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The Relationship Between Surgeon Gender and Stress During the Covid-19 Pandemic

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Objective: To investigate the relationship between surgeon gender and stress during the Covid-19 pandemic.

Background: Although female surgeons face difficulties integrating work and home in the best of times, the Covid-19 pandemic has presented new challenges. The implications for the female surgical workforce are unknown.

Methods: This cross-sectional, multi-center telephone survey study of surgeons was conducted across 5 academic institutions (May 15–June 5, 2020). The primary outcome was maximum stress level, measured using the validated Stress Numerical Rating Scale-11. Mixed-effects generalized linear models were used to estimate the relationship between surgeon stress level and gender.

Results: Of 529 surgeons contacted, 337 surgeons responded and 335 surveys were complete (response rate 63.7%). The majority of female respondents were housestaff (58.1%), and the majority of male respondents were faculty (56.8%) ($P = 0.008$). A greater proportion of male surgeons (50.3%) than female surgeons (36.8%) had children ≤ 18 years ($P = 0.015$). The mean maximum stress level for female surgeons was 7.51 (SD 1.49) and for male surgeons was 6.71 (SD 2.15) ($P < 0.001$). After adjusting for the presence of children and training status, female gender was associated with a significantly higher maximum stress level ($P < 0.001$).

Conclusions: Our findings that women experienced more stress than men during the Covid-19 pandemic, regardless of parental status, suggest that there is more to the gendered differences in the stress experience of the pandemic than the added demands of childcare. Deliberate interventions are needed to promote and support the female surgical workforce during the pandemic.

Keywords: COVID-19, disaster, female surgeon, pandemic, stress, surgeon gender, vulnerable population, workforce

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In the best of times, surgeons experience high levels of tension between work and home, with significant well-established differences by gender.^{1,2} In pre-pandemic studies, it has been shown that female surgeons are less likely than male surgeons to be married and to have children.¹ Further, female surgeons are more likely to report conflicts between family and career.¹

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The Coronavirus Disease 2019 (Covid-19) pandemic has presented a new challenge to the healthcare workforce, both personally and professionally,^{3–5} and the implications on the female surgical workforce are unknown. In the spring of 2020, operative volume dramatically declined, many surgeons were redeployed in unfamiliar settings across health systems, and remote clinical and academic responsibilities increased the volume of work required to be performed at home.^{6,7} Simultaneously, the complexity of the new home environment increased due to the indefinite closure of schools and non-essential businesses, and the loss of in-home childcare for many.^{5,8–10} This was further compounded by the interruption of many supply chains, which increased the day-to-day difficulty of even the most routine chores (eg, grocery shopping).¹¹

As a result, working women in particular are expected to see long-term professional setbacks as a result of the pandemic.¹² Already, Covid-19 has disproportionately affected the productivity of female academics, with female authors submitting fewer publications than their male colleagues since the onset of the disease in the United States.^{13,14} Additionally, other studies suggest that in times of disasters, there is often an exacerbation of preexisting gender disparities due to the greater responsibilities of women across productive, reproductive, and community work.¹⁵

We hypothesized that the stress associated with the Covid-19 pandemic would be greater for female surgeons. In this study, we aimed to investigate the relationship between surgeon gender and stress level during the Covid-19 pandemic, to provide constructive recommendations for the workforce.

METHODS

This is a cross-sectional, multi-center study of surgeons conducted across 5 institutions: Brigham and Women's Hospital, New York – Weill Cornell Medicine, the University of Michigan, the Hospital of the University of Pennsylvania, and the University of California, San Francisco. The study protocol was approved by the Institutional Review Boards (IRB) of Weill-Cornell Medicine (IRB Protocol #20-04021776-02) and of the University of Pennsylvania (IRB Protocol #8943009), which additionally served as the IRB of record for the 3 other sites.

All surgical housestaff and faculty were eligible at each of the 5 study sites. Details regarding survey design have been previously described.¹⁶ In brief, structured phone interviews were used to administer a 25-item survey. The stress numerical rating scale-11 (Stress NRS-11)¹⁷ was used to assess stress levels at their maximum point during the pandemic and at the time of the survey, referred to as the study period stress level. This SNRS-11 is a single-point assessment, analogous to the pain scale, in which respondents rate their stress on a scale from 0 to 10.¹⁷ The survey also included items on basic demographics, training status, domestic status and support, and workplace and personal experiences specific to the Covid-19

pandemic. See Supplement #1, <http://links.lww.com/SLA/C919>. Survey results were collected using REDCap,^{18,19} an encrypted web-based database, hosted at the University of Pennsylvania.

