Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.JournalofSurgicalResearch.com

Association for Academic Surgery

COVID Stressed, but Not due to the Virus

Julie Y. Valenzuela, MD,[a,*] *R. Jonathan Robitsek, PhD,*[a] *Melissa K. James, PhD,*[a] *Katherine McKenzie, DO,*[a] *and Thomas J. Esposito, MD, MPH*[b]

[a] *Department of Surgery, Jamaica Hospital Medical Center, Jamaica, New York*
[b] *Department of Medicine, University of Illinois College of Medicine, Peoria, Illinois*

ARTICLE INFO

Article history:
Received 1 March 2022
Received in revised form
17 September 2022
Accepted 16 October 2022
Available online 24 November 2022

Keywords:
Acute care surgery
COVID-19
Pandemic
PTSD
Stress
Surgeons

ABSTRACT

Introduction: Acute care surgeons can experience posttraumatic stress disorder (PTSD) due to the cumulative stress of practice. This study sought to document the potential impact of the COVID-19 pandemic on PTSD in acute care surgeons and to identify potential contributing factors.

Methods: The six-item brief version of the PTSD Checklist-Civilian Version (PCL-6), a validated instrument capturing PTSD symptomology, was used to screen Eastern Association for the Surgery of Trauma members. Added questions gauged pandemic effects on professional and hospital systems–level factors. Regression modeling used responses from attending surgeons that fully completed the PCL-6.

Results: Complete responses from 334 of 360 attending surgeons were obtained, with 58 of 334 (17%) screening positive for PTSD symptoms. Factors significantly contributing to both higher PCL-6 scores and meeting criteria for PTSD symptomology included decreasing age, increased administrative duties, reduced research productivity, nonurban practice setting, and loss of annual bonuses. Increasing PCL-6 score was also affected by perceived illness risk and higher odds of PTSD symptomology with elective case cancellation. For most respondents, fear of death and concerns of illness from COVID-19 were not associated with increased odds of PTSD symptomology.

Conclusions: The prevalence of PTSD symptomology in this sample was similar to previous reports using surgeon samples (15%-22%). In the face of the COVID-19 pandemic, stress was not directly related to infectious concerns but rather to the collateral challenges caused by the pandemic and unrelated demographic factors. Understanding factors increasing stress in acute care surgeons is critical as part of pandemic planning and management to reduce burnout and maintain a healthy workforce.

* *Corresponding author*. Department of Surgery, Jamaica Hospital Medical Center, 8900 Van Wyck Expressway, Jamaica, NY 11418. Tel.: +1 360 840 0757.
E-mail address: jvalenzu@jhmc.org (J.Y. Valenzuela).

0022-4804/$ – see front matter © 2022 Elsevier Inc. All rights reserved.
https://doi.org/10.1016/j.jss.2022.10.065

Introduction

COVID-19 was declared a pandemic in March of 2020, with rapid disruption of nonemergency medical and surgical services ensuing.[1-3] During the initial outbreak, much attention was focused on the stress endured by medical personnel or emergency room physicians due to the rapid rise in hospital admissions of patients ailing from COVID-19.[4,5] The pandemic's impact on acute care surgeons was largely ignored, although acute care surgeons were still essential personnel, ensuring trauma and emergency general surgical services were maintained within an already strained environment. Furthermore, acute care surgeons were mobilized to increase the provision of critical care services and as a way to increase surge capacity.[6,7]

Acute care surgeons are known to be at risk of posttraumatic stress disorder (PTSD) from the cumulative exposure to stress experienced in complex, high acuity scenarios as part of daily practice.[8-11] Previous studies have shown increased stress among health care workers during the severe acute respiratory syndrome epidemic.[12,13] However, whether the mobilization of acute care surgeons during the initial peak of the COVID-19 pandemic contributed to increased stress and risk of PTSD remains unknown. In this study, the aim was to examine if the stress and systems-related issues associated with the COVID-19 pandemic increased the risk of PTSD among acute care surgeons. We hypothesized factors that increased stress would be related to infectious concerns due to widespread shortages of supplies, increased work exposure, and personal life challenges and concerns.

Methods

Survey and participants

A Web-based survey was created using SurveyMonkey and distributed to members of the Eastern Association for the Surgery of Trauma (EAST; see Supplementary Material). Three email notifications containing the link to the survey were sent between September 28 and December 11, 2020; data were collected until January 4, 2021. EAST members were informed that participation was voluntary, that the survey results would be used for research purposes only, and that all participants would remain anonymous. This study was approved by the EAST research committee and was deemed exempt by the Institutional Review Board at Jamaica Hospital Medical Center. There was no informed consent, as completing the survey was considered consent to participate. The median time to complete the survey was 6.4 (interquartile range [IQR]: 5.2, 9.4) min.

