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COVID-19 Impact in Neurosurgery Residency: Grit During Pandemic

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BACKGROUND: The coronavirus disease—19 (COVID) pandemic has presented a significant challenge to health care providers. Neurosurgical patients are often critically ill and at particularly high risk for COVID, and the pandemic has produced ever-shifting circumstances to allow their continued care. This study explores the psychologic impact of the pandemic on neurosurgical residents at a single institution.

METHODS: Residents completed the Perceived Stress Scale (PSS) and the Inventory of Depressive Symptomology 30 (IDS-30), two validated surveys, before and during the pandemic. PSS scores range from 0 to 40 with higher scores indicative of increased stress. IDS-30 ranges from 0 to 84 with higher scores indicating more severe levels of depression. Survey results were compared collectively among residents and statistically analyzed.

RESULTS: The surveys had 19 out of 28 total responders (68%). Mean score on the PSS was 16.1 prepandemic and 14.7 during the pandemic ($P > 0.05$). The mean score on the IDS-30 was 14.7 prepandemic and 12.0 during the pandemic ($P > 0.05$). Matching the survey questionnaire results by each resident revealed an average decrease of 2.3 and 2.4 for the PSS and IDS-30, respectively.

CONCLUSIONS: There were no significant changes in perceived stress or depressive symptoms among neurosurgical residents during the pandemic.

INTRODUCTION

The current pandemic caused by the novel coronavirus severe acute respiratory syndrome—coronavirus 2 presents a significant change and challenge to our society. In addition, the novelty of the pandemic has presented several challenges in clinical management. Furthermore, the transmissibility has presented a threat to the safety of physicians and other health care providers. Hospitals have adapted their practices to deal with these challenges. Particularly challenging has been identifying an equitable way to allocate health care resources. Physicians are one such resource, and balancing both exposure risk and clinical need has forced many institutions to make changes in scheduling and placement.

At academic centers, a large portion of the workforce consists of resident physicians. Pandemic-related changes affect both clinical duties and resident education. The field of neurosurgery is particularly susceptible to stress given it has fewer residents with large case volumes, which often require intensive and higher-level patient care. Managing these ever-changing factors in the midst of the pandemic certainly proves challenging. However, as a field, resilience and perseverance are commonly sought and taught traits among neurosurgical residents as these qualities are crucial to long-term success within the profession. Lack of composure, emotional volatility, and sensitivity to criticism were all negative selection factors in personality assessment tools provided to incoming neurosurgical applicants. As a quaternary care center and a busy neurosurgical service, the University of Pittsburgh’s Medical Center (UPMC) became one of the centers for management of the pandemic’s public health crisis in Allegheny County. In response to these challenges, the University of Pittsburgh Department of Neurosurgery initiated a unique approach to both patient and resident management described by Fernandes-Cabral et al. This study examines the impact of the pandemic on measures of...
resident stress through validated surveys conducted before and during the height of the pandemic in Pittsburgh.

METHODS
A prospective survey study was conducted with UPMC institutional review board approval (STUDY19020291) to evaluate the effect of the pandemic and the changes it caused on the well-being of neurosurgical residents. The coronavirus was first identified in China on January 7, 2020. While few cases were identified in the United States at that time, the virus was officially declared a pandemic March 13, 2020. Most (19) of the 28 residents at UPMC filled out online, self-reported surveys through Qualtrics Online Survey Service at 2 different time points before and during the pandemic after procedural changes. The 2 surveys used were the Perceived Stress Scale (PSS) and Inventory of Depressive Symptomology 30 (IDS-30). On the PSS, scores from 0–13 are considered low stress, 14–26 moderate stress, and 27–40 high stress. The IDS-30 is self-reported with higher scores indicative of more severe depressive symptomology. Scores ≤13 are considered indicative of no depression, 14–25 of mild depression, 26–38 as moderate depression, 39–48 as severe depression, and >49 as very severe depression. The research data were analyzed in a deidentified fashion, and respondents were assured of anonymity and data security. A 2-sample t-test was used to evaluate difference between sample means, and a paired t-test was used when analyzing the data with matching for respondents who filled out each survey at both time points. Statistical tests were performed using Minitab Statistical Software (Minitab 19, Champaign, Illinois, USA).

RESULTS
Table 1 shows the average scores and standard deviations from each of the 2 surveys for all respondents used at 2 different time points. The first time point has responses from January to February of 2020 while the second time point contains responses from March to May 2020. The mean score for the PSS was 16.1 at the first time point and 14.7 at the second time point. The mean score for the IDS-30 was 14.7 at the first time point and 12 at the second time point. The difference between these means was not found to be statistically significant for either the PSS (P = 0.5150) or IDS-30 (P = 0.3969). In addition, when responses were matched up for respondents who filled out each survey at both time points, the average decrease in score was 2.3 for the PSS and 2.4 for the IDS-30. The P values for these matched differences were 0.106 and 0.065, respectively. At least 17 of the 28 neurosurgical residents filled out at least 1 survey at both time points. Scores for these respondents are displayed in Table 2.

DISCUSSION
During the past several decades, several novel viruses have emerged with pandemic potential with the ability to have global impacts. Influenza A was most recent during the spring of 2009. However, severe acute respiratory syndrome—coronavirus 2 has had the largest social and economic impact of any pandemic this century and is comparable with the 1918 influenza pandemic. The crisis has impacted physicians on multiple levels. Furthermore, providers have had to adapt their process on both personal and institutional levels. Neurosurgical residents represent a crucial part of any institution’s workforce and have faced changes in their practice and education. Within our department, neurosurgery residents alternated work weeks to preserve the workforce in the case of infection of a member and the need for quarantine. During weeks working, residents covered twice the volume of typical duties given the need to split the residency cohort into 2 groups. During the time of this study, no residents were diagnosed with coronavirus-19 despite the center being a hub for coronavirus transfers and multiple infected patients requiring neurosurgical care. This study seeks to determine what impact these changes had on the population through externally validated surveys.

Given the demanding nature of the work, resiliency and grit are commonly sought traits in assessing applicants’ fit for neurosurgical residency. Within the concept of resident well-being, burnout is a topic of concern and discussion. However, Shakir et al found a burnout rate of 36.5% among neurosurgery residents. This is actually lower than the prevalence of burnout of all physicians combined at 54.4% and the prevalence of burnout among all surgical specialties at around 40%. This evidence may indicate that, for unknown reasons, neurosurgical residents may be less susceptible to burnout than other specialties. In any case, the factors involved in burnout are multifactorial and warrant further study. Perhaps one factor is that several institutions have employed changes in practices over recent years to promote resident health and well-being. The pandemic has generated new potential stressors, such as the reduction in elective surgeries, which has a negative impact on resident education. Other potential stressors include management of infected patients, expeditiously managing neurosurgical emergencies in the face of new mandates and hospital protocols, and covering additional workloads to accommodate for a smaller resident cohort. In the long run, as the pandemic continues and if the virus has delayed peaks, the risk of residents failing to meet Accreditation Council for Graduate Medical Education (ACGME) required case volumes for clinical competency may increase. Finally, another potential stressor is altered rotation schedules and expectations. However, resiliency and grit become important traits for coping with these stressors; both being skills which are refined during residency.

| Table 1. Means and Standard Deviations in Both Survey Scores |
|-------------|-------|-------|
|             | Respondents | Mean  | Standard Deviation |
| PSS time point 1 | 18    | 16.1  | 1.23           |
| PSS time point 2 | 18    | 14.7  | 1.72           |
| IDS-30 time point 1 | 17   | 14.7  | 2.24           |
| IDS-30 time point 2 | 19    | 12    | 2.21           |
| Matched difference PSS | 16 | 2.3   | 1.39          |
| Matched difference IDS-30 | 17 | 2.4   | 1.19          |

Matched differences consist of score at time point 1 minus time point 2 for respondents who filled out the given survey at both time points.