The primary outcome of interest was maximum stress level by surgeon gender, and the secondary outcome was current stress level by surgeon gender. Subset analyses were performed by the presence of children in the home. Descriptive statistics and univariate analyses were performed using Chi-square tests and ANOVA, as appropriate. Mixed-effects generalized linear models were used to estimate the relationship between surgeon stress level and gender for maximum stress levels and for study period stress levels controlling for potential confounders. We included potential confounders that were found to be significant in univariate analysis for all respondents. A subset analysis was performed among partnered surgeons included partner employment status. Random effects were used to control for clustering at the level of the study sites. For all comparisons, a *P*-value of less than 0.05 was considered to be statistically significant.

All statistical analysis was performed using STATA (Version 15.1, StataCorp).²⁰ Figures were generated using GraphPad Prism version 8.2.1 for Windows (GraphPad Software, San Diego, California, www.graphpad.com).

RESULTS

A total of 337 surgeons across 5 study sites responded to the survey out of 529 who were contacted (response rate 63.7%). Two surveys were incomplete and were discarded, leaving 335 surveys for final analysis. The majority of respondents were male (59.4%). The mean overall surgeon age was 39.4 [standard deviation (SD) 10.7], which varied by gender (*P* < 0.0001). On average, male surgeons were older than female surgeons (*P* < 0.0001). The majority of female respondents were housestaff (58.1%), and the majority of male respondents were faculty (56.8%) (*P* = 0.008). For faculty, the mean number of years in practice overall was 13.2 (SD 9.5); male

surgeons had a higher mean number of years in practice than female surgeons (*P* = 0.003). The majority (89.6%) of surgeons experienced a decrease in their operative volume due to Covid-19; there was no difference between male and female surgeons (*P* = 0.560). The majority (80.5%) of surgeons were notified that they could be redeployed outside of their typical practice area, and the minority (26.6%) were redeployed. There was no difference in notification of redeployment or in redeployment between male and female surgeons (*P* = 0.470).

The most common relationship status overall, and for both men and women, was married (68.1% overall), and the second most common was single or divorced (15.2% overall). The distribution of relationship statuses did not vary significantly by surgeon gender (*P* = 0.118). Surgeons who reported their relationship status as married or in a domestic partnership were considered to be partnered. Of the 256 partnered surgeons, 206 reported that their partner was employed. A significantly greater proportion of female surgeons (90.8%) than male surgeons (74.1%) reported that their partner was employed (*P* = 0.001). See Table 1.

Surgeon-reported dependent status varied significantly by surgeon gender (*P* = 0.001). A greater proportion of male surgeons (50.3%) than female surgeons (36.8%) reported having children under the age of 18 in the home (*P* = 0.015). A small minority (3.0%) of all surgeons reported having a dependent over the age of 60 in their home. A greater proportion of male surgeons than female surgeons reported a current pregnancy in their household (*P* = 0.028). See Table 2. The minority (10.2%) of surgeons updated their will or other legal documents in response to the pandemic, and there was a trend towards a greater proportion of female (14.1%) than male surgeons (7.6%) doing so (*P* = 0.064). See Table 1.

Female surgeons reported significantly higher mean maximum and study period stress levels than did male surgeons. The mean maximum stress level for female surgeons was 7.51 (SD 1.49) and for

