The Prevalence of Burnout Among US Neurosurgery Residents

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BACKGROUND: Burnout is a syndrome of emotional exhaustion, depersonalization, and reduced personal accomplishment. Its prevalence among US physicians exceeds 50% and is higher among residents/fellows. This is important to the practice of neurosurgery, as burnout is associated with adverse physical health, increased risk of substance abuse, and increased medical errors. To date, no study has specifically addressed the prevalence of burnout among neurosurgery residents.

OBJECTIVE: To determine and compare the prevalence of burnout among US neurosurgery residents with published rates for residents/fellows and practicing physicians from other specialties.

METHODS: We surveyed 106 US neurosurgery residency training programs to perform a descriptive analysis of the prevalence of burnout among residents. Data on burnout among control groups were used to perform a cross-sectional analysis. Nonparametric tests assessed differences in burnout scores among neurosurgery residents, and the 2-tailed Fisher's exact test assessed burnout between neurosurgery residents and control populations.

RESULTS: Of approximately 1200 US neurosurgery residents, 255 (21.3%) responded. The prevalence of burnout was 36.5% (95% confidence interval: 30.6%-42.7%). There was no significant difference in median burnout scores between gender ($P = .836$), age ($P = .183$), or postgraduate year ($P = .963$) among neurosurgery residents. Neurosurgery residents had a significantly lower prevalence of burnout (36.5%) than other residents/fellows (60.0%; $P < .001$), early career physicians (51.3%; $P < .001$), and practicing physicians (53.5%; $P < .001$).

CONCLUSION: Neurosurgery residents have a significantly lower prevalence of burnout than other residents/fellows and practicing physicians. The underlying causes for these findings were not assessed and are likely multifactorial. Future studies should address possible causes of these findings.

KEY WORDS: Burnout, Neurosurgery, Residency, Surveys

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Burnout is described as the psychological syndrome of emotional exhaustion (EE, overload and personal conflict), depersonalization (DP, dehumanization), and reduced personal accomplishment (PA, decreased feelings of competence and productivity) pertaining to workplace experiences.[1] Public service professions, such as teaching or caregiving, are susceptible to creating a situational context that leads to burnout.[2] The costs of burnout in medicine include negative effects on a physician's psychological and physical health. Physician burnout may also affect individuals within the physician's job environment.[3] In addition, burnout impairs interpersonal relationships and increases the risk of alcohol and substance abuse. Burnout may contribute to an increase in the rate of medical errors among both resident and attending physicians.[4-7]

More than half of US physicians experience burnout, with a noted increase in the prevalence from 45.5% in 2011 to 54.4% in 2014.[8] In

ABBREVIATIONS: aMBI, abbreviated Maslach Burnout Inventory; **CI,** confidence interval; **DP,** depersonalization; **EE,** emotional exhaustion; **PA,** personal accomplishment; **PGY,** postgraduate year

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comparison, the prevalence of burnout within the general US working population in 2014 was 28.4%.[8] Within surgical specialties as a whole, the prevalence of burnout is 40%.[9] For neurosurgery in particular, the prevalence of burnout is estimated to be 27% to 56.7%, which is among the highest rates of all surgical subspecialties.[10,11]

Although attending surgeons report high rates of burnout, single-institution studies of surgical residents demonstrate even higher rates.[12] Residents are especially susceptible to burnout. The residents' work environment includes a high level of responsibility coupled with a low level of control, which puts them at risk for experiencing role ambiguity or overload.[13] General factors that further increase the risk of burnout among medical and surgical residents include being of relatively younger age and being near the beginning of one's overall training and career.[3] Furthermore, recognition and management of burnout is neglected in most traditional medical educational programs. Current published studies pertaining to burnout in residents address broad groups of medical or surgical residents; however, no study has specifically addressed burnout among neurosurgery residents.