PSS, Perceived Stress Scale; IDS-30, Inventory of Depressive Symptomology 30.
On the basis of these study findings, neurosurgical residents did not demonstrate significant elevations in stress level or worse quality of life in the midst of the pandemic. The average score for residents in the department on both the PSS and IDS-30 decreased by >2 points after these changes were implemented. Similar decreases of over 2 points were seen when scores were matched up by responder. This study shows that there was no increase in subjective stress levels during the pandemic within this cohort. This can be due to a multitude of factors; however, personal qualities likely played a role. Yet, neurosurgical residents have shown increased resiliency when faced with professional difficulties in other groups’ work.14 This study shows a similar stress response before and during the pandemic among residents. The University of Pittsburgh and neurosurgical department implemented an approach to maximize patient safety and physician experience during the pandemic, which may have also played a role in producing the results seen.7 However, an alternative explanation could be that the period of time between the 2 survey points is not sufficiently long enough to capture a psychologic or emotional variation. This study is limited by the lack of statistical significance of the noted decrease in stress levels through the survey. This is likely due to the small sample size inherent to a single neurosurgical residency program causing the design to be insufficiently powered. However, it is also important to note that the studies did not find any statistically significant increase in stress levels in response to the cohort being placed in an inherently stressful situation. This may be remedied by mandated participation and tighter control of the duration of each time point. However, this change would negatively affect voluntary participation and may be impractical. Another important consideration was the timing of the surveys. While the coronavirus was not officially declared a pandemic in the United States until March 13, 2020, there were cases present in the United States in the months preceding, which may have biased the prepandemic survey points with added stress. In addition, these findings may not be generalizable to residents of other specialties and subspecialties given differences in exposure to coronavirus, work hours, and predominant mode/location of work.

**CONCLUSION**

There were no significant increases in stress or depressive symptomology among neurosurgical residents during the pandemic as measured through validated surveys. These findings have multiple possible explanations but are of value in understanding the psychologic and emotional impact of the pandemic on a subset of our health care workers.

**CRediT AUTHORSHIP CONTRIBUTION STATEMENT**

**Hanna Algattas**: Conceptualization, Formal analysis, Investigation, Methodology, Writing - original draft. **Souvik Roy**: Writing - review & editing. **Nitin Agarwal**: Conceptualization, Supervision, Resources, Data curation. **Joseph Maroon**: Conceptualization, Supervision, Resources, Data curation.

**Table 2. Survey Scores for the 17 Respondents Who Completed at Least 1 Survey at Both Time Points**

| Respondent | PSS Time Point 1 | PSS Time Point 2 | Decrease | IDS-30 Time Point 1 | IDS-30 Time Point 2 | Decrease |
|------------|------------------|------------------|----------|---------------------|---------------------|----------|
| 1          | 25               | 24               | 1        | 17                  | 18                  | -1       |
| 2          | 19               | 20               | -1       | 41                  | 40                  | 1        |
| 3          | 24               | 20               | 4        | 15                  | 18                  | -3       |
| 4          | 14               | 18               | -4       | 9                   | 8                   | 1        |
| 5          | 19               | 18               | 1        | 17                  | 5                   | 12       |
| 6          | 14               | 13               | 1        | 11                  | 6                   | 5        |
| 7          | 11               | 12               | -1       | 3                   | 8                   | -5       |
| 8          | 20               | 10               | 10       | 15                  | 7                   | 8        |
| 9          | 14               | 3                | 11       | 11                  | 12                  | -1       |
| 10         | 8                | 16               | -8       | 10                  | 8                   | 2        |
| 11         | 7                | 5                | 2        | 7                   | 5                   | 2        |
| 12         | 23               | 21               | 2        | 12                  | 16                  | -4       |
| 13         |                 |                  |          | 15                  | 10                  | 5        |
| 14         | 14               | 0                | 14       | 14                  | 2                   | 12       |
| 15         | 18               | 16               | 2        | 33                  | 32                  | 1        |
| 16         | 11               | 12               | -1       | 11                  | 9                   | 2        |
| 17         | 17               | 13               | 4        | 9                   | 6                   | 3        |

PSS, Perceived Stress Scale; IDS-30, Inventory of Depressive Symptomology 30.
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