TABLE 1. Study Population Characteristics

| Surgeon Characteristics | Total | Male | Female | <i>P</i> -value |
|--|-------------|-------------|------------|-----------------|
| N (%) | 335 (100.0) | 199 (59.4) | 136 (40.6) | |
| Age, mean (SD) | 39.4 (10.7) | 41.5 (11.4) | 36.3 (8.7) | <0.001 |
| Housestaff, N (%) | 165 (49.3) | 86 (43.2) | 79 (58.1) | 0.008 |
| PGY level, mean (SD) | 3.4 (2.1) | 3.5 (2.0) | 3.4 (2.3) | 0.687 |
| Faculty, N (%) | 170 (50.7) | 113 (56.8) | 57 (41.9) | 0.008 |
| Years in practice, mean (SD) | 13.2 (9.5) | 14.8 (9.8) | 10.2 (8.3) | 0.003 |
| Updated will or other legal documents due to pandemic, N (%) | 34 (10.2) | 15 (7.6) | 19 (14.1) | 0.064 |
| Relationship Status, N (%) | | | | 0.118 |
| Married | 228 (68.1) | 146 (73.4) | 82 (60.3) | |
| Domestic Partnership | 28 (8.4) | 12 (6.0) | 16 (11.8) | |
| Monogamous Relationship, not otherwise specified | 23 (6.9) | 12 (6.0) | 11 (8.1) | |
| Single or Divorced | 51 (15.2) | 27 (13.6) | 24 (17.6) | |
| Other | <10 | <10 | <10 | |
| Total partnered, N (%) | 256 (76.4) | 158 (79.4) | 98 (72.1) | 0.120 |
| Operative volume Decreased, N (%) | 300 (89.6) | 178 (89.5) | 122 (89.7) | 0.560 |
| Notified of potential redeployment, N (%) | 198 (80.5) | 121 (81.2) | 77 (79.4) | 0.724 |
| Redeployed, N (%) | 89 (26.6) | 50 (25.1) | 39 (28.7) | 0.470 |
| Partner characteristics (N = 256) | | | | |
| Partner employed, N (%) | 206 (80.5) | 117 (74.1) | 89 (90.8) | 0.001 |
| Partner occupation, N (% of employed partners) | | | | 0.033 |
| Physician | 91 (44.2) | 53 (45.3) | 38 (42.7) | |
| Non-physician Healthcare Worker | 10 (4.9) | <10 | <10 | |
| Business Person | 45 (21.8) | 19 (16.2) | 26 (29.2) | |
| Other | 60 (29.1) | 36 (30.8) | 24 (27.0) | |
| Employed by same health system, if partner is healthcare worker, N (%) | 54 (53.5) | 35 (56.5) | 19 (48.7) | 0.448 |

(1) Cell counts less than 10 are not reported to protect privacy. (2) Updated will or other legal documents was queried as a proxy for surgeons' fear about safety, survival, and ability to provide for their families. (3) Those who reported their relationship status as "married" or in a "domestic partnership" were considered to be partnered. (4) Non-physician healthcare workers include nurses, advanced practice providers, and pharmacists.

TABLE 2. Household Characteristics

| N (%) | Total | Male | Female | P-value |
|--------------------------------|------------|------------|-----------|---------|
| Dependents | | | | 0.001 |
| None | 122 (36.4) | 68 (34.2) | 54 (39.7) | |
| Pets only | 43 (12.8) | 16 (8.0) | 27 (19.9) | |
| Children or adults | 170 (50.7) | 115 (57.8) | 55 (40.4) | |
| Number, mean (SD) | 2.1 (0.9) | 2.2 (0.9) | 1.9 (0.8) | 0.044 |
| Children ≤18 yr | 150 (44.8) | 100 (50.3) | 50 (36.8) | 0.015 |
| Adult Dependents, 19–59 yr | 24 (7.2) | 22 (11.1) | <10 | 0.001 |
| Adult Dependents, ≥60 yr | 10 (3.0) | <10 | <10 | 0.055 |
| Current pregnancy in household | 15 (4.5) | 13 (6.5) | <10 | 0.028 |

Cell counts less than 10 are not reported to protect privacy.

male surgeons was 6.71 (SD 2.15) ($P < 0.001$). The mean study period stress level for female surgeons was 4.65 (SD 1.86) and for male surgeons was 4.18 (SD 2.13) ($P = 0.034$). In a subset analysis by the presence of children under the age of 18 in the home, female surgeons both with and without children reported significantly higher maximum stress levels than did male surgeons ($P < 0.05$ for all). There was no significant difference in the analogous subset analysis of study period stress levels ($P > 0.05$ for all). See Figure 1.

Using separate mixed-effect linear regression models, controlled for clustering by study site, female gender was associated with significantly higher maximum and study period stress levels, after adjustment for the presence of children and training status ($P < 0.05$ for both). See Table 3. We found similar results in the subset analysis of partnered surgeons, which included partner employment status ($P > 0.05$).

DISCUSSION

In this multi-institutional, geographically diverse examination of academic surgeons in the early months of the Covid-19 pandemic, we found that female surgeons experienced consistently higher levels of stress than their male colleagues. Stress levels among women surgeons were higher despite no gender-related differences in pandemic-related professional experiences or partnership status, and a greater proportion of male surgeons with children under the age of 18. Although having children was associated with significantly higher maximum stress levels, women also reported significantly higher maximum stress levels than their male colleagues among non-parent surgeons.

Our findings that women experienced more stress than men during the Covid-19 pandemic, regardless of parental status, suggest that there is more to the gendered differences in the stress experience of the pandemic than the added demands of childcare. By extending this work into the non-parent space, we add to the current body of literature on Covid-19 and gender. It has already been shown that the pandemic has increased the time spent on domestic tasks and home-schooling for mothers more than for fathers²¹ and female academics were less productive in the early months of the pandemic.¹³ However, there are many other potential reasons female surgeons may experience higher levels of stress. Even for nonparents, the pandemic may have led to an increase in domestic chores performed by women, including housework and other tasks that may have been previously outsourced. In non-pandemic times, this type of unpaid work has been demonstrated to be linked to an increase in stress levels and the stress response.^{22,23} Further, the pandemic has brought an unprecedented level of social isolation and has pushed people away from their communities and into their homes.²⁴ Social isolation has been well-documented to worsen both cardiovascular and mental health

outcomes,^{25,26} and the effect has been shown to be significantly more pronounced in women than in men.^{27,28}

The difference in stress levels between male and female surgeons is unlikely to be due to a difference in household composition, as our data also suggest that the composition of the households of male and female surgeons are more similar than previously suggested. Approximately 3-quarters of both male and female surgeons were partnered, with no significant difference in relationship status between male and female surgeons. A survey of surgeons published in 2002 reported a much greater gap between rates of marriage for male and female surgeons: 89% of male surgeons versus 68% of female surgeons, a 21 percentage-point gap compared to the 13 percentage-point difference in our data.¹ Further, in contrast to a 2015 survey, a much larger proportion of surgeons reported having an employed partner, with significantly more female surgeons (90.8% vs 74% in the prior study) reporting having an employed partner than male surgeons (74.1% vs 18% in the prior study).²⁹ In the subset analysis of partnered surgeons, inclusion of partner employment status did not alter the relationship between surgeon gender and stress, nor was partner employment status independently associated with surgeon stress level. However, similar to prior studies, we did find that male surgeons were more likely to have children than female surgeons,^{1,2} though this may have been a product of the age distribution in our study, as male surgeons were older, on average, than female surgeons.

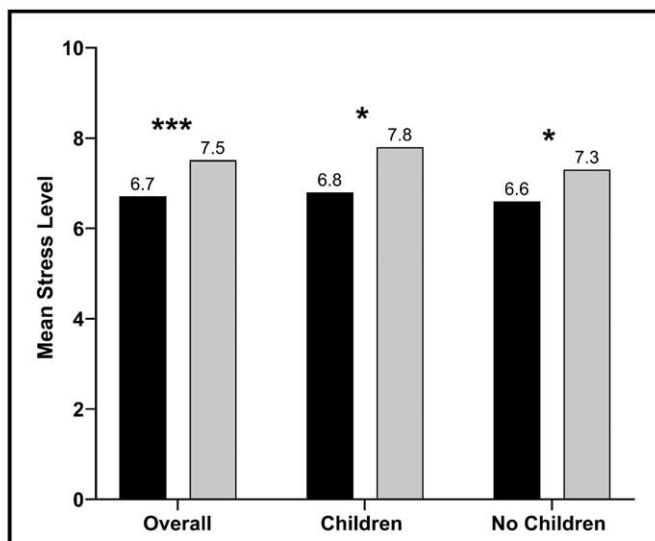
Looking forward, we can expect even greater numbers of women in the surgical workforce. Our study reinforces the well-established shifting demographics of the surgical workforce, with an increasing proportion of female surgical housestaff as compared to faculty, and a younger average age of the female surgeons than their male colleagues. This is consistent with the increasing number of female medical school graduates who pursue surgical specialties and prior findings that female full professors of surgery are exceedingly rare.³⁰ As the surgical workforce continues to evolve, we must focus on building diverse communities within surgical departments, with particular attention to leadership and senior faculty roles, where gender diversity remains uncommon.³¹