The purpose of this study is to determine the prevalence of burnout among neurosurgery residents and assess the relationship between certain demographics and burnout. In addition, a cross-sectional analysis compares the burnout scores of neurosurgery residents with the residents of other specialties and practicing physicians. We hypothesized that the intense demands of neurosurgical residency lead to higher rates of burnout among neurosurgery residents. We present results from a national survey to determine the prevalence of burnout among US neurosurgical residents.

METHODS

Participants

Neurosurgery Resident Sample

All current trainees (~1200 individuals) of an accredited US neurosurgery residency program were eligible for inclusion in the study. Contact information for program directors and program coordinators for the 106 US neurosurgery residency training programs was obtained from the Society of Neurological Surgeons website (https://www.societyns.org/match_information.html). A canvassing email was sent to all 106 program directors in October 2016 describing the purpose of the study, along with a link to the study survey. Program directors were asked to forward the survey to their respective residents. A follow-up request was sent to the program directors 2 wk after the initial request and a third follow-up request was sent to the program coordinators 4 wk after the initial request. Responses were collected for 2 mo from the initial request. In an effort to diminish voluntary response bias, survey responses were collected anonymously and did not included individually identifiable data. Survey responses with missing data were excluded from analysis. Institutional review board approval was not required as there was no human research involved in this study.

Control Populations

The neurosurgery resident sample was compared to previously published data on burnout rates among residents/fellows, early career physicians (<5 yr of practice), and practicing physicians from all specialties. The control data for the resident/fellow and early career physician populations were obtained from the study by Dyrbye et al,[14] which surveyed 1701 residents/fellows (22.5% response rate) and 880 early career physicians (26.7% response rate) in 2011. Data for practicing physicians were obtained from the study by Shanafelt et al,[8] which in 2015 surveyed 6880 practicing physicians (19.2% response rate) from all specialties using the American Medical Association Physician Master File. Both studies assessed burnout via the 22-item Maslach Burnout Inventory (MBI) questionnaire.[15] Data obtained from these studies included the proportions of the population with high, intermediate, and low scores in EE, DP, and PA, as well as the reported burnout rate.

Study Measures

The electronic survey completed by neurosurgery residents consisted of questions about demographics (age, gender, postgraduate year [PGY], and training program location) and burnout (see **Appendix**, **Supplemental Digital Content**). Burnout was assessed via the abbreviated Maslach Burnout Inventory (aMBI),[16,17] a publicly available assessment developed by McManus et al,[17,18] which uses a 9-item questionnaire to assess the 3 components of burnout (EE, DP, and PA). Each component was scored on an 18-point scale and categorized as a low (0-6 points), intermediate (7-12 points), or high (13-18 points) score. Burnout was defined as a high score in either EE or DP.[14]

Statistical Analysis

Differences Among Neurosurgery Residents

Standard descriptive statistics were used to describe the distribution of aMBI scores for all neurosurgery residents as well as the proportion and 95% confidence interval (CI) for the number of individuals receiving low, intermediate, and high scores for each of the 3 components of burnout.

The distribution of scores did not follow a normal distribution based on an Anderson-Starling test; therefore, the appropriate nonparametric tests (2-sample Mann-Whitney test for 2 category analyses and Kruskal-Wallis for 3 or more category analyses) were performed to assess the difference in median scores among neurosurgery residents by gender, age, and PGY.

Differences Between Neurosurgery Residents and Control Populations

A cross-sectional analysis using a 2-population, 2-tailed Fisher's exact test was performed to determine the difference in the proportions of burnout between neurosurgery residents vs residents/fellows, early career physicians, and all physicians.

For all tests, statistical significance was determined using $\alpha = 0.05$. To control for multiple comparisons ($m = 33$), a Bonferroni correction (α/m) was used to determine a P-value $\leq .001$ as statistically significant. All data were analyzed using the Minitab software (Minitab Inc, State College, Pennsylvania; Released 2013. Minitab 17, version 17.3.1 for Windows).