PTSD symptomology assessment and six-item PTSD Checklist-Civilian version scoring

The survey included the six-item brief version (PCL-6) of the PTSD Checklist-Civilian (PCL-C) questionnaire, a 17-item self-report measure reflecting the Diagnostic and Statistical Manual of Mental Disorders-IV-TR symptoms of PTSD.[14] The PCL-6 is a reliable and valid Likert-scaled self-report instrument that can be used to screen for PTSD in health care settings.[15] Response options for the PCL-6 are as follows: "*not at all*" = 1 point, "*a little bit*" = 2 points, "*moderately*" = 3 points, "*quite a bit*" = 4 points, or "extremely" = 5 points. For each respondent, the items on the PCL-6 screen are summed to generate a total score ranging from 6 to 30, with higher scores indicating greater PTSD symptomology.

A threshold score of 14 or greater was used and indicated a positive screen for PTSD, which yields a sensitivity of 0.92 ± 0.19, specificity of 0.72 ± 0.06, and diagnostic efficiency of 0.75 ± 0.06 when compared with the "gold standard" for PTSD diagnosis, the Clinician-Administered PTSD Scale.[15-17] We specified the COVID-19 pandemic as the traumatic event to be considered when responding to the PCL-6 questions. As such, positive screens for PTSD symptomology should be related to the pandemic and not previous stressful/traumatic life events.

Additional data points collected

Participants were asked to share demographic information such as their age, gender identification, relationship status, job role, practice location, and specialty. The survey also included additional Likert-scaled and free-text questions to ascertain how the COVID-19 pandemic impacted individuals personally and professionally. For questions with a free-text component allowing further comment or specification where the desired option was not provided, all responses were manually reviewed, followed by text processing that searched for specific terms to discretize the response. If the comment could not be categorized, it was coded as not applicable and excluded. This was performed for questions in section II (q3, q12) and section IV (q2, q6, q11, q15; see survey in Supplementary Materials). For questions where multiple responses could be selected (e.g., supply shortages, Section IV, q6), responses were discretized to obtain an overall rate that referred to the overarching theme (i.e., were supply shortages experienced?), as well as the rate for each specified option (i.e., gloves, N-95s, gowns). Respondents who completed all six questions in the PCL-6 screen were included in the study.

Statistical analysis

R statistical software version 4.0.5 was used for all statistical analyses.[18] Nominal variables are presented as percentages, with Fisher's exact test used for bivariate comparisons and the single proportion z-test for univariate comparisons. The results of Fisher's exact test are supplemented with odds ratios with 95% confidence intervals and presented as (OR [95% CI]). Continuous variables are presented as median [IQR], and comparisons between groups used the Mann–Whitney *U*-test or Kruskal–Wallis rank sum test as appropriate. Respondents were stratified into groups for analysis based on the validated threshold score of <14 or ≥ 14. Stepwise regression was performed to determine which factors were associated with increasing PCL-6 scores (linear regression) and higher odds of a positive PTSD screen (logistic regression).

Responses from the additional questions separate from the PCL-6 with more than two response levels were transformed into a three-level factor that varied depending on the original question. Questions with "-agree" based responses were categorized as "disagree" ("strongly disagree" and "disagree" responses), "neutral," and "agree" ("agree" and "strongly agree"), whereas "-likely" based responses were categorized as "unlikely" ("extremely unlikely" and "unlikely"), "neutral," and "likely" ("likely" and "extremely likely"). This transformation was performed to reduce the chance of spurious results due to the lower response rate than anticipated and associated heterogeneity of responses in this sample, as well as to decrease the familywise alpha rate by reducing the need for multiple post hoc comparisons across PCL-6 response levels. Collapsing response levels for Likert-scaled items is regression modeling was performed using all demographic variables and non-PCL-6 questions querying the effects of the pandemic as independent variables, with either total PCL-6 score or a binary indicator for positive PTSD symptomology as dependent variables for linear and logistic regression models, respectively.

Results

The survey was distributed to 2302 EAST members, of which 17.8% ($n = 410$) responded. Of the total respondents, 87.8% ($n = 360$) were attendings practicing within 42 US states plus the District of Columbia, with 92.8% ($n = 334$) completing the full PCL-6 screening. Most of the respondents were male (64.1%; $P < 0.0001$), with an overall sample median age of 44 (39-52) y. The majority practiced in an urban ($n = 235$, 70.4%), academic ($n = 201$, 60.2%), hospital-based group ($n = 299$, 89.5%) practice environment. Trauma surgeons comprised 96% ($n = 321$) of the respondents, with the remaining 13 specifying specialties of pediatric surgery ($n = 4$, 1.2%), emergency medicine ($n = 3$, 0.9%), anesthesia ($n = 2$, 0.6%), acute care surgery ($n = 1$, 0.3%), burn/critical care surgery ($n = 1$, 0.3%), critical care ($n = 1$, 0.3%), and orthopedics ($n = 1$, 0.3%). Of the 334 attendings who completed the survey in full, 96.1% (321/334) practiced trauma and general surgery.