Our study has several important limitations. First, there are well-described differences in how men and women both report and experience stress, which may confound our results.^{17,32,33} However, existing physiologic data confirm underlying differences in the male and female stress response that support our findings.^{27,28} Second, this study was conducted across academic medical centers, which may limit the generalizability of our results. Third, study subjects were often familiar with their interviewers and therefore may have been reluctant to disclose true stress levels, though this was true for both male and female respondents. Additionally, due to the reflective

Stress Level by Surgeon Gender and the Presence of Children in the Home

■ Male ■ Female

Maximum Stress Level



Study Period Stress Level

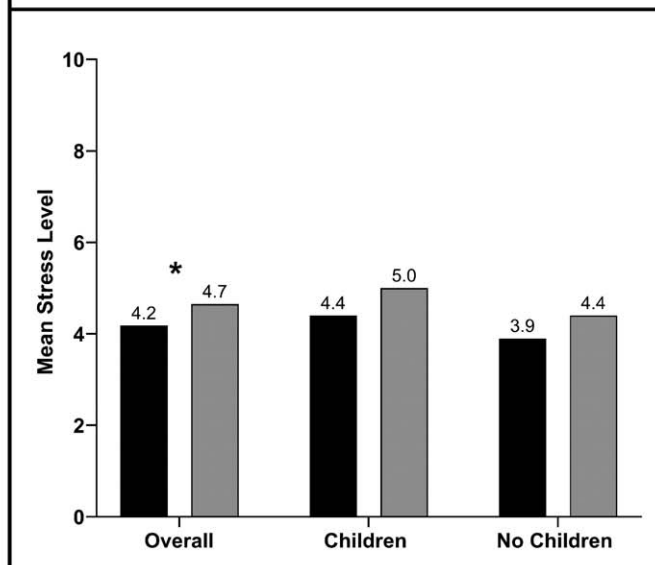


FIGURE 1. Stress level by surgeon gender and the presence of children in the home. Asterisk indicates significance (* = P-value < 0.05, *** = P-value < 0.0001).

TABLE 3. The Relationship Between Female Gender and Stress – Multivariable Linear Regression Models, Including Random Effects of Study Sites

| Variable | Model 1: Maximum Stress Score | | Model 2: Stress Score at Time of Survey | |
|--------------------------|-------------------------------|---------|---|---------|
| | Coefficient | P-value | Coefficient | P-value |
| Gender: Female | 0.79 | <0.001 | 0.57 | 0.011 |
| Children ≤18 yr | 0.56 | 0.021 | 0.40 | 0.120 |
| Training status: faculty | -0.52 | 0.032 | 0.27 | 0.285 |

These models do not include interaction terms between female gender and stress and either the presence of children or faculty status because there was no evidence of effect modification when tested.

nature of the primary outcome, maximum stress, there may have been recall bias. However, the difference in stress levels by gender was also seen for current stress levels, suggesting there was also a real difference in reported stress levels at both time points. Further, due to the limitations of sample size, we did not perform a subset analysis on either faculty or housestaff with respect to the effect of years of experience or post-graduate years, respectively. Years of experience and post-graduate year of training may confer some resilience regardless of the pandemic.

As Covid-19 continues to spread in the United States, healthcare systems must continue to provide support for their workforce. Our data suggest that female surgeons represent a particularly vulnerable community at this time. For surgeons who are also parents, we suggest that employers sponsor safe, on-site daycare or in-home childcare collaboratives, to help fill the gaps created in many regions by ongoing school, camp, and daycare closures. The creation of networks, particularly inclusive of women surgeons, centered on common professional interests may be a valuable approach to maintaining a sense of belonging, while facilitating professional productivity. Regardless of the mechanism, deliberate interventions, designed with input from women, are needed to promote and support the female surgical workforce during the pandemic.

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