TABLE 1. Demographic Characteristics of 255 Neurological Surgery Resident Respondents

	n	Proportion
Sex		
Men	205	0.804
Women	50	0.196
Age (yr)		
<25	4	0.016
25-29	98	0.384
30-34	120	0.471
>34	33	0.129
Year in training		
PGY-1	51	0.200
PGY-2	34	0.133
PGY-3	33	0.129
PGY-4	45	0.176
PGY-5	33	0.129
PGY-6	37	0.145
PGY-7	22	0.086
Training location[a]		
East North Central (IL, IN, MI, OH, WI)	46	0.180
East South Central (AL, KY, MS, TN)	20	0.078
Mid Atlantic (NJ, NY, PA)	63	0.247
Mountain (AZ, CO, ID, MT, NM, NV, UT, WY)	11	0.043
New England (CT, MA, ME, NH, RI, VT)	18	0.071
Pacific (AK, CA, HI, OR, WA)	22	0.086
South Atlantic (DC, DE, FL, GA, MD, NC, SC, VA, WV)	23	0.090
West North Central (IA, KS, MN, MO, ND, NE, SD)	30	0.118
West South Central (AR, LA, OK, TX)	22	0.086

PGY, postgraduate year.
[a]Regions defined by the AMA Residency and Fellowship Database.

RESULTS

Of the ~1200 US neurosurgery residents invited to participate in the study, 255 (21.3%) completed the survey. The demographic characteristics of the 255 neurosurgery respondents are shown in Table 1. The demographic composition of the sample demonstrates a significantly higher proportion of men (80.4%) compared to women (19.6%) and a relatively low proportion of PGY-7 residents (8.6%). Both of these findings were expected. In regard to gender, fewer women than men matriculate into neurosurgery residency. A lower proportion of PGY-7 residents compared to other PGYs was expected. This is due to the small number of neurosurgery training programs that have yet to matriculate PGY-7 residents. However, it is unclear if this reason completely explains the difference or if additional confounding factors are present.

Burnout Within Neurosurgery Residents

Among the neurosurgery residents surveyed, the prevalence of burnout was 36.5% (95% CI: 30.6%-42.7%), with 32.5% (95% CI: 26.8%-38.7%) having high EE and 21.6% (95% CI: 16.7%-27.1%) experiencing high DP, as shown in Table 2. Compared to both EE and DP, the prevalence of high scores in PA was significantly higher, 87.1% (95% CI: 82.3%-90.9%).

There was no statistically significant difference between the median scores when comparing neurosurgery residents by gender (Mann-Whitney *P*-values: EE .392; DP .081; PA .418; burnout .0836), age (Kruskal-Wallis *P*-values: EE .313; DP .059; PA .708; burnout .183), or PGY (Kruskal-Wallis *P*-values: EE .798; DP .414; PA .348, burnout .963), as shown in Table 3. The trend in burnout rates for PGY-1 through PGY-7 is demonstrated in Figure.

Burnout Comparison Between Neurosurgery Residents and Other Residents/Fellows and Practicing Physicians

Compared with control samples of other residents/fellows, early career physicians, and practicing physicians from a sample of all medical specialties,[8,14] neurosurgery residents have a significantly different distribution of burnout scores, as shown in Table 2. For the overall prevalence of burnout, neurosurgery residents have a statistically lower prevalence of burnout (36.5%) than other residents/fellows (60.0%; $P < .001$), early career physicians (51.3%; $P < .001$), and all practicing physicians (53.5%; $P < .001$).

In regard to the components of burnout, neurosurgery residents have a statistically significant lower proportion of high EE scores (32.5%) compared to residents/fellows (44.2%; $P < .001$) and practicing physicians (46.0%; $P < .001$), but not early career physicians (39.4%; $P < .048$). For DP, neurosurgery residents have a statistically significant lower proportion of high scores (21.6%) compared to residents/fellows (50.3%; $P < .001$), early career physicians (37.4%; $P < .001$), and all practicing physicians (33.8%; $P < .001$). For PA, neurosurgery residents have a statistically significant higher proportion of high scores (87.1%) compared to residents/fellows (48.1%; $P < .001$), early career physicians (56.1%; $P < .001$), and all practicing physicians (59.1%; $P < .001$).