Quantile regression (controlling for gender, age, PCL-6 score, and if free-text comments were made) showed only that the median completion time was 2.5 (95% CI: 1.6, 3.4) min longer for respondents making comments (8.4 [IQR: 7.1, 12.3]) than for respondents that did not (6.28 [IQR: 5.25; 8.26] min; $P < 0.0001$). Of the 334 attendings responding completely, 17.4% ($n = 58$) scored 14 or greater on the PCL-6 questionnaire, indicating a positive screen for PTSD symptomology. Correspondingly, the median PCL-6 score in those screening positive was two times higher than in those who did not (16 [15-21] *versus* 8 [6-10]; $z = -11.9$; $P < 0.0001$; Fig.). Bivariate analyses of demographic and hospital systems–level factors stratified by the threshold score of 14 are presented in Table 1. Demographic factors associated with increased odds of screening positive for PTSD symptoms included nonmale gender (1.86 [1.01-3.4]), not having children (1.98 [1.09-3.6]), nonurban practice setting (2.06 [1.09-3.85]), and reduced research productivity (1.95 [1.1-3.48]). Hospital systems–level factors contributing to increased odds of a positive PCL-6 screen included financial losses (lost wages: 2.08 [1.1-4.0]; bonus withheld: 2.09 [1.1-3.9]), more administrative duties (1.87 [1.02-3.48]) and cancellation of elective surgeries (1.9 [1.04-3.5]). Most respondents ($n = 171$, 51%) were not concerned with contracting COVID-19 and were less likely to screen positive on the PCL-6 than those believing they would likely become infected ($n = 73$, 21.9%; 0.27 [0.14-0.53]; $P < 0.001$). Most attendings surveyed ($n = 233$, 69.9%) were not fearful of death resulting from caring for patients with COVID-19; 23% ($n = 77$) were neutral, and 6.9% expressed concerns of increased risk of death ($n = 23$; Table 1). Those attendings who did not believe they would die because of COVID-19 were also less likely to show PTSD symptomology than the minority that did think death was a possibility ($n = 23$, 6.9%; 0.32 [0.13-0.91]; $P = 0.02$).

Linear regression modeling revealed increasing PCL-6 scores were associated with decreasing age, practicing in a rural setting, more administrative responsibilities, reduced research productivity, and loss of annual bonuses (Table 2, left). PCL-6 scores were also modulated by the perceived risk of infection; scores were higher in those believing their risk of infection was likely compared with those believing infection risk was unlikely or were neutral regarding infection risk (Table 2, left). Logistic regression showed increased odds of scoring above threshold on the PCL-6 to be associated with decreasing age, suburban and rural practice settings, increased administrative workload, elective case cancellation, loss of annual bonuses, and decreased research productivity. Twenty-three percent ($n = 76$) of those surveyed undertook novel research pertaining to COVID-19. In addition to the 34% of respondents reporting decreased research activity (Table 1), 67.6% ($n = 226$; $P < 0.0001$) reported loss of professional and academic visibility due to cancellation of professional conferences because of the pandemic. Only 2.9% of responding attendings ($n = 10$) reported no impact professionally.

Concerns of contracting COVID-19 were associated with increasing PCL-6 scores overall (Table 2, left) but were not associated with increased odds of a positive PTSD screen (Table 2, right). More than half of the sample (59.6%; $n = 199$; $P = 0.0005$) had been tested for COVID-19, whereas only 6.9% ($n = 23$) reported contracting the virus, and <1% ($n = 1$) required hospitalization. When asked about the fear of potential exposure to the virus at the workplace because of the pandemic, 63.8% ($n = 213$) stated they were not afraid, and only 21.9% ($n = 73$; Table 1) had concerns of serious illness resulting from caring for COVID-19 patients. When asked about preferences to provide clinical care for patients with COVID-19, 57.4% were willing to do so ($n = 191$), whereas 22.8% ($n = 76$) of respondents preferred not to care for patients with COVID-19 or were neutral ($n = 66$, 19.8%; $P < 0.0001$) on the subject. Thus, most attendings expressed willingness to provide care for patients and had little concern for contracting the virus. Eighty-seven percent of respondents reported experiencing shortages of at least one supply ($n = 283/327$; $P < 0.0001$), with most reporting shortages of N-95 masks (65.4%; $n = 212/324$), surgical masks (53.1%; $n = 173/326$), medications (51.9%; $n = 168/324$), and gowns (51.1%; $n = 166/325$). Contrary to what media outlets were reporting, only 18.4% reported problems with ventilator access (18.4%; $n = 59/321$). Shortages were reported across practice venues

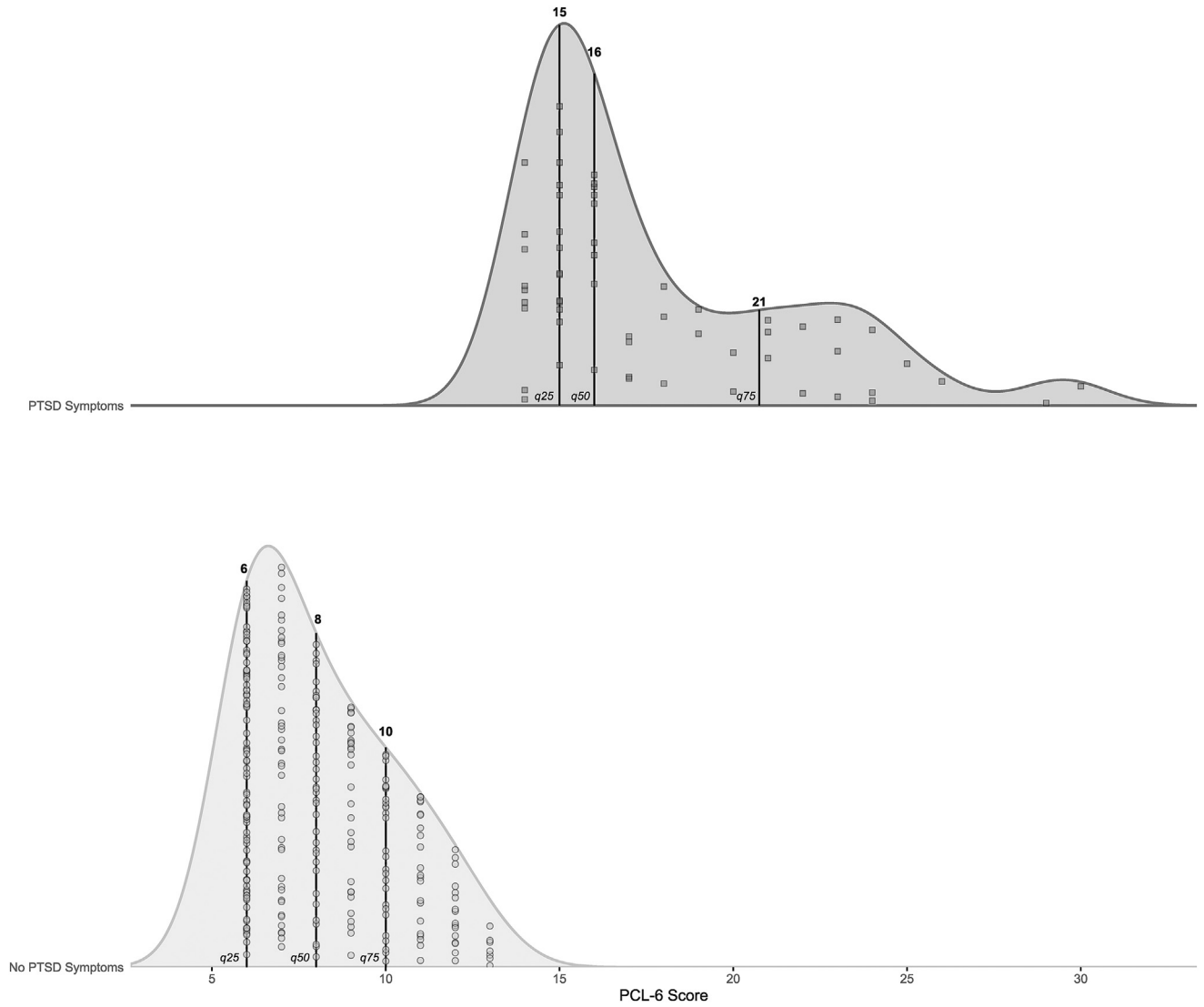

Fig. – Scatterplot with overlaid density histograms of observed PCL-6 scores for those scoring <14 on the PCL-6 (*no PTSD symptoms*; lower panel) and those scoring ≥14 on the PCL-6 (*PTSD symptoms*; upper panel). Vertical lines denote the first quartile, median, and third quartile, respectively (*q25*, *q50*, *q75*).

(*academic*: 83%, *n* = 172/207; *community*: 88%, *n* = 107/122; *other* [military, private practice, locums tenens]: 50%, *n* = 4/8) and practice settings (*urban*: 86.1%, *n* = 198/230; *suburban*: 82.9%, *n* = 58/70; *rural*: 100%, 27/27). The pandemic resulted in increased intensive care coverage demands for 39.8% of respondents, but this was not significantly associated with elevated odds of screening positive for symptoms of PTSD (Table 2). Increased administrative workload was reported by 55.9%, contributing significantly to both increasing PCL-6 score and odds of a positive screen for PTSD symptoms (Table 2).

As may be expected, an overall increase in perceived stress as a result of the COVID-19 pandemic was reported by the majority of attendings (*n* = 257, 76.9%; *P* < 0.0001), and there were 23.8% (95% CI: 15.6%-31.8%) more reports of increased stress among those screening positive for PTSD symptoms (*n* = 56/58, 96.6%) than in those who did not (*n* = 201/276, 72.8%; *P* < 0.0001). This increase in perceived stress was reported equivalently across practice venues (*academic*: 78.6%, *n* = 158/201; *community*: 74.4%, *n* = 93/125; *other*: 75%, *n* = 6/8) and practice settings (*urban*: 77.5%, *n* = 182/235; *suburban*: 77.5%, *n* = 55/71; *rural*: 71.4%, 20/28).

With regard to factors modulating perceived stress potentially attributable to the COVID-19 pandemic, the odds of perceiving more stress were higher among those experiencing supply shortages (2.2 [1.12-4.36]; *n* = 225/253; 88.9% *versus* *n* = 58/74; 78.4%; *P* = 0.022), wage losses (1.67 [1.00-2.79]; *n* = 143/257; 55.6% *versus* *n* = 33/77; 42.9%; *P* = 0.048), and decreased research productivity (1.9 [1.07-3.5]; *n* = 95/113; 84.1% *versus* *n* = 153/208; 73.6%; *P* = 0.034). Demographic factors contributing to increased stress included gender, with nonmales more likely to report elevated stress (6.6 [3.25-15.5]; *n* = 112/120; 93.3% *versus* 145/214; 67.8%; *P* < 0.0001), and age, where the median age was lower among those perceiving more pandemic-related stress (42 [38-50] *versus* 51 [41-61]).

Table 1 – Candidate factors contributing to PTSD symptomology by PCL-6 threshold score.

Variable	PCL-6 score <14 ($n = 276$)	PCL-6 score ≥14 ($n = 58$)	P
Gender			**0.035**
Male	184 (86.0)	30 (14.0)	
Not male	92 (76.7)	28 (23.3)	
Age			0.09
Median (IQR)	44 [39-53]	43 [38-50]	
Relationship status			0.1
Unmarried	41 (14.9)	14 (24.1)	
Married	235 (85.1)	44 (75.9)	
Child status			**0.03**
No	65 (23.6)	22 (37.9)	
Yes	211 (76.4)	36 (62.1)	
Region			0.5
Northeast	74 (26.8)	17 (29.3)	
South	94 (34.1)	20 (34.5)	
Midwest	74 (26.8)	11 (18.9)	
West	34 (12.3)	10 (17.2)	
Practice setting			**0.01**
Urban	202 (73.2)	33 (56.9)	
Suburban	56 (20.3)	15 (25.9)	
Rural	18 (6.5)	10 (17.2)	
Lost wages			**0.02**
No	139 (50.4)	19 (32.8)	
Yes	137 (49.6)	39 (67.2)	
Bonus withheld			**0.02**
No	210 (76.1)	35 (60.3)	
Yes	66 (23.9)	23 (39.7)	
Supply shortage			0.053
No	41 (15.2)	3 (5.3)	
Yes	229 (84.8)	54 (94.7)	
Missing	6 (-)	1 (-)	
Increased ICU coverage			0.1
No	163 (59.1)	28 (48.3)	
Yes	113 (40.9)	30 (51.7)	
Elective case cancellation			**0.03**
No	168 (60.9)	26 (44.8)	
Yes	108 (39.1)	32 (55.2)	
Increased administrative duties			**0.04**
No	162 (58.7)	25 (43.1)	
Yes	114 (41.3)	33 (56.9)	
Research productivity			**0.02**
No research	178 (64.5)	30 (51.7)	
Increase	13 (4.7)	0 (0)	
Decrease	85 (30.8)	28 (48.3)	
COVID-19 illness risk			**0.0005**
Likely	49 (17.8)	24 (41.4)	
Neutral	76 (27.5)	14 (24.1)	
Unlikely	151 (54.7)	20 (34.5)	
COVID-19 death risk			**0.003**
Likely	16 (5.8)	7 (12.1)	

(continued)

Table 1 – (*continued*)

Variable	PCL-6 score <14 ($n = 276$)	PCL-6 score ≥14 ($n = 58$)	P
Neutral	55 (19.9)	22 (37.9)	
Unlikely	204 (73.9)	29 (50.0)	

Bivariate analysis on variables hypothesized to contribute to PTSD symptomology. Data presented as frequency (%) for comparisons of respondents with PCL-6 scores <14 *versus* respondents with a PCL-6 score ≥14.
P values for significant predictors in bold.
ICU = intensive care unit.

Discussion

The positive screening rate for PTSD symptomology among this sample was 17.4%, which is within the range of previously reported rates of PTSD among trauma surgeons exposed to the stress of daily practice.[8,9] The higher likelihood of PTSD symptomology associated with increased administrative duties, decreased research productivity, and financial losses that were observed in this study is not unexpected. Similar to a study by Mavroudis *et al.*, this study also found nonmale respondents had a higher likelihood of screening positive for PTSD symptomology.[19]

Most respondents reported supply shortages of masks and other personal protective equipment (PPE), consistent with the national unavailability of supplies at the start of the pandemic. However, concern for contracting the virus was low despite the lack of PPE and increased intensive care unit workload, and those who were concerned about falling ill had higher PCL-6 scores than those who were not. Similar results were seen in the bivariate comparisons on the risk of death and screening positive for PTSD symptoms; those who thought their risk of dying from COVID-19 was low were less likely to screen above the threshold on the PCL-6. Although respondent fear of death was not significantly associated with either increasing PCL-6 score or odds of screening positive, this factor remained in both the final linear and logistic regression models and approached significance. This can be taken to mean that this construct is indeed important within the overall context of a model attempting to explain factors contributing to PTSD symptomology as captured by the PCL-6. The results of this study did not show increased stress directly related to infectious concerns, but increased stress was associated with the collateral challenges the pandemic created as well as demographic factors.

The similar rate of PTSD symptomology to that observed in earlier studies[8,10,11] despite the stress of a novel virus, limited PPE and COVID-19 testing capability, and lack of vaccinations at the time of this survey may reflect the resilience of acute care surgeons. When compared with other health care workers who also cared for patients with COVID-19, surgeons were found to have less stress.[20] Protective factors from burnout for surgeons include autonomous clinical responsibility, camaraderie with peers, and having a sense of clinical competency.[21] Not only are surgeons now trained to be more mindful about work–life balance and self-care due to the stressors of daily practice, but the challenges associated with COVID-19 may have provided an environment to allow for enriching experience shared among acute care surgeons that tempered and mitigated the stress associated with the novel virus. Furthermore, as clinical practices evolved with increasing knowledge on how best to manage patients with COVID-19, self-perceived clinical competency most likely increased, potentially leading to lower levels of stress when our survey was administered than when the idea was conceived of after the initial New York City wave in 2020.

The respondent's physical location was perhaps a protective factor from PTSD symptomology for those practicing at academic and urban hospital centers. Presumably, this could be due to both the availability of resources and surge capabilities present at these larger institutions. In contrast, rural and suburban settings were likely to have experienced limited resources and supplies, reducing the capacity to respond robustly. The disruption of research endeavors and associated reduced productivity were of significant concern for many. This was similarly reported by Delaney *et al.* in a survey of surgical residents and attendings who expressed concerns for decreased career advancement due to the COVID-19 pandemic,[22] a sentiment echoed in some of the free-text responses to questions in this survey.

Other collateral challenges created by the pandemic range from the sudden change in work structure to cessation of elective procedures, increased workload, and disruption of hospital services including provision of trauma care, all of which impact acute care surgeons greatly.[23-25] Although current literature touches on the personal impact and increased stress due to disruption of surgical services, there is little mention of the financial impact the pandemic has had on surgeons. Not only did respondents report personal financial losses, but this was further expounded on within free-text comments, with multiple reports of essential personnel losses reducing adequate support for trauma and surgical services.

In some instances, respondents described the loss of entire private practices, loan repayments mandating remittance regardless of income loss, staff layoffs across departments, and failure of hospital infrastructure due to financial difficulties resulting in hospitals being unable to provide prepandemic levels (i.e., usual) care. For some respondents, their critical care services were not required, and patients with COVID-19 were primarily managed by medical services. For others, with the cessation of elective surgeries, there were concurrent personnel losses from the surgical department that were reassigned to manage patients with COVID-19, ultimately resulting in the loss of support staff for trauma and emergency general surgery. Thus, the increased stress among

Table 2 – Multivariable regression modeling on PCL-6 score and odds of PCL-6 score ≥14.

Variable	Linear regression (↑ PCL-C Score)			Logistic regression (↑ odds PCL-6 score ≥14)		
	Estimates	CI	P	Odds ratios	CI	P
Age	−0.05	−0.10 to −0.00	**0.031**	0.96	0.92 to 1.00	**0.034**
Relationship status (unmarried)	1.13	−0.04 to 2.30	0.058	2.17	0.94 to 4.90	0.065
Practice setting (urban)	-	-	-	-	-	-
Suburban	0.62	−0.47 to 1.70	0.265	2.68	1.19 to 6.01	**0.016**
Rural	2.94	1.35 to 4.53	**0.001**	5.24	1.87 to 14.53	**0.001**
Region (Northeast)	-	-	-	-	-	-
South	−0.90	−2.01 to 0.22	0.115	-	-	-
Midwest	−0.99	−2.21 to 0.23	0.112	-	-	-
West	0.48	−1.00 to 1.95	0.526	-	-	-
Increased administrative duties (Yes)	1.47	0.56 to 2.37	**0.002**	2.16	1.07 to 4.50	**0.035**
Increased ICU coverage (Yes)	-	-	-	1.73	0.87 to 3.49	0.119
Elective case cancellation (Yes)	-	-	-	2.11	1.02 to 4.41	**0.044**
Bonus withheld/lost (Yes)	1.18	0.21 to 2.14	**0.017**	2.22	1.06 to 4.69	**0.035**
Loss of academic conferences (No)	-	-	-	1.79	0.81 to 3.97	0.148
Novel COVID-19 research (Yes)	−0.87	−1.93 to 0.19	0.109	0.50	0.20 to 1.16	0.120
Research productivity (no research)	-	-	-	-	-	-
Increase	−0.15	−2.38 to 2.08	0.897	0.00	NA to $1.6e^{23}$	0.988
Decrease	1.52	0.53 to 2.50	**0.003**	2.82	1.32 to 6.20	**0.008**
COVID-19 illness risk (Likely)	-	-	-	-	-	-
Neutral	−1.67	−3.02 to −0.32	**0.015**	-	-	-
Unlikely	−2.07	−3.49 to −0.64	**0.005**	-	-	-
COVID-19 death risk (Likely)	-	-	-	-	-	-
Neutral	0.01	−1.98 to 2.00	0.993	1.12	0.34 to 4.09	0.855
Unlikely	−1.99	−4.06 to 0.08	0.059	0.34	0.10 to 1.18	0.076

Results from stepwise regression modeling examining factors contributing to increasing PCL-6 score (linear regression, left) and odds of scoring ≥14 on the PCL-6 (logistic regression, right). The reference level for each factor is in parentheses next to the variable for two-level factors and on its own line for factors with three or more levels. All variables remaining in the models are presented, with *P* values for significant predictors in bold. The adjusted R^2 for the linear model is 0.225 and 0.211 for the logistic model.

respondents may reflect the frustration of not being able to provide adequate patient care despite minimal concerns for personally contracting COVID-19.

There are several limitations to the present study. First, the overall response rate is low at 17.8%, which limits the ability to extrapolate survey findings. Furthermore, the survey was distributed from September to December 2020, which was after the initial peak of the pandemic and just before COVID-19 vaccination being widely available. At that time, only a few epicenters in the United States had been severely impacted by the pandemic, whereas other parts of the country would not be affected until later periods. As such, responses may vary regionally due to differing infection and hospitalization rates at the time of this survey, and potential participants may not have felt inclined to respond if the pandemic had not yet affected their community. Furthermore, this study did not provide definitions of demographic factors, and thus, responses may have differed if respondents miscategorized the responses. And although prior studies show less stress among surgeons while caring for patients with COVID-19,[20] the lack of difference in PTSD in our population may not be due to better resiliency but factors that this study could not identify and sample size too small to detect a meaningful difference.

As the pandemic continues, attending sentiment and their responses can evolve over time, resulting in the factors identified from this study as contributing to stress and PTSD symptomology no longer being as relevant as they were at the time of this study. Despite the low response rate, limited PPE availability, and a vaccine not being widely available at the time, the stressors for acute care surgeons were not directly related to infectious concerns. It is unlikely this would change once vaccinations became widely available.

Conclusions

In summary, the rate of PTSD symptoms was not increased among acute care surgeons at the initial phase of the pandemic. Identifying the factors that increase stress or mitigate stress will help to focus mitigation efforts and to maintain a strong, healthy workforce.

Supplementary Materials

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jss.2022.10.065.

Author Contributions

J.Y.V., R.J.R., M.K.J., K.M., and T.J.E. were all involved in the concept and design of the study. R.J.R. implemented the survey and performed the primary data analysis. M.K.J. scored the PCL-6 survey responses. J.Y.V. wrote the manuscript. R.J.R., M.K.J., T.J.E., and K.M. revised the article. All authors made substantial contributions that warranted authorship.

Disclosure

None declared.

Funding

None.

Meeting Presentation

Portions of this research were presented as a Quickshot Presentation at the 2022 Academic Surgical Congress held in Orlando, FL. The results were presented on February 1, 2022, as part of *Session 11 - Clinical/Outcomes: Trauma/Critical Care Quickshot Session I* (*Abstract ID*: ASC20220455).

REFERENCES

1. Wu Y, Ho W, Huan Y, et al. SARS-CoV-2 is an appropriate name for the new coronavirus. *Lancet*. 2020;395:949–950.
2. Søreide K, Hallet J, Matthews JB, et al. Immediate and long-term impact of the COVID-19 pandemic on delivery of surgical services. *Br J Surg*. 2020;107:1250–1261.
3. Barach P, Fisher SD, Adams MJ, et al. Disruption of healthcare: will the COVID pandemic worsen non-COVID outcomes and disease outbreaks? *Prog Pediatr Cardiol*. 2020;59:101254.
4. Lai J, Ma S, Wang Y. Factors associated with mental health outcomes among health care workers exposed to Coronavirus Disease 2019. *JAMA Netw Open*. 2020;3:e203976.
5. Sung C-W, Chen C-H, Fan C-Y, et al. *Burnout in medical staffs during a coronavirus disease (COVID-19) pandemic*. SSRN Electron J; 2020. Available at SSRN 3594567.
6. Ross SW, Lauer CW, Miles WS, et al. Maximizing the calm before the storm: tiered surgical response plan for novel coronavirus (COVID-19). *J Am Coll Surg*. 2020;230:1080–1091.e3.
7. Klein MJ, Frangos SG, Krowsoski L, et al. Acute care surgeons' response to the COVID-19 pandemic: observations and strategies from the epicenter of the American crisis. *Ann Surg*. 2020;272:e66–e71.
8. Joseph B, Pandit V, Hadeed G, et al. Unveiling posttraumatic stress disorder in trauma surgeons: a national survey. *J Trauma Acute Care Surg*. 2014;77:148–154.
9. Jackson T, Provencio A, Bentley-Kumar K, et al. PTSD and surgical residents: everybody hurts… sometimes. *Am J Surg*. 2017;214:1118–1124.
10. Jackson TN, Morgan JP, Jackson DL, et al. The crossroads of posttraumatic stress disorder and physician burnout: a national review of United States trauma and nontrauma surgeons. *Am Surg*. 2019;85:127–135.
11. Luftman K, Aydelotte J, Rix K, et al. PTSD in those who care for the injured. *Injury*. 2017;48:293–296.
12. Liu X, Kakade M, Fuller CJ, et al. Depression after exposure to stressful events: lessons learned from the severe acute respiratory syndrome epidemic. *Compr Psychiatry*. 2012;53:15–23.
13. Esterwood E, Saeed SA. Past epidemics, natural disasters, COVID19, and mental health: learning from history as we deal with the present and prepare for the future. *Psychiatr Q*. 2020;91:1121–1133.

14. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. 4th ed. Washington, DC: American Psychiatric Association; 2000.
15. Lang AJ, Stein MB. An abbreviated PTSD checklist for use as a screening instrument in primary care. *Behav Res Ther*. 2005;43:585–594.
16. Wilkins KC, Lang AJ, Norman SB. Synthesis of the psychometric properties of the PTSD checklist (PCL) military, civilian, and specific versions. *Depress Anxiety*. 2011;28:596–606.
17. Han B, Wong EC, Mao Z, Meredith LS, Cassells A, Tobin JN. Validation of a brief PTSD screener for underserved patients in federally qualified health centers. *Gen Hosp Psychiatry*. 2016;38:84–88.
18. R Core Team. R. R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria, 4.0.5. Available at: https://www.r-project.org/.
19. Mavroudis CL, Landau S, Brooks E, et al. The relationship between surgeon gender and stress during the Covid-19 pandemic. *Ann Surg*. 2021;273:625.
20. Huffman EM, Athanasiadis DI, Anton NE, et al. How resilient is your team? Exploring healthcare providers' well-being during the COVID-19 pandemic. *Am J Surg*. 2021;221:277–284.
21. Galaiya R, Kinross J, Arulampalam T. Factors associated with burnout syndrome in surgeons: a systematic review. *Ann R Coll Surg Engl*. 2020;102:401–407.
22. Delaney RK, Locke A, Pershing ML, et al. Experiences of a health system's faculty, staff, and trainees' career development, work culture, and childcare needs during the COVID-19 pandemic. *JAMA Netw Open*. 2021;4:e213997.
23. Balasubramanian A, Paleri V, Bennett R, Paleri V. Impact of COVID-19 on the mental health of surgeons and coping strategies. *Head Neck*. 2020;42:1638–1644.
24. Haut ER, Leeds IL, Livingston DH. The effect on trauma care secondary to the COVID-19 pandemic: collateral damage from diversion of resources. *Ann Surg*. 2020;272:e204.
25. Tan YQ, Wang Z, Yap QV, et al. Psychological health of surgeons in a time of COVID-19: a global survey. *Ann Surg*. 2021 [epub ahead of print].