Burnout and Stress Among US Surgery Residents: Psychological Distress and Resilience

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BACKGROUND: Burnout among physicians affects mental health, performance, and patient outcomes. Surgery residency is a high-risk time for burnout. We examined burnout and the psychological characteristics that can contribute to burnout vulnerability and resilience in a group of surgical trainees.

STUDY DESIGN: An online survey was distributed in September 2016 to all ACGME-accredited general surgery programs. Burnout was assessed with an abbreviated Maslach Burnout Inventory. Stress, anxiety, depression, resilience, mindfulness, and alcohol use were assessed and analyzed for prevalence. Odds ratios (ORs) were used to determine the magnitude of presumed risk and resilience factors.

RESULTS: Among 566 surgical residents who participated in the survey, prevalence of burnout was 69%, equally driven by emotional exhaustion and depersonalization. Perceived stress and distress symptoms (depression, suicidal ideation, and anxiety) were notably high across training levels, but improved during lab years. Higher burnout was associated with high stress (OR 7.8; $p < 0.0001$), depression (OR 4.8; $p < 0.0001$), and suicidal ideation (OR 5.7; $p < 0.0001$). In contrast, dispositional mindfulness was associated with lower risk of burnout (OR 0.24; $p < 0.0001$), stress (OR 0.15; $p < 0.0001$), anxiety (OR 0.21; $p < 0.0001$), suicidal ideation (OR 0.25; $p < 0.0001$), and depression (OR 0.26; $p = 0.0003$).

CONCLUSIONS: High levels of burnout, severe stress, and distress symptoms are experienced throughout general surgery training, with some improvement during lab years. In this cross-sectional study, trainees with burnout and high stress were at increased risk for depression and suicidal ideation. Higher dispositional mindfulness was associated with lower risk of burnout, severe stress, and distress symptoms, supporting the potential of mindfulness training to promote resilience during surgery residency. (J Am Coll Surg 2018;226:80–90. © 2017 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

Burnout, defined as a "prolonged response to chronic emotional and interpersonal stressors on the job," comprises emotional exhaustion, depersonalization, and diminished satisfaction with one's work,[1] and has been documented among front-line physicians since 1981.[2] Since then, burnout has been reported in medical students, trainees, and every medical specialty examined, including 69% of surgical residents[3] and 40% to 60% of practicing physicians.[4] The problem is growing; a recent national survey of US physicians reported an 8.9% increase in burnout between 2011 and 2014.[5]

Simultaneously, the relationship between physician burnout and performance deficits and the development of mental and physical illness is crystallizing. Burnout has been linked to diminished professionalism,[6] increased medical errors,[7-9] poorer patient outcomes,[10-13] and worse hospital economics.[14-17] In addition, burnout appears to be a surrogate measure of heightened distress among physicians. Although practicing surgeons are known to have

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nearly 3 times the alcohol misuse[18] and suicidal ideation[19] of the general population, the likelihood increases by 25% and 90%, respectively, when burnout exists. Similarly, the typically average risk of depressive symptoms among physicians increases by 170% when burnout is present.[20]

Despite global concern about burnout, relatively little is known about burnout causality or risk and resilience factors. It has been proposed that burnout, depression, and overwhelming stress exist in a spectrum, but the directionality is unclear.[21] Longitudinal data from practicing physicians suggest reciprocal causation between severe stress and emotional exhaustion,[21] and among medical students, high perceived stress increases vulnerability to burnout and decreases the likelihood of recovery.[22] In general, chronic or overwhelming stress in the absence of adequate coping skills is believed to promote psychological distress symptoms, such as depression,[23,24] suicidal ideation,[25] and substance abuse.[26] Collectively, these observations suggest a role for overwhelming stress in the genesis of burnout and distress sequelae seen in physicians. Dispositional mindfulness, that is, the innate ability to pay attention to one's thoughts, emotions, and experiences in a nonreactive way, has been shown to have a buffering effect against perceived stress and burnout among healthcare workers[27] and trainees.[28,29] To date, one study has examined burnout in a national sample of surgical trainees, exploring demographic factors and institutional elements associated with burnout risk.[3] Although it is imperative to understand the institutional factors contributing to this problem, recent meta-analyses suggest that interventions aimed at both institutional and individual factors might be required to arrest this alarming trend and guide necessary changes to the healthcare system as a whole.[30,31] Although an extensive body of literature exists on the prevalence of burnout throughout healthcare,[5,32] there is a paucity of information on causality. To our knowledge, no one has examined the role of intrinsic or psychological factors that might influence burnout in surgery residents on a national level, and doing so could provide targets to follow in future longitudinal studies of causality. In addition, although the prevalence of burnout and stress have been well-documented in surgery,[3,32-34] the extent of psychological distress in surgical trainees remains unknown.