DISCUSSION

Occupational burnout is not specific to medicine, as many other professions, such as law, accounting, and business, have similar rates of burnout. However, how physicians react to burnout and its effect on patient care is unique.[19] For this reason, academic interest in burnout and its effects on physicians and patient care has increased over the past decade. To our knowledge, this is the first study to assess the prevalence of burnout specifically among neurosurgery residents in the United States. Despite numerous seemingly proactive changes made to residency training by the American College of Graduate Medical Education including work hour regulations, as well as new focuses on resident health, burnout is still prevalent across all residency programs.[14,18,20]

Neurosurgery training is long, competitive, and both technically and psychologically challenging. Neurosurgery is among

TABLE 2. The Difference in Burnout[a] and aMBI Components Among Neurosurgery Residents and Other Physicians

	Neurosurgery residents (n = 255)			vs All physicians (n = 6880)[8]					vs Early career physicians (n = 880)[14]					vs Residents/fellows (n = 1701)[14]				
	n	Prop.	95% CI	n	Prop.	Diff.	95% CI	*P*-value	n	Prop.	Diff.	95% CI	*P*-value	n	Prop.	Diff.	95% CI	*P*-value
Emotional exhaustion																		
% Low score	66	0.259	(0.206 to 0.317)	2299	0.334	−0.075	(−0.130 to −0.020)	.012	325	0.369	−0.110	(−0.184 to −0.060)	***<.001***	538	0.316285	−0.057	(−0.116 to 0.001)	.069
% Intermediate score	106	0.416	(0.355 to 0.479)	1283	0.186	0.229	(0.168 to 0.290)	***<.001***	205	0.233	0.183	(0.116 to 0.249)	***<.001***	404	0.237507	0.178	(0.114 to 0.242)	***<.001***
% High score	83	0.325	(0.268 to 0.387)	3165	0.460	−0.135	(−0.193 to −0.076)	***.001***	347	0.394	−0.069	(−0.135 to −0.003)	.048	752	0.442093	−0.117	(−0.179 to −0.054)	***<.001***
Depersonalization						0.000												
% Low score	118	0.463	(0.400 to 0.526)	2951	0.429	0.034	(−0.028 to 0.096)	.303	338	0.384	0.079	(0.010 to 0.148)	.025	490	0.288066	0.175	(0.110 to 0.240)	***<.001***
% Intermediate score	82	0.322	(0.265 to 0.383)	1434	0.208	0.113	(0.055 to 0.171)	***<.001***	206	0.234	0.087	(0.024 to 0.151)	.005	344	0.202234	0.119	(0.059 to 0.180)	***<.001***
% High score	55	0.216	(0.167 to 0.271)	2325	0.338	−0.122	(−0.174 to −0.070)	***<.001***	329	0.374	−0.158	(−0.218 to −0.098)	***<.001***	857	0.503821	−0.288	(−0.342 to −0.230)	***<.001***
Personal accomplishment					0.000													
% Low score	1	0.004	(0.000 to 0.022)	1085	0.158	−0.154	(−0.165 to −0.142)	***<.001***	158	0.180	−0.176	(−0.202 to −0.149)	***<.001***	371	0.218107	−0.214	(−0.235 to −0.193)	***<.001***
% Intermediate score	32	0.125	(0.087 to 0.172)	1495	0.217	−0.092	(−0.134 to −0.050)	***<.001***	214	0.243	−0.118	(−0.167 to −0.068)	***<.001***	499	0.293357	−0.168	(−0.214 to −0.122)	***<.001***
% High score	222	0.871	(0.823 to 0.909)	4064	0.591	0.280	(0.237 to 0.323)	***<.001***	494	0.561	0.309	(0.026 to 0.362)	***<.001***	818	0.480894	0.390	(0.342 to 0.390)	***<.001***
Burnout[a]	93	0.365	(0.306 to 0.427)	3680	0.535	−0.170	(−0.230 to −0.110)	***<.001***	451	0.513	−0.148	(−0.215 to −0.080)	***<.001***	1021	0.600235	−0.236	(−0.299 to −0.172)	***<.001***

aMBI, abbreviated Maslach Burnout Inventory; CI, confidence interval; Diff., difference; Prop., proportion.
[a]Burnout: high score in either emotional exhaustion or depersonalization.

