

# The Negative Impact of COVID-19 on Medical Education amongst Medical Students Interested in Plastic Surgery: A Cross-sectional Survey Study

Caleb Haley, BS\*  
 Jasmine Lee, BA†  
 Helen Xun, BS‡  
 Pooja Yesantharao, MS‡  
 Ian T. Nolan, BM†  
 Muhammad Harirah, MD§  
 Christopher S. Crowe, MD¶  
 Joseph Lopez, MD, MBA†  
 Shane D. Morrison, MD, MS¶  
 Brian C. Drolet, MD, FACS||  
 Jeffrey E. Janis, MD, FACS\*\*

**Background:** The COVID-19 pandemic has resulted in unprecedented changes to medical education. Medical students interested in urology and neurosurgery have reported concerns regarding COVID-19's effects on clinical experience and the residency application process; however, the impact amongst students interested in plastic surgery is unknown. We hypothesized that students applying into plastic surgery may experience much distress as a result of the COVID-19 pandemic.

**Methods:** An electronic survey was developed by 3 plastic surgery residents and 2 academic plastic surgeons and later refined by 4 fourth-year medical students. Questions focused on medical education curricular changes, perceived impact on medical education, and demographics. From April–May 2020 the survey was distributed to medical students who were interested in plastic surgery. Participants were identified through plastic surgery residency program personnel and social media platforms.

**Results:** In total, 130 of the 140 respondents reported interest in plastic surgery careers. An estimated 67% were in their clinical years or completing research year(s) before residency applications. Of the respondents, 80% believed that the COVID-19 pandemic had a negative impact on their medical education. Clinical-level students compared with preclinical-level students, and students applying to residency during the 2020–2021 match cycle compared with students not applying during the 2020–2021 match cycle were significantly more likely to perceive the COVID-19 pandemic as having a negative impact on their medical education ( $P = 0.04$  and  $0.03$ , respectively).

**Conclusion:** Medical students interested in plastic surgery perceive the COVID-19 pandemic as having a negative impact on their education, likely due to a reduction in clinical exposure. (*Plast Reconstr Surg Glob Open* 2021;9:e3535; doi: [10.1097/GOX.0000000000003535](https://doi.org/10.1097/GOX.0000000000003535); Published online 26 February 2021.)

From the \*University of Michigan Medical School, Ann Arbor, Mich.; †Hansjörg Wyss Department of Plastic Surgery, New York University Grossman School of Medicine, New York, N.Y.; ‡Department of Plastic & Reconstructive Surgery, Johns Hopkins Medicine, Baltimore, Md.; §Department of Plastic Surgery, University of Texas Southwestern Medical Center, Dallas, Tex.; ¶Division of Plastic Surgery, Department of Surgery, University of Washington School of Medicine, Seattle, Wash.; ||Department of Plastic Surgery, Vanderbilt University Medical Center, Nashville, Tenn.; \*\*Department of Plastic & Reconstructive Surgery, Wexner Medical Center, The Ohio State University, Columbus, Ohio.

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Authors Haley, Lee, Xun, and Yesantharao contributed equally to this work.

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## INTRODUCTION

In the Spring of 2020, the American Association of Medical Colleges recommended that medical schools in the United States enforce social distancing precautions and halt all clinical experiences due to the COVID-19 pandemic, resulting in drastic changes to medical student education.<sup>1,2</sup> One group of medical students that may be especially affected by restrictions on clinical rotations are those interested in plastic surgery. A recent study found 84.7% of medical students have no formal exposure to plastic surgery during their medical education; thus introduction to plastic surgery through clinical rotations is critical.<sup>3</sup> Direct exposure to plastic surgery helps students determine if it is a desirable

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career path.<sup>4</sup> Prior studies have documented the misconceptions of plastic surgery by many groups, including medical students, who often do not recognize the breadth of plastic surgery (eg, hand and craniofacial surgery).<sup>5</sup> Based on these studies, it can be inferred that medical students interested in plastic surgery often rely on clinical rotations to make informed decisions regarding application to residency. However, due to the COVID-19 pandemic, many of these opportunities are currently unavailable.<sup>6-9</sup>

In addition to clinical rotations at their home institution, the majority of plastic surgery applicants have historically completed away rotations with the goal of becoming more competitive and matching at specific institutions outside their medical school's affiliated hospital.<sup>10</sup> In fact, a prior study found that program directors rank performance during an away rotation as the most important factor for residency selection.<sup>10</sup> However, based on guidance from the American Council on Academic Plastic Surgeons, the majority of these away rotations did not take place this year due to the COVID-19 pandemic.<sup>11,12</sup> Thus, the limitations on clinical rotations due to social distancing practices interfere with this evaluation metric, which may negatively affect students applying into plastic surgery.

The true impact of the abrupt reduction in clinical opportunities for medical students interested in plastic surgery remains unknown and has not been robustly examined. A recent urology study showed that 82% of students reported a decrease in exposure to the field, 42% reported cancellations in away rotations, 68% were concerned about acquiring letters of recommendation, and 55% were concerned about seeing fewer procedures or surgeries.<sup>13</sup> Furthermore, the most common themes amongst the free text responses were students' concerns regarding the inability to evaluate programs and build meaningful relationships.<sup>13</sup> Additionally, a neurosurgery study demonstrated similar findings: 56% of clinical-level students reported cancellations to home neurosurgical subinternships, 62% reported cancellations to away subinternships, and the majority of clinical-level students were concerned about subinternships (91%), letters of recommendation (75%), and the residency interview process (65%).<sup>14</sup>

Given the aforementioned changes to medical education and preliminary evidence from other surgical subspecialties, we hypothesized that the COVID-19 pandemic resulted in much distress to medical students interested in plastic surgery. In this study, we investigated how medical students interested in plastic surgery were impacted by COVID-19-associated curriculum changes, as it relates to educational opportunities and career development. Although this study was completed in Spring 2020 before many professional organizations and residency programs implementing educational opportunities targeted toward these students (such as virtual subinternships and virtual application workshops),<sup>15-17</sup> we believe our findings allow for evidence-based recommendations to best support the development of such educational initiatives.

## METHODS

This was an Institutional Review Board-exempt (University of Washington Protocol STUDY00010308) cross-sectional investigation of the impact of the COVID-19 pandemic on medical students interested in plastic surgery.

### Survey Development

An electronic survey was created and distributed using a web-based survey tool, University of Washington Catalyst (Catalyst Web Tools, Seattle, Wash.). The survey was developed by an expert panel on plastic surgery education, consisting of 3 plastic surgery residents (CSC, JL, and SDM) and 2 academic plastic surgeons (BCD and JEJ) from 4 academic institutions. The survey was iteratively refined by 4 fourth-year medical students from 2 academic institutions (JL, IN, HX, and PY) after feedback from medical students at Johns Hopkins University, New York University, The Ohio State University, and Vanderbilt University. (See **survey, Supplemental Digital Content 1**, which shows the final distributed survey. <http://links.lww.com/PRSGO/B626>.)

The survey instrument queried 3 main topics: (1) changes to medical education curricula in the context of COVID-19; (2) COVID-19-related concerns and changes to plastic surgery education for medical students; and (3) participant demographics. Demographic information included gender, medical school year, medical school location, and living situation. Participants had the option to report the name of their medical school. No data were collected regarding student participation in virtual rotations or student participation in traditional away rotations if their home institution did not have a plastic surgery program. Survey participation was voluntary.

### Survey Distribution

Medical students interested in plastic surgery were identified through plastic surgery program directors, program coordinators, and interest groups. Additionally, the survey was advertised through social media platforms (Instagram and Twitter), which included a QR code to electronically access the survey. (See **pdf, Supplemental Digital Content 2**, which shows the survey advertisement. <http://links.lww.com/PRSGO/B627>.) The survey was conducted over a four-week period (April–May 2020), and reminders were sent every 4 days. All survey responses were anonymous, other than a voluntary section requesting participants to submit their email address for long-term follow-up.

### Survey Validation

Survey reliability was assessed using split-half testing of questions on COVID-related curriculum changes. Survey validity was assessed by determining concordance of participants' responses to convergent questions during pilot testing: 98% of participants who were planning on applying to a plastic surgery residency in the 2020–2021 cycle and who answered their surgical experience or plastic surgery rotations were impacted by COVID-19 also responded their application to residency would be significantly impacted by COVID-19. This indicates survey participants answered questions that queried similar topics in a consistent manner.

### Power Analysis

The survey was pilot tested by sending the survey to medical students interested in plastic surgery at Johns Hopkins University, New York University, The Ohio State University, and Vanderbilt University. Based on these students' responses, a priori power analysis were completed to predict expected differences in responses regarding the net effect of the COVID-19 pandemic on medical student education. (See survey, Supplemental Digital Content 1, which shows the final distributed survey. <http://links.lww.com/PRSGO/B626>.) A sample size of 102 was determined to be necessary to adequately investigate differences in responses between student participants from different medical schools to achieve a power of 0.8 at an  $\alpha$  value of 0.05.

### Statistical Analyses

All statistical analyses were completed using Stata, version 15.1 (StataCorp, College Station, Tex.). Participants' responses were compared between cohorts using Fisher Exact analyses. Univariable followed by stepwise multivariable logistic regression was used to identify risk factors for student-reported perceptions of a net negative impact of the COVID-19 pandemic on their medical education. All analyses accounted for clustering at the school-level. The 2-tailed threshold for statistical significance was set at an  $\alpha$  value of 0.05.

## RESULTS

### Demographics

In total, 140 US medical students responded to the survey, of whom 130 stated they were interested in applying to a plastic surgery residency program. The majority of the respondents were women (65%) (Table 1). Of the senior medical student respondents, most were in their clinical years (47%), followed by those completing a research year(s) before residency applications (20%). The remainder were preclinical students in their first or second years of medical school (33%). Sensitivity analyses demonstrated nonresponse bias did not significantly impact survey results. (See pdf, Supplemental Digital Content 3,

**Table 1. Student Demographics\***

Characteristic	Survey Respondents, N (%)
Gender	
Men	44 (34)
Women	84 (65)
Non-binary	2 (1)
Class year	
Preclinical (MS 1 or 2)	43 (33)
Clinical (MS 3 or 4)	61 (47)
Research year	26 (20)
School region	
Northeast	29 (22)
Midwest	21 (16)
South	44 (34)
West	36 (28)
School affiliated with a hospital with a plastic surgery department/division/section	115 (88)

\*In total, 130 respondents interested in plastic surgery answered these questions.

which describes the sensitivity analyses. <http://links.lww.com/PRSGO/B628>.)

All (100%) respondents reported the location of their medical school. Respondents were relatively evenly distributed amongst the 4 geographic regions of the United States, as determined by the United States Census Bureau: Northeast, Midwest, South, and West.<sup>18</sup> No respondents indicated they attended medical schools from outside the United States. In total, 76% of respondents reported which medical school they attend; of these respondents, 47 unique medical schools were represented with an average of 2.30 respondents from each school (range 1–7). Most respondents (88%) attended a medical school with a hospital that had an affiliated plastic surgery department/division/section.

### COVID-19-Associated Medical Curriculum Restructuring

Most medical student respondents reported cancellations within their medical school curricula to reduce potential exposure to COVID-19, including both core clerkships (77%) and elective rotations (76%) (Table 2). Approximately one-quarter noted their medical schools offered early graduation to fourth year medical students (22%). In terms of alternative curricula, most respondents attended schools that offered online courses (91%), although some still had in-person rotations with restricted schedules (46%).

As a result of COVID-19 precautions, 16% of respondents had their previously scheduled USMLE Step 1/COMLEX examinations cancelled, and 29% of respondents had their previously scheduled USMLE Step 2/COMLEX exams cancelled (Fig. 1).

Additionally, 41% of clinical-level students had core clerkships cancelled, and 28% of clinical-level students had surgical electives or subinternships cancelled (Table 3). Approximately half of respondents with core clerkships or surgical electives/subinternships cancelled reported that they would be required to make up their missed curricular work at a later date (53% and 50%, respectively).

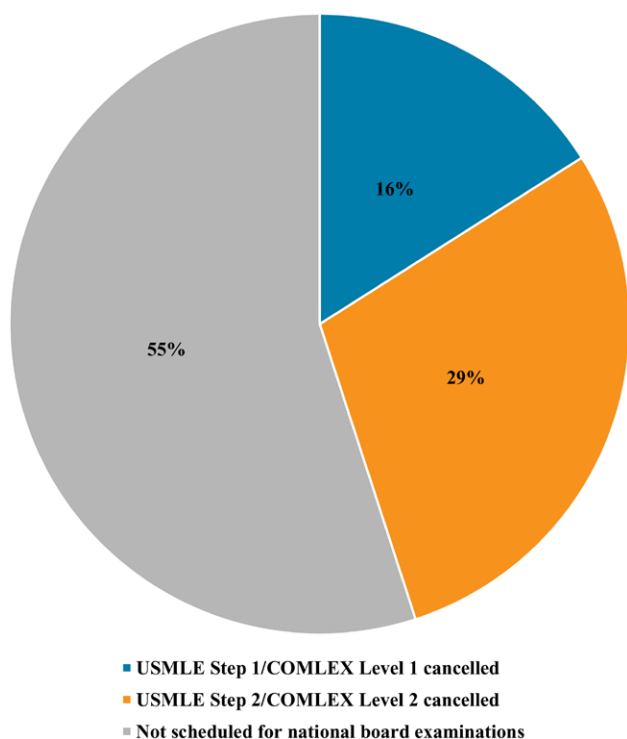
### Psychosocial Support and Overall Impact

An estimated 94% of respondents felt that their medical schools were at least "fairly supportive" of their

**Table 2. Medical School Response and Overall Student Perceptions during COVID-19\***

	Survey Respondents, N (%)
Cancellations	
Core clerkships	100 (77)
Electives	99 (76)
Medical school offered early graduation due to COVID-19	29 (22)
Medical school at least fairly supportive of psychosocial well-being	122 (94)
Alternative curricula	
Online courses	118 (91)
In-person rotations with limited or restricted schedules	60 (46)
Net negative effect of COVID-19	104 (79)

\*In total, 130 respondents interested in plastic surgery answered these questions.



**Fig. 1.** The effect of COVID-19 on national board examinations.

psychosocial well-being during the COVID-19 pandemic (Table 2). Overall, 80% of respondents believed the COVID-19 pandemic had a net negative impact on their medical education. After accounting for both school- and student-level factors as well as clustering at the school-level, multivariate regression identified 2 factors that significantly increased the odds of perceiving the COVID-19 pandemic as having a net negative impact on the respondent’s medical education: clinical-level students, when compared with preclinical-level students (OR = 4.4, CI = 1.1–17.6,  $P = 0.04$ ) and students applying to residency in the 2020–2021 match cycle, when compared with students not applying to residency in the 2020–2021 match cycle (OR = 4.2, CI = 1.8–7.8,  $P = 0.03$ ) (Table 4).

**Specific Impact on Plastic Surgery Residency Applicants**

An estimated 43% of the survey respondents reported they would be applying for a plastic surgery residency program in the 2020–2021 academic cycle. Of these respondents, 78% had plastic surgery electives or subinternships

**Table 3. Types of Rotations Cancelled Due to COVID-19 for Students in Clinical or Research Years\***

	Survey Respondents, N (%)
Core clerkships	36 (41)
Makeup required	19 (53)
Nonsurgical elective or subinternship	4 (5)
Surgical elective or subinternship	24 (28)
Makeup required	12 (50)

\*In total, 87 respondents were in their clinical or research years at the time of this survey.

**Table 4. Multivariable Regression to Identify Risk Factors for Student Perceptions of Net Negative Impact of COVID-19**

Characteristic	Odds Ratio	95% Confidence Interval	P
No school psychosocial support	1.7	0.5–8.6	0.5
Presence of alternative curriculum	1.1	0.1–9.7	0.9
Presence of curriculum makeup requirements	0.6	0.1–3.1	0.5
Students in their clinical years	4.4	1.1–17.6	<b>0.04</b>
Student applying in 2020–2021 cycle	4.2	1.8–7.8	<b>0.03</b>

scheduled in preparation for the 2020–2021 application cycle that were cancelled due to COVID-19-related precautions (Table 5). In total, 64% believed COVID-19-related cancellations would significantly impact their surgical experience (Table 5). Only 4% of respondents believed plastic surgery curricular changes and cancellations would have a minimal impact on their surgical experience. Of the respondents, 38% reported their institution developed alternative opportunities for plastic surgery education in response to COVID-19-related cancellations, with 89% of these opportunities being virtual lectures or didactics. Only 26% of these respondents stated that they would be required to make up their plastic surgery electives or subinternships in-person.

The respondents were queried regarding their personal alternative educational strategies utilized to help expand their fund of knowledge in plastic surgery during the COVID-19 pandemic (Table 6). In total, 39% reported participating in plastic surgery-related research was the most useful way to learn about plastic surgery-related topics, whereas 26% believed virtual lectures were the most useful learning strategy. Less popular modalities included self-directed reading and practicing surgical skills (17% and 14%, respectively).

Among the respondents who were planning to apply for a plastic surgery residency program during the 2020–2021 match cycle, 60% believed the COVID-19 pandemic would significantly impact their application (Table 7). An estimated 17% considered a career change, of whom 60% considered applying to a different surgical field or dual applying, 20% considered applying to a different nonsurgical field, and 20% considered completing a research year instead of applying.

**DISCUSSION**

We are just beginning to understand students’ concerns given the drastic changes to medical student curricula, reduction in clinical exposure, and disruption to professional development due to the COVID-19 pandemic,<sup>19–21</sup> and this is the first study directly investigating the effects on medical students interested in plastic surgery. From our study, 80% of the respondents interested in plastic surgery believed the COVID-19 pandemic had a net negative impact on their education. Of students in their clinical or research years, 41% had core clerkships cancelled, and 28% had surgical electives or subinternships cancelled. Furthermore, 78% of respondents planning to apply for plastic surgery in the 2020–2021 application cycle reported cancellation of plastic surgery



**Table 5. Perceptions of Students Whose Plastic Surgery Elective or Subinternships Were Cancelled Due to COVID-19\***

	Survey Respondents, N (%)
Significant impact on surgical experience	30 (64)
Alternative plastic surgery curriculum available	18 (38)
Virtual lectures or didactics	16 (89)
Mock patient	2 (11)
Makeup required	12 (26)

\*In total, 47 respondents had a plastic surgery elective or subinternship cancelled due to COVID-19.

**Table 6. Alternative Learning Strategies\***

	Survey Respondents, N (%)
Virtual lectures	34 (26)
Self-directed reading	22 (17)
Plastic surgery research	51 (39)
Practicing surgical skills	18 (14)

\*In total, 130 respondents interested in plastic surgery answered these questions.

**Table 7. Considerations for Students Applying into Plastic Surgery in the 2020–2021 Cycle\***

	No. Students, N (%)
COVID-19 significantly impacted application	36 (60)
Considering career change	10 (17)
Applying to different surgical field or dual applying	6 (60)
Applying to different nonsurgical field	2 (20)
Taking a research year instead of applying	2 (20)

\*In total, 60 respondents were planning to apply into plastic surgery during the 2020–2021 cycle.

electives and subinternships due to COVID-19. The net effect of these cancellations, both at students' home institutions and away institutions, is likely decreased exposure to plastic surgery and increased concerns regarding their success in the plastic surgery residency application cycle. This was supported by our multivariate regression, which demonstrated that clinical-level students and those applying to residency during the 2020–2021 application cycle had increased odds of perceiving the COVID-19 pandemic as having a net negative impact on their medical education. Specifically, among the students applying for plastic surgery residency in the 2020–2021 application cycle, 60% believed the COVID-19 pandemic would significantly impact their application. These results are consistent with evidence showing that clinical exposure and away rotations are critical experiences for medical students when deciding to pursue a career in plastic surgery and deciding on which programs to rank highly.<sup>22,23</sup>

Surveys of medical students interested in other surgical subspecialties demonstrate similar results—COVID-19 has had a substantial impact on medical education.<sup>13,14</sup> Compared with our survey showing that 78% of prospective applicants reported cancellations of plastic surgery rotations, 76% of students interested in neurosurgery reported cancelled or postponed

neurosurgery rotations, and 82% of students interested in urology reported decreased exposure to urology.<sup>13,14</sup> Students in these surveys also reported concerns regarding decreased clinical rotations and exposure, obtaining letters of recommendation, and the residency application process, which is consistent with the results from our study.<sup>13,14</sup>

Thus, given the educational challenges associated with the COVID-19 pandemic, our results serve as an important justification for the development of virtual educational opportunities in plastic surgery, over and above what is currently available.<sup>24</sup> Of the survey respondents whose plastic surgery rotations were cancelled, only 38% were offered alternative plastic surgery curriculum opportunities. Since the implementation of this survey, many residency programs and professional organizations such as the American Council on Academic Plastic Surgeons have developed such actions to support medical students interested in plastic surgery, including virtual subinternships and virtual application workshops.<sup>15–17</sup> We support these interventions that create equitable access to educational opportunities and residency application support. Although these alternatives do not replace the in-depth exposure medical students may have to plastic surgery during clinical rotations, they offer complementary learning strategies and maintain the accessibility of the field. When developing these educational opportunities, we encourage residency programs and professional organizations to consider the results from our survey that suggest that medical students interested in plastic surgery prefer research (39%) and virtual lectures (26%) over self-directed reading (17%) and practicing surgical skills (14%) as alternative learning strategies. Interestingly, in contrast to our results, virtual surgical skills workshops were the most desired educational intervention by clinical-level students interested in neurosurgery.<sup>14</sup>

Although it is unknown how these COVID-19 associated challenges will truly impact medical student career development, the perceived net negative impact on their education should be continually addressed by the plastic surgery community. For example, 17% of respondents had considered a career change, of whom 60% considered applying to a different surgical field or dual applying and 20% considered applying to a different non-surgical field. These results are similar to preliminary data in urology showing that only 9% of prospective applicants were less likely to apply given the COVID-19 pandemic.<sup>13</sup> It is reassuring that the majority of students planning on applying into plastic surgery at the time of this survey likely continued to do so; however, it will be important to continue to monitor early plastic surgery career development as the pandemic continues. This has already taken place regarding the 2020–2021 plastic surgery interview season, with recommendations for virtual interviewing best practices.<sup>25,26</sup>

This study has several limitations. First, this was a cross-sectional investigation amongst medical students using a nonprobability-based sampling strategy, and thus the generalizability and external validity of results are limited, especially when considering the entire pool of plastic

surgery applicants. The cross-sectional design of the study and the rapidly changing nature of the pandemic also may yield to changes in respondents' perspectives and experiences since completing the survey, and thus, our results may not accurately reflect their current viewpoint. Secondly, there were limitations inherent to survey-based research. To address the issue of nonresponse bias (ie, only those who felt strongly about the impact of COVID-19 on their medical school or plastic surgery-focused education may have responded), we distributed multiple rounds of the survey and completed sensitivity analyses for nonresponse bias. To minimize bias introduced by the survey instrument itself, we used pilot testing for survey development and validation. To improve participant honesty and minimize the risk of confidentiality loss, we anonymized the survey; therefore, we were unable to confirm that the survey was not filled out more than once by a single respondent, although the authors believe this is highly unlikely. Given that we are unable to accurately estimate the total number of students interested in plastic surgery or the number of students who were invited to participate in this survey, we cannot report the response rate. Lastly, subgroup analyses were limited by study sample size; the study sample was not adequately powered to investigate all of the individual student characteristics that may have impacted perceptions of the impact of COVID-19 on medical education.

## CONCLUSIONS

Although the results from this study represent medical students' perspectives from Spring 2020 before many educational initiatives such as virtual subinternships were implemented, results indicate medical students interested in plastic surgery face unexpected and unique challenges due to the COVID-19 pandemic. This has resulted in many students perceiving the COVID-19 pandemic as having a net negative impact on their education. From decreased exposure to plastic surgery to the lack of opportunities for away rotations, the consequences of these changes in medical education are still unknown. As the pandemic continues, it will be critical to continue to examine COVID-19's effects on medical education and career progression of medical students interested in plastic surgery.

**Jeffrey E. Janis, MD, FACS**

915 Olentangy River Road  
Suite 2140, Columbus  
OH 43212

E-mail: [Jeffrey.Janis@osumc.edu](mailto:Jeffrey.Janis@osumc.edu)

Twitter: [@jjanismd](https://twitter.com/!jjanismd)

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