To address these gaps, we conducted a cross-sectional study and examined associations of burnout with presumed risk and resilience factors. In so doing, we were guided by the following questions: First, in a sample of trainees who have purposefully selected the high-stress environment of surgery, do burnout and high perceived stress have the same strong association as seen in other populations? Second, among surgical trainees, how prevalent are distress symptoms (such as high anxiety, clinically relevant depression, suicidal ideation, and alcohol abuse), and what is their relationship to high stress and burnout? Lastly, are there modifiable psychological factors associated with lower risk of burnout, high stress, and distress symptoms in this population?

METHODS

All general surgery residents (clinical and lab years) enrolled in an ACGME-accredited general surgery training program were eligible to participate in the study. We obtained approval from the Association of Program Directors in Surgery and, in September 2016, the survey was sent to program directors of all 246 programs, along with an email message asking them to distribute the survey. The email also included a cover letter for the residents, asking for their voluntary participation, explaining the confidentiality of results, and providing a hyperlink to the survey. Three reminder emails were sent at 3-week intervals and the survey was closed at the end of November 2016. The IRB at University of California, San Francisco, reviewed and approved the study.

Because a recent national survey of burnout in the same population evaluated demographic factors comprehensively,[3] our 68-item survey included just 4 demographic questions: sex, level of training (PGY1 to 5 or lab), program type (academic, community, military, or mixed), and geographic region. Additional survey items were related to burnout, stress, state anxiety, trait resilience, dispositional mindfulness, depressive symptoms, and alcohol use. A write-in field gathered information on major life stressors of the last year.

Burnout

To measure burnout, we used the abbreviated, 9-item form of the Maslach Burnout Inventory-Human Services Survey, which has previously been used for burnout evaluation in physicians.[35] Response options used a 7-point Likert scale ranging from 0 to 6. Three subscales of burnout (emotional exhaustion, depersonalization, and personal accomplishment) are evaluated with this inventory and scored separately, as described previously.[3] Scores corresponding to high burnout have been empirically determined in healthcare workers,[35] and adjusted for use with this abbreviated form.[21,36] Per convention, we defined the presence of clinically relevant burnout as scoring high for emotional exhaustion or depersonalization.[22]

Perceived stress

To measure perceived stress, we used the 10-item form of Cohen's Perceived Stress Scale, a standardized and reliable scale designed to assess the degree to which situations in

life are perceived as stressful. The 10-item form of Cohen's Perceived Stress Scale has been shown to predict psychological and physiological symptoms, as well as the use of health services.[37,38] Various forms of the scale, considered psychometrically equivalent, have been widely used to study stress, including among physician trainees.[28,39] Response options used a 5-point Likert scale ranging from 0 to 4. A total score is calculated and compared with normative data of the general population. For working adult men and women the mean 10-item form of Cohen's Perceived Stress Scale score is 16.23 ± 7.31. Cronbach's α coefficient for internal reliability of the scale is 0.91.[38] A score ≥17 has been used as the cutoff for high stress in longitudinal studies of medical students.[22]

State anxiety

State anxiety was assessed using Spielberger's State Trait Anxiety Index state scale, which consists of 20 items with responses that use a 4-point Likert scale to evaluate how respondents feel "right now" about measures of subjective feeling (eg apprehension, tension) and autonomic arousal.[40] This scale has been used to assess anxiety in trainees both in real-life[41] and simulated[42] trauma scenarios. The internal consistency of Spielberger's State Trait Anxiety Index state scale has an α of 0.92. In a population of working adults (1,387 men and 451 women), the mean Spielberger State Anxiety Index is 35.7 ± 10.4. A score of ≥40 has been used as the cutoff for high anxiety in other studies.[43,44]

Symptoms of depression and suicidal ideation

Symptoms of depression and suicidal ideation were assessed using the 9-item form of the Patient Health Questionnaire, a self-report component of the Primary Care Evaluation of Mental Disorders inventory designed to screen for depressive symptoms and shown to be reliable with physicians.[45] Response options used a 4-point Likert scale ranging from 0 to 3 and a total score from 0 to 27 is calculated. Total scores are interpreted as representing symptoms of depression that are minimal 1 to 4; mild 5 to 9; moderate 10 to 14; moderately severe 15 to 19; and severe 20 to 27. A score of 10 or more has a positive likelihood ratio of 2.86, a 93% sensitivity, and an 88% specificity for diagnosing major depression.[45] Recent suicidal ideation was assessed by asking participants the single question, "In the last two weeks how often have you been bothered by thoughts that you would be better off dead or of harming yourself in some way?" Response to this question is included in the global score, but a positive response indicates the presence of recent suicidal ideation.[46,47]

Trait resilience

Trait resilience was assessed with the 10-item Block Ego-Resiliency Scale. Response options used a 4-point Likert scale ranging from 1 to 4. A global score is calculated, with higher scores indicating more resilience. This scale has been used in clinical and nonclinical populations, in longitudinal studies of children and youth, and in adults. This scale derives from Block's theory of ego-resilience as a trait with 2 components: ego-control and ego-resilience. The temporal stability of this construct was demonstrated in a 30-year longitudinal study.[48,49] The internal consistency of the 10-item Block Ego-Resiliency Scale has an α of 0.84.[50] In comparison with the Revised Connor-Davidson Resilience Scale, the 10-item Block Ego-Resiliency Scale is believed to be better at assessing the ability to adapt to changing environmental demands,[50] which is the facet of resilience we were most interested in for this cohort and context.[51] A score of ≥25 has been used as a cutoff for high resilience.[49]

Mindfulness

Mindfulness was assessed with the Cognitive Affective Mindfulness Scale-Revised, a 10-item scale reliable for use in populations without prior experience in mindfulness or mindfulness practices.[52] Response options used a 4-point Likert scale ranging from 1 to 4 and a global score is calculated. In a study of dispositional mindfulness in college students, the normative mean value was 31, with an overall α reliability of 0.7 to 0.74.[52] Scores ≥31 were considered to indicate high mindfulness. The Cognitive Affective Mindfulness Scale-Revised measures a mindfulness construct composed of 4 aspects of mindfulness (attention, present focus, awareness, and acceptance) and has been shown to have strong and significant correlations with the Mindfulness Attention Awareness Scale and the Freiburg Mindfulness Inventory, 2 other widely accepted measures of mindfulness.[27]

Alcohol use

Alcohol use was assessed using the 3-item Alcohol Use Disorders Identification Test, form C, a screening tool developed by the WHO and validated in multiple populations of men and women.[53-55] Response options use a 5-point Likert scale, ranging from 0 to 4, with a global score calculated from 0 to 12. A score ≥4 in men or ≥3 in women is considered positive for hazardous drinking (sensitivity 0.86 and 0.80, specificity 0.89 and 0.91, respectively), which is defined as drinking habits that put one at risk for physical or mental injury. Criteria include recurrent binge drinking (>6 drinks at once), heavy daily drinking, and (to a lesser extent) drinking >4 days per week. A score ≥5 for males or ≥4 in females

is considered positive for alcohol abuse, which is defined as drinking that causes physical and mental injury.[55]

Data management and analysis

Numerical scores were used to create continuous variables that allowed high burnout, high stress, and distress factors to be explored in relation to demographic variables of the study sample using analysis of covariance and regression. Binary categorical variables were used to create ORs to assess risk and associations of high burnout and stress with distress symptoms defined as the presence of suicidal ideation, clinically relevant (ie moderate to severe) depressive symptoms, high anxiety, and alcohol misuse or abuse (scoring details in Methods). Fisher's exact tests were used to compare categorical variables. Statistical significance was assessed at an α level of 0.05 and 95% CIs are shown. All computations were performed with SAS, version 9.4 (SAS Institute).

RESULTS

Of the 566 general surgery trainees who participated in the survey from September through November 2016, 51% were female and 76% came from an academic setting. These demographic characteristics are similar to those reported in the largest national survey of general surgery residents to date, the National Study of Expectations and Attitudes of Residents in Surgery.[56] The distribution of respondents by training level (PGY1 33%, PGY2 18%, PGY3 13%, PGY4 11%, PGY5 12%, and lab 12%) was similar to that reported in other studies of this population.[3,56]

Associations among Burnout, Sex, Training Year, and Resilience

For associations among burnout, sex, training year, and resilience factors, Table 1 shows that emotional exhaustion was equally prevalent in women and men, but that depersonalization was significantly more prevalent in men (62% vs 51% in women, chi-square 6.2499; $p = 0.01$). Emotional exhaustion was significantly higher in PGY2s and significantly lower in lab residents. There were no other statistically significant differences in burnout levels across training years. Presumed resilience factors (dispositional mindfulness or resilience) were not significantly associated with sex or training level.

For associations among stress, distress, sex, and training level, we found no significant relationship between sex and the prevalence of high stress, but did find that alcohol misuse and alcohol abuse were more prevalent in women (58% and 41% vs 40% and 26% for men; $p = 0.0002$ and $p = 0.0008$, respectively). Postgraduate year 3 was notable for the prevalence of high stress and distress symptoms (58% high stress, 32% moderate to severe depressive symptoms, 16% suicidal ideation, 50% high anxiety, and 61% alcohol misuse), yet for the most part, the prevalence of these factors did not differ significantly across training levels (Table 2). There were some exceptions: scores for high stress and high anxiety were significantly lower in the lab, and scores for alcohol misuse were significantly higher in the lab and in PGY3 compared with other training levels (Table 2).

Burnout, stress, and distress compared with general population and practicing surgeons

Within this national cohort, burnout prevalence was equally driven by emotional exhaustion and depersonalization, with the lack of personal accomplishment barely present (Table 3). Total burnout prevalence (68.95%) was equivalent to that found in other recent studies of the same population.[3] Almost half of the cohort (42%) scored high for burnout in 2 subscales. More than half of the cohort (53%) scored positive for high stress compared with normative data from the general population.[38] Moderate to severe depressive symptoms (20%) were 2 times more prevalent than reported in age-matched peers (9.5%).[46] The prevalence of suicidal ideation (11%) was more than 3 times higher than reported in the general population (3%)[46] and nearly 2 times higher than reported in practicing surgeons (6%).[19] Of note, the prevalence of alcohol misuse (49%) was more than 5 times greater than in the general population (9%).[18] Alcohol abuse or dependence (33%) was 2 times more prevalent than in practicing surgeons (16%).[18] More than one-third (35.4%) of the cohort scored high in dispositional mindfulness, and the vast majority (93.8%) scored high in trait resilience (Table 3).

Association between risk and resilience

The presence of high stress was strongly associated with both the presence of high emotional exhaustion and the presence of high depersonalization (Table 4). The presence of high emotional exhaustion, high depersonalization, and high stress were each strongly associated with increased risk of moderate to severe depressive symptoms, suicidal ideation, and high anxiety. High emotional exhaustion, high depersonalization, and high stress were not significantly associated with an increased risk of alcohol misuse or abuse (Table 4).

Greater dispositional mindfulness and greater trait resilience were each significantly associated with a decreased risk of burnout from high emotional exhaustion, high depersonalization, or low personal accomplishment. Greater dispositional mindfulness and greater trait

Table 1. Demographic Characteristics of Study Sample and Association with Burnout, Stress, Distress, and Presumed Resilience Factors

Subgroup	Total	Emotional exhaustion*	Depersonalization†	Perceived stress‡	Depression§	Suicidal ideation‖	Anxiety¶	Alcohol misuse#	Alcohol abuse**	Mindfulness††	Resilience‡‡
Sex§§											
Female	286 (50.89)	127 (52.70)	122 (50.62)	144 (54.34)	46 (19.33)	25 (10.50)	100 (46.30)	138 (57.98)	97 (40.76)	91 (31.93)	267 (93.36)
Male	276 (49.11)	132 (59.46)	138 (62.16)	125 (52.08)	45 (20.36)	26 (11.76)	82 (42.49)	89 (40.27)	57 (25.79)	104 (38.81)	260 (94.55)
p Value‖‖		0.1601	0.0148	0.6554	0.8153	0.7666	0.4856	0.0002	0.0008	0.1089	0.5987
Level of clinical training¶¶											
Intern	188 (33.33)	87 (54.38)	80 (50.00)	101 (57.71)	28 (17.61)	17 (10.69)	73 (50.69)	66 (41.25)	45 (28.13)	65 (34.95)	180 (95.74)
PGY2	104 (18.44)	55 (67.90)	54 (66.67)	51 (56.67)	18 (22.78)	9 (11.39)	32 (45.71)	45 (56.96)	28 (35.44)	32 (31.07)	96 (92.31)
PGY3	74 (13.12)	38 (60.32)	40 (63.49)	39 (58.21)	20 (32.26)	10 (16.13)	28 (50.91)	38 (61.29)	23 (37.10)	24 (32.88)	68 (93.15)
PGY4	62 (10.99)	26 (53.06)	27 (55.10)	28 (49.12)	8 (16.33)	4 (8.16)	18 (40.00)	21 (42.86)	16 (32.65)	20 (33.33)	56 (90.32)
PGY5	70 (12.41)	32 (55.17)	34 (58.62)	33 (55.00)	11 (19.30)	6 (10.53)	20 (41.67)	24 (42.11)	19 (33.33)	29 (42.65)	68 (97.14)
Lab	66 (11.70)	22 (40.00)	26 (47.27)	19 (32.20)	6 (10.91)	5 (9.09)	12 (24.49)	33 (61.11)	23 (42.59)	26 (40.00)	60 (90.91)
p Value‖‖		0.0474	0.0944	0.0191	0.0709	0.8102	0.0392	0.0119	0.4705	0.6474	0.3870

Values n (%) unless otherwise noted.
*High if score ≥9 on Abbreviated Maslach Burnout Inventory (aMBI).
†High if score ≥6 on aMBI.
‡High if score ≥17 on Cohen's Perceived Stress Scale.
§Moderate to severe depression if score ≥10 on 9-item Patient Health Questionnaire (PHQ-9).
‖Exists if score >0 to single item on PHQ-9.
¶High if score ≥40 on Spielberger State Anxiety Index.
#High if score ≥3 (females) or ≥4 (males) on Alcohol Use Disorders Identification Test, form C (AUDIT-C).
**High if score ≥4 (females) or ≥5 (males) on AUDIT-C.
††High if score ≥31 on Cognitive Affective Mindfulness Score-Revised.
‡‡High if score ≥25 on Block Ego-Resiliency Scale.
§§Missing data, n = 4.
‖‖p Values indicate whether a factor differs significantly by sex and/or level of clinical training.
¶¶Missing data, n = 2.

Table 2. Percentages of High Scores for Study Variables Significantly Associated with Training Year

Factor	Intern	PGY2	PGY3	PGY4	PGY5	Lab	p Value
Emotional exhaustion	54.38	67.90	60.32	53.06	55.17	40.00	0.0474
High stress	57.71	56.67	58.21	49.12	55.00	32.20	0.0191
High anxiety	50.69	45.71	50.91	40.00	41.67	24.49	0.0392
Alcohol misuse	41.25	56.96	61.29	42.86	42.11	61.11	0.0119

Values are percentages unless otherwise noted.

resilience were also each significantly associated with a decreased risk of moderate to severe depressive symptoms, suicidal ideation, and high anxiety. Greater dispositional mindfulness was associated with an 85% decrease in the risk of high stress and greater trait resilience was associated with a 65% decrease in the risk of high stress (Table 5).

DISCUSSION

Overwhelming stress, in the absence of adequate coping skills, has been proposed to have a critical relationship to burnout, although the direction of causality is not clear.[21,35,57] Overwhelming stress has also been shown to precipitate or exacerbate symptoms of distress in clinical and nonclinical populations.[23-26] Surgical trainees have purposefully chosen a field with high baseline stress by definition, presumably due in part to the widely held belief among surgeons that not all stress is bad. Although burnout among surgical residents is known to be high,[3] it is unclear if stress and distress have the same strong associations with burnout as seen in other groups. In addition, to our knowledge, psychological traits that might influence burnout, stress, and distress have not been evaluated among surgical trainees on a national level. To address these gaps, we surveyed a national sample of US general surgery residents and evaluated the relationship between high stress and burnout, the prevalence of associated distress symptoms, and the presence of potentially modifiable individual characteristics that can contribute to risk and resilience.

Three key findings emerged from our study. First, even among surgical trainees who have willingly chosen a high-stress career, overwhelming stress exists, as evidenced by

Table 3. Proportion of Respondents Who Scored Positive for Burnout, Stress, Distress, and Presumed Resilience Factors

Factor	n	%	Lower CI, %	Upper CI, %
Total burnout*	322	68.95	64.76	73.14
Emotional exhaustion†	260	55.79	51.28	60.30
Depersonalization‡	261	56.01	51.50	60.52
Lack of personal accomplishment§	5	1.07	0.13	2.01
Burnout 2 subscale‖	196	41.97	37.66	46.28
Burnout 3 subscale¶	4	0.86	0.10	1.62
High stress#	271	53.24	48.91	57.57
High anxiety**	183	44.53	39.73	49.33
Depressed††	91	19.74	16.11	23.37
Suicidal ideation‡‡	51	11.06	8.20	13.92
Alcohol misuse§§	227	49.24	44.67	53.81
Alcohol abuse‖‖	154	33.41	29.10	37.72
Mindfulness¶¶	197	35.37	31.39	39.35
Resilience##	530	93.81	91.83	95.79

*High if at least 1 of emotional exhaustion, depersonalization, or lack of personal accomplishment is high.
†High if score ≥9 on Abbreviated Maslach Burnout Inventory (aMBI).
‡High if score ≥6 on aMBI.
§High if score >12.
‖High if 2 (only) of emotional exhaustion, depersonalization, or lack of personal accomplishment are high.
¶High if all 3 of emotional exhaustion, depersonalization, or lack of personal accomplishment are high.
#High if score ≥17 on Cohen's Perceived Stress Scale.
**High if score ≥40 on Spielberger State Anxiety Index.
††Moderate to severe depression if score ≥10 on 9-item Patient Health Questionnaire (PHQ-9).
‡‡Exists if score >0 to single item on PHQ-9.
§§High if score ≥3 (females) or ≥4 (males) on Alcohol Use Disorders Identification Test, form C (AUDIT-C).
‖‖High if score ≥4 (females) or ≥5 (males) on AUDIT-C.
¶¶High if score ≥31 on Cognitive Affective Mindfulness Score-Revised.
##High if score ≥25 on Block Ego-Resiliency Scale.

Table 4. Odds Ratios of Distress Factors with High Burnout and Stress

	Emotional exhaustion		Depersonalization		Stress	
Factor	**OR**	**p Value**	**OR**	**p Value**	**OR**	**p Value**
High stress	7.7519	<0.0001	2.8812	<0.0001	—	—
High anxiety	7.2490	<0.0001	2.9767	<0.0001	18.5500	<0.0001
Moderate to severe depression	4.8163	<0.0001	2.3557	0.0009	10.2865	<0.0001
Suicidal ideation	5.7840	<0.0001	2.1827	0.0165	9.8505	<0.0001
Alcohol misuse	0.9618	0.8513	1.3980	0.0899	0.9949	1.0000
Alcohol abuse	1.1621	0.4864	1.4230	0.0901	1.1025	0.6924

OR, odds ratio.

the strong association between higher relative stress and burnout. Second, a toxic threshold of stress seems to exist, as evidenced by the remarkably high prevalence of distress symptoms and the dramatic increase in risk when high stress is present. Third, dispositional mindfulness can be a potentially modifiable personal characteristic that confers resilience to stress, as evidenced by the association of greater dispositional mindfulness with a substantially lower risk of experiencing high stress, burnout, and distress symptoms across this cohort.

Our first finding, that stress can be overwhelming even among surgical trainees, is supported by our observation that higher perceived stress in this cohort is associated with a multifold increased risk of burnout. Evidence linking higher perceived stress and burnout comes from longitudinal studies of practicing physicians,[21] healthcare workers,[35] and medical students.[22] Respectively, these studies showed reciprocal causation between higher stress and emotional exhaustion, that perceived high stress is a central element in the development of burnout, and that higher stress increases vulnerability to burnout and decreases the odds of recovery from burnout. Although our finding of a relationship between stress and burnout in surgical residents is not surprising, explicitly demonstrating this relationship is important. If higher stress is associated with increased risk of burnout in surgical trainees, and burnout is associated with diminished mental health and performance, then addressing stress and burnout among our trainees should be a priority. Relatedly, interventions in other populations that have successfully addressed burnout through mitigating stress might show efficacy here.

Our second finding, that distress symptoms are highly prevalent in this population, is evidenced by our results that moderate to severe depression, suicidal ideation, high state anxiety, and alcohol misuse or abuse are more prevalent in trainees at every level than in both the general population and practicing surgeons. In addition, these distress symptoms (with the interesting exception of alcohol misuse and abuse) have the highest likelihood of occurring in the presence of higher stress, supporting the idea that stress can become toxic in this population.

Decades of work in animals and humans have shown that stress is a double-edged sword, with the dose-response relationship between stress and performance described as "an inverted U-shaped curve."[23] Although stress is initially stimulating, there is a tipping point when demands outstrip resources and stress becomes overwhelming.[58,59] In the absence of adequate coping skills, overwhelming stress has been associated with

Table 5. Odds Ratios of High Dispositional Mindfulness and High Trait Resilience with Burnout, Stress, and Distress Symptoms

	Mindfulness				Resilience			
Factor	**OR**	**Lower CI**	**Upper CI**	**p Value**	**OR**	**Lower CI**	**Upper CI**	**p Value**
Emotional exhaustion	0.2425	0.1588	0.3696	<0.0001	0.2950	0.0969	0.7616	0.0070
Depersonalization	0.2938	0.1938	0.4447	<0.0001	0.2360	0.0694	0.6450	0.0019
Lack of personal accomplishment	0.0000	0.0000	0.1653	1.0000	0.2679	0.0255	13.6434	0.2836
High stress	0.1526	0.1009	0.2307	<0.0001	0.3580	0.2577	0.8128	0.0261
High anxiety	0.2105	0.1332	0.3328	<0.0001	0.1560	0.0581	0.4190	<0.0001
Moderate to severe depression	0.2625	0.1432	0.5750	<0.0001	0.2486	0.1164	0.5307	0.0005
Suicidal ideation	0.2527	0.1111	0.4812	0.0003	0.1264	0.0571	0.2801	<0.0001
Alcohol misuse	1.0220	0.6982	1.4961	0.9228	0.8392	0.3997	1.7619	0.7077
Alcohol abuse	0.8707	0.5797	1.3078	0.5374	0.7370	0.3455	1.5721	0.4293

OR, odds ratio.

cognitive impairment,[60-62] mental illness,[23,24] and physiologic deterioration.[63]

Demonstrating the prevalence of distress symptoms and their relationship to stress in surgical training is critical. There is a widespread perception within surgical culture that stress is a positive element that advances mastery in individuals with the right disposition. Our findings underscore that purposefully joining a high-stress culture, and naturally thriving on challenge, does not make individuals immune to the effects of overwhelming stress. This is particularly critical to drive home in light of the 11% suicidal ideation rate found in our cohort. National studies show that approximately one-third of people with suicidal ideation will make a suicide plan and nearly three-fourths of those with a plan will attempt suicide.[46] Without diluting the seriousness of our findings, we also note that distress in this cohort is not universal. This suggests there are coping mechanisms that some trainees use to effectively mitigate the negative effects of stress and burnout.

Our third finding, that individuals with higher dispositional mindfulness had significantly decreased risk of burnout, stress, and distress symptoms, is supported by our observation that the risk of emotional exhaustion, depersonalization, suicidal ideation, moderate to severe depression, high stress, and high anxiety is significantly lower in those with higher dispositional mindfulness. Substantial evidence supports the existence of various personality characteristics that enhance resilience or mitigate burnout among physicians and trainees.[64-67] Similarly, our data show that higher trait resilience correlates with less stress, less distress, and lower burnout risk. Although interesting, it is difficult to translate "resilience" into an intervention because, by many definitions, resilience is a phenotype or attribute derived from complex life experiences.[68,69] This same hurdle is faced for the practical application of studies showing that emotional intelligence,[64] grit,[65] or positive affect[65,66] reduces the risk of burnout and stress. How does one teach such things?

It has been proposed that a central cognitive characteristic in the resilient phenotype is mindfulness[70,71] and, indeed, in our study population, we found that the presence of higher dispositional mindfulness provided risk-reducing benefits equivalent to, or better than, those found with higher trait resilience. This is particularly striking because although mindfulness can be dispositional or inherent, it can also be taught. Therefore, our findings suggest that mindfulness training can be a promising stress-resilience intervention for this high-stress and high-performance group.

Our study has several limitations. First, like most studies examining burnout to date, our cross-sectional survey is limited by design and we cannot infer protection or causality from the associations found. Second, our response rate is approximately 10%, based on the total number of general surgery residents believed to be in ACGME-accredited programs in the US. Our survey was distributed through the Association for Program Directors, and although it was sent to all ACGME-accredited general surgery training programs in the US, we have no way of knowing how many of those programs distributed the survey to their residents. Therefore, our response rate might be much higher, depending on the number of actual recipients. Selection bias should be kept in mind when interpreting our results. In the future, linking such a survey to an annual mandatory event like the American Board of Surgery In-Training Examination or ACGME program evaluation could provide response rates and data truly representative of the whole national general surgery cohort. Second, our study was timed in the second quarter of the academic year, which we hoped would capture residents after the novelty of new roles had worn off, but before reported third- and fourth-quarter decrements in mood and empathy can occur.[72] Whether such timing biases results is unknown, but again should be considered in interpreting our findings.

Our study yielded several surprising results. First, there were some important differences between our findings and those from the first national study of burnout in general surgery trainees,[3] despite the overall similarity between study cohorts. Although emotional exhaustion and depersonalization predominate in both studies, we found >10-fold less burnout in the subdomain of personal accomplishment (1.07% vs 16%). Although this might be because we included residents in lab/research years (widely thought to be a time of very high productivity), it is more likely due to our use of an abbreviated (9-item) form of the Maslach Burnout Inventory-Human Services Survey. Although the abbreviated (9-item) form has been used reliably among physicians,[21,36] it only contains 3 of the 8 personal accomplishment items found in the original Maslach Burnout Inventory-Human Services Survey. The potential error in our data would be one of under-reporting, but in a subdomain that many have suggested is less meaningful among highly productive physicians.[73,74]

Second, and also in contrast to Elmore and colleagues,[3] we found emotional exhaustion to be equivalent between the sexes, but depersonalization to be significantly higher among males. Interestingly, high burnout is often reported as being equally prevalent between sexes[3,75] or more prevalent in females,[76-78] but very few studies break this assignation down to component parts. Across specialties, very few studies have analyzed the relationship between sex and burnout,[67,75,79] and even fewer have analyzed the relationship between sex and burnout

subscales. Our finding of higher depersonalization among males is not unprecedented,[80] but does deserve additional investigation.

In summary, burnout is a growing problem with negative sequelae that affect physician well-being and performance, the institutional climate, hospital economics, and patient outcomes. Although a strong association between burnout and stress is known, our finding that this relationship is reiterated in surgical trainees, and that surgical trainees with higher stress and burnout manifest profound distress symptoms, makes it clear that this population is not immune to stress, regardless of their remarkable capability and endurance.

A problem with such broad ramifications that affects such a highly resilient population surely merits recourse aimed at both individuals and institutions. Nevertheless, an impassioned argument has arisen about who is responsible for "fixing" the current situation, with the implication that individually based interventions effectively blame the victims. Certainly, perceived weakness among physicians carries significant stigma and, in general, psychological health is still culturally seen as a static character trait rather than a skill to be developed.[81,82] Ironically, this results in physicians who are technical and intellectual experts with little or no formal preparation for the inherent stressors of their work.[83] We propose that stress prophylaxis and intervention should be as commonplace as quality improvement initiatives and pursued in the same global manner. Proactive techniques to promote psychological health should be included in the standard training of physicians, and institutional changes that promote a healthy work environment should happen concomitantly. Evidence that such joint cultural shifts are possible comes from the US Army which, in response to the psychological devastation of soldiers returning from the Middle-East conflict, developed an evidence-based mental training program for incoming recruits in cooperation with the University of Pennsylvania.[84,85] Over time, this training has filtered outward and upward to include noncommissioned officers and even top brass.[86] When such a cultural shift draws on the natural strengths of individuals, teaches practical skills to address real-life issues, and is supported by multi-tiered institutional change, it is bound to succeed.

In this context, our finding that dispositional mindfulness reduces the risk of overwhelming stress, burnout, and distress symptoms in surgical trainees provides the first evidence of a trainable, individual asset that enhances stress resilience in this population. Although mindfulness-based interventions have shown mixed effectiveness in other branches of medicine and healthcare, they have not been tried in surgeons, due in part to a seeming disconnect between surgical culture and contemplative practices.

CONCLUSIONS

Our findings demonstrate that inherent mindfulness is already in use to combat stress and burnout in surgical trainees and, more importantly, it appears to work. Based on this evidence, mindfulness training can be a critical component of any intervention aimed at enhancing stress resilience and preventing or treating burnout in surgical trainees.

Author Contributions

Study conception and design: Lebares, Ascher, O'Sullivan, Harris, Epel
Acquisition of data: Lebares, Guvva
Analysis and interpretation of data: Lebares, Epel
Drafting of manuscript: Lebares, Guvva, Ascher, O'Sullivan, Harris
Critical revision: Lebares, Epel

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