TABLE 3. Differences in aMBI Scores Among Neurosurgery Residents

		Emotional exhaustion			Depersonalization			Personal accomplishment			Burnout	
	N	Median	Mean	(95% CI)	Median	Mean	(95% CI)	Median	Mean	(95% CI)	Proportion	(95% CI)
Gender												
Men	205	11.0	9.727	(9.076 to 10.377)	6.5	7.961	(7.288 to 8.634)	16.0	15.322	(14.968 to 15.676)	0.3610	(0.2454 to 0.5146)
Women	50	10.0	10.380	(9.063 to 11.697)	7.0	6.500	(5.137 to 7.863)	16.0	15.040	(14.323 to 15.757)	0.3800	(0.2945 to 0.4274)
P-Value (power)		***.392(.341)***			***.081(.920)***			***.418(.233)***			***.836(.993)***	
Age												
< 25	4	13.5	13.000	(8.350 to 17.650)	14.0	12.750	(7.950 to 17.550)	14.0	13.000	(10.470 to 15.530)	0.7500	(0.2770 to 1.0000)
25 - 29	33	10.0	9.424	(7.806 to 11.043)	6.0	6.394	(4.723 to 8.065)	16.0	14.970	(14.090 to 15.849)	0.2424	(0.0777 to 0.4072)
30 - 34	98	9.0	9.408	(8.469 to 10.347)	8.0	8.122	(7.153 to 9.092)	16.0	15.347	(14.836 to 15.857)	0.3670	(0.2718 to 0.4629)
> 34	120	10.0	10.233	(9.385 to 11.082)	6.0	7.492	(6.615 to 8.368)	16.0	15.358	(14.897 to 15.820)	0.3833	(0.2969 to 0.4697)
P-Value (power)		***.313(>.999)***			***.059(>.999)***			***.708(>.999)***			***.183(>.999)***	
Post-Graduate year												
PGY-1	51	9.0	9.529	(8.218 to 10.840)	9.0	8.333	(6.976 to 9.691)	16.0	14.745	(14.039 to 15.451)	0.3725	(0.2383 to 0.5068)
PGY-2	34	10.5	10.794	(9.189 to 12.400)	8.5	9.029	(7.367 to 10.692)	16.0	15.353	(14.488 to 16.218)	0.4412	(0.2768 to 0.6056)
PGY-3	33	9.0	9.394	(7.764 to 11.024)	6.0	7.360	(5.680 to 9.050)	15.0	14.879	(14.001 to 15.756)	0.3636	(0.1968 to 0.5305)
PGY-4	45	11.0	0.156	(8.760 to 11.551)	6.0	4.022	(5.577 to 8.468)	16.0	15.467	(14.715 to 16.218)	0.3111	(0.1682 to 0.4540)
PGY-5	33	9.0	9.030	(7.401 to 10.660)	6.0	7.697	(6.009 to 9.385)	16.0	16.121	(15.244 to 16.999)	0.3636	(0.1968 to 0.5305)
PGY-6	37	11.0	10.081	(8.542 to 11.620)	7.0	7.108	(5.514 to 8.702)	16.0	14.973	(14.144 to 15.802)	0.3514	(0.1938 to 0.5089)
PGY-7	22	10.0	10.091	(8.095 to 12.087)	6.0	6.770	(4.710 to 8.840)	16.0	15.727	(14.652 to 16.802)	0.3640	(0.1590 to 0.5680)
P-Value (power)		***.798(.900)***			***.414(>.999)***			***.348(.999)***			***.963(.593)***	

aMBI, abbreviated Maslach Burnout Inventory.

the longest training programs within medical residencies and the third most competitive specialty based on match rate (76%), behind vascular surgery (71%), and orthopedic surgery (75%).[21] In addition, neurosurgery residents tend to work more hours than most other specialties. This is evident by the Accreditation Council for Graduate Medical Education approval of the request by the Review Committee for Neurological Surgery for duty hour exceptions up to 88 h/wk, which is a 10% increase over the 80-h limit for other specialties.[22] Given these factors, we expected the prevalence of burnout among neurosurgery residents to be higher than the published rate of burnout in other medical residencies. However, this hypothesis was not supported in the data, as neurosurgery residents experienced a significantly lower prevalence of burnout than residents and fellows as a whole.

Although not the primary purpose, therefore not specifically addressed in the methods, the results of the present study raise the question "What is the cause for the relatively low prevalence of burnout among neurosurgery residents?" We believe this to be multifactorial. One possible reason, based on our results, is their higher sense of PA compared to residents of other specialties. This is likely protective against EE and/or DP and therefore decreases burnout. For example, neurosurgery residents care for acutely ill patients and witness firsthand the successful outcomes of surgical intervention. Conversely, many other medical specialties are exposed to more chronic illnesses and may not have the opportunity to observe a significant change in outcome during the acute setting, which may increase EE and/or DP. Another possibly protective personality characteristic is resilience. Although not specifically addressed in our methods, by nature, the elevated level of challenges faced in neurosurgical training may attract residents with higher levels of resilience, which may have a causal association with lower burnout rates. However, no study has compared differences in resilience among residents of various specialties and its effect on burnout. Additional research is needed to assess the association of these factors and burnout, as well as other potential factors, such as well-being training, work hours, average sleep, marital status, and number of children. Such studies are important, as they may assist in the creation of interventions to decrease burnout in the future.

Another possible cause for the lower prevalence of burnout among neurosurgery residents is a selection bias due to the demographic distribution inherent to neurosurgery residents compared to residents in other medical specialties, specifically the high proportion of men. The overall effect of selection bias on our results is likely low, given that there was no statistically significant difference in aMBI scores by age or gender. This is notably different from the findings among general surgery residents, where female residents have significantly higher rates of EE and DP.[23] Further research must be done to address the factors that cause burnout in residents of various specialties in order to better understand the findings of this study.

A study by Dyrbye et al[14] on the prevalence of burnout in medical students, residents/fellows, and early career physicians concluded that distress among physicians, based on burnout scores, peaks during residency and fellowship training. This pattern of burnout may not be seen in neurosurgery, as our findings demonstrate that neurosurgery residents have a significantly lower prevalence of burnout compared to early career physicians (<5 yr in practice) and all practicing physicians. However, it is difficult to generalize this pattern to practicing neurosurgeons due to a lack of consensus in the published burnout rates among practicing neurosurgeons. Two studies performed by similar groups of authors published widely different burnout rates of 27% and 56.7% for practicing neurosurgeons in the United States.[10,24] Although both studies used the MBI to define burnout, the first study included only 81 neurosurgeons (47.9% response rate) and the second included 750 neurosurgeons (23.1% response rate).[10,11] Therefore, further research into the prevalence of burnout specifically among practicing neurosurgeons and residents in training must be completed to confirm or dispute these findings.

An understanding of potential causes of resident burnout is important for program directors and clinical faculty, because the potential adverse effects of burnout are not trivial. Among physicians, burnout is associated with an increased risk of depression and substance abuse, as well as adverse patient outcomes, lower patient satisfaction, and prolonged hospital stays.[19,25,26] Although not statistically significant, an important finding in our study is the trend in burnout rates over time by PGY (Figure 1). As interns (PGY-1), residents are burdened with the expectations of working as physicians and the stress that accompanies their responsibilities. The stress, and therefore burnout, peaks during PGY-2, which is often the most time intense residency year due to the high level of nonsurgical clinical responsibilities. As a mid-level resident (PGY-3 to PGY-4), many of these responsibilities are diminished and the majority of the surgical responsibility is placed on the senior residents; as such, