of study, the specialists and consultants experienced more burn out both 18.9% respectively. Most of the residents did not feel any burnout compared with the consultants and the specialists (Table 9).

**Table 9** Compared to before, during the COVID-19 pandemic I feel:

| | Level of study | | | |
|---|---|---|---|---|
| Burnout | Consultants | Residents | Specialists | |
| No burnout | 4 (3.6%) | 12 (10.8%) | 10 (9%) | $\chi^2$ (4) = 10.57; $p$ = 0.032 |
| Less burned out | 2 (1.8%) | 8 (7.2%) | 15 (13.5%) | |
| More burned out | 21 (18.9%) | 18 (16.2%) | 21 (18.9%) | |
| Total | 27 (24.3%) | 38 (34.2%) | 46 (41.4%) | |

***Pandemic anxiety and future concern***

More males than females were more concerned COVID-19 pandemic would make them less prepared in the future (Table 10). Equally, most males were also not concerned that COVID-19 pandemic would make them less prepared for the future.

**Table 10** How concerned you are that the COVID-19 pandemic will make you less prepared in the future?

| | Gender | | |
|---|---|---|---|
| Future pandemic concerns | Female | Male | |
| Not concerned | 6 (5.4%) | 22 (19.8%) | $\chi^2$ (3) = 8.18; $p$ = 0.04 2 |
| Concerned | 4 (3.6%) | 21 (18.9%) | |
| Somewhat concerned | 20 (18%) | 24 (21.6%) | |
| Very concerned | 5 (4.5%) | 9 (8.1%) | |
| Total | 35 (31.5%) | 76 (68.5%) | |

Most general surgical doctors who took care of COVID-19 patients (40.5%) stated they experienced anxiety while working in the hospital (Table 11).

**Table 11** During the COVID-19 pandemic, do you experience excessive anxiety while working in the hospital?

| | COVID-19 Patientcare | | |
|---|---|---|---|
| Anxiety while working | No | Yes | |
| No | 29 (26.1%) | 24 (21.6%) | $\chi^2$ (1) = 12.29; $p$ < 0.001 |
| Yes | 13 (11.7%) | 45 (40.5%) | |
| Total | 42 (37.8%) | 69 (62.2%) | |

The dependent variables that showed significant *p*-values in the inferential section above were further tested using binary logistic regression and their findings are elaborated further under the discussion section.

## 4. DISCUSSION

The current study performed a survey to assess the effects of COVID-19 on surgical training, education and burnout among consultants, residents and specialists in the Qassim region of Saudi Arabia. Binary logistic regression was the main multivariate analytical method performed in the current study. COVID-19 patient care was the dependent variable, while clinical scheduling, operation volume, instructional programs, surgical training and education and burnout as the independent variable. Gender and the level of study were covariates.

The first objective evaluated how the COVID-19 epidemic had affected the clinical scheduling, operation volume and instructional programs of general surgeons in the Qassim Region. The pandemic did not significantly affect clinical scheduling. Thus, we state that the medical school program did not alter its schedule in any way in reaction to the COVID-19 pandemic. Regarding the operation volume, there were no significant differences on what modifications to the operating room the hospitals in the current study implemented to reduce the number of people during the pandemic. Significant decreases on roles in examining patients on rounds were recorded by both genders: Roles examining patients on rounds changed among females (adjOR = 0.260, 95% CI: 0.084-0.809; $p$ = 0.020), while the number of days off in a month among females was (adjOR = 0.159, 95% CI: 0.029-0.875; $p$ = 0.035). The changes on roles examining patients on rounds among males was (adjOR = 0.426, 95% CI: 0.232-0.780; $p$ = 0.006). There were no significant relationships between the number of days off in a month, on the allotted 80 hours of duty in a week, on average surgical cases performed in a week, the number of clinical days attended per week and COVID-19 patient care.

On matters instructional programs, a significant difference was observed between COVID-19 patientcare and meeting ACGME's minimum requirements among specialists (adjOR = 0.163, 95% CI: 0.042-0.634; $p$ = 0.009). There was no significant effect regarding graduating with fewer cases than the previous number needed by the ACGME. The second objective assessed the impact of COVID-19 on surgical training, education and burnout in the Qassim Region. It is worth noting that there was no significant relationship between COVID-19 patient care and surgical training and education. Thus, we state that COVID-19 patient care had no impact on the volume of educational didactic offered by the medical program. Regarding burnout, it is worth noting, that

statistically significant difference in terms of concerns on COVID-19 pandemic making one less prepared for the future was only among male specialist (adjOR = 0.074, 95% CI: 0.007-0.739; $p = 0.027$). Neither experiencing excessive anxiety nor anxiety worsening in form of intensity, frequency, or amount of distress had a statistically significant relationship with COVID-10 patient care.

Although the multivariate finding on the relationship between clinical scheduling and COVID-19 patient care was non-significant, a significant relationship was observed between changing in terms of roles and COVID-19 patient care. Overall, sixty-two percent of the respondents stated their roles changed while 38% said their role did not change. A closer look at the univariate statistics indicated 40.5% experienced no change, followed by 14.4% who experienced change less frequently and 7.2% who experienced change more frequently among those attending the COVID-19 patients. The same scenario was replicated among gender with 31.5% of males recording no change compared with 23% of the females. It is equally important to note that although there was no significant relationship between established between COVID-19 patient care and its impact in altering the work schedule for the residents, 20.3% confirmed there were no changes. Twenty-three-point two percent stated a smaller team if in-house residents were assigned to cover more patients and equally, 23.2% said more work was delegated to advanced practice providers.

These findings are similar to what was reported by Aziz et al., (2021) study in the United States that found the COVID-19 pandemic affected surgical residents' clinical schedules. This can be associated with the high number of COVID-19 patients requiring much attention and thus minimum time dedicated to the residents. This fact is also supported by the decline in the operation volumes. There was a significant decline in the roles on examining patients on ward rounds and the decline was much weaker among the males ($\beta = 0.43$; $p = 0.006$) compared with the female participants ($\beta = 0.26$; $p = 0.020$). This is an area that needs further investigation to clarify why the decline was more among the males compared with the females.

The current study also noted a significant decline in the number of days off ($\beta = 0.16$; $p = 0.035$) in a month among the females. The finding for the male colleagues was non-significant. The decline in the number of days off could be attributed to the increased daily number of COVID-19 patients in the wards. Thus, any extra hand was important in the daily management of COVID-19 cases. This finding is contrary to what was reported in Aziz et al., (2021) where residents felt that limiting them in the operating rooms would lead to a reduction of their surgical experience resulting in concerns in terms of readiness for program completion. Regarding the impact of COVID-19 on the instructional programs, the study participants were worried that should the pandemic continue affecting their normal training program, it would impact them negatively in terms of meeting the ACGME's minimum case requirements. However, this fact was not significant among the residents and consultants but the specialists ($\beta = 0.16$; $p = 0.009$).

There was no significant impact of COVID-19 on surgical training and education among the study participants in the Qassim region. Thus, COVID-19 had no statistically significant impact on the volume of education didactic offered by the medical program. This fact is supported by the fact that only 27% stated their program had completely moved online, while 73% stated their program were running as usual. Equally, the 67.6% of study participants stated that there were changes in their educational curriculum, 16.2% stated the changes were in-person while 16.2% said there were no changes. The reasons for no changes were probably due to the fact that the facilities concerned were fully staffed and thus we cannot relate the changes in curriculum with under staffing. Work burnout is a major issue not only in health facilities but in most organizations as employees strive to meet their set targets and deadlines. When the COVID-19 pandemic attacked the world, the majority of facilities or governments were unprepared for the high number of cases that would appear at the facilities. The soaring cases could lead to straining of the already limited resources, the reallocation of the personal to emergency sections to handle COVID-19 cases and an increase in extra working hours which could in turn lead to burnout. The current study investigated the impact of COVID-19 on burnout.

The study found that the male specialists were significantly concerned that the COVID-19 pandemic made one less prepared for the future. Probably, this could be attributed to the fact that COVID-19 presented new gaps in the medical field which the facilities were ill prepared for including handling of soaring daily new cases. For example, the ICU was designed to handle only few cases that required specialized services. However, COVID-19 cases created a huge demand for the same ICU services which the facilities had not prepared well for in the past. However, the current study had its own limitation which could affect the generalizability of the findings. The sample size for this study was 111 which were not sufficient enough to make conclusive generalization. Regarding gender, there seemed to be an imbalance in terms of numbers between females and males participants which can lead to biases in comparative gender analysis.

## 5. CONCLUSION

The current study investigated how the impact of COVID-19 pandemic affected clinical scheduling, operation volume, instructional surgical training programs and burnout. The study found a negative impact on the operation volume on the role of examining patients on round, the likelihood of not meeting the ACGME's minimum requirements and burnout concerns in making the specialist feel less prepared for the future. The residents and consultants seemed not to be statistically and significantly affected by COVID-19 compared with specialist. Although the findings for this study were not statistically significant, it is worth noting that 60% of the educational didactics shifted to online didactics, which probably the residents to connect anywhere in the world with experts.

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**Authors' contributions**

**Principal investigator**

Ahmed Mohammed Alshammari: From the inception of the research proposal through its conclusion, I organized and supervised the whole project and participated in all aspects of the study.

**Co-authors**

Emad aljohani: He was responsible for proposal writing and data gathering and participated in the majority of research phases, from proposal writing through conclusion.

Reem A Alsalamah: The supervisor for the research involved in every stage of the study, from proposal preparation to the end.

Ali K Alshaya: He was responsible for the final introduction and data gathering and participated to the majority of the study phases from proposal preparation to conclusion.

Saif M Alshammari: He was responsible for proposal writing and data gathering and participated in the majority of research phases, from proposal writing through conclusion.

Zakiyah S Almutairi: He was responsible for questionnaire design, data collecting and analysis and data gathering and participated in the majority of research phases, from proposal writing through conclusion writing.

Samah F Alkuraydis: He was responsible for discussion and conclusion writing and participated largely during research phases, from proposal writing through conclusion writing.

Khozama B Alaql: Helped with the development of the questionnaire, the gathering and analysis of data and many other aspects of the study process from proposal writing through report writing.

**Further information**

All authors have confirmed that they have no current or historical financial relationships to any organizations that would have an interest in the submitted work and that they have no other affiliations or activities that might be construed to have influenced the work.

**Ethical approval**

The study was approved by the Medical Ethics Committee of Qassim Regional Research Ethics Committee registered at National Committee of Bio & Med. Ethics (NCBI) Registration No. H-04-Q-001.

**Informed consent**

Written informed consent was obtained from all individual participants included in the study.

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**Conflict of interest**

The authors declare that there is no conflict of interests.

**Data and materials availability**

All data sets collected during this study are available upon reasonable request from the corresponding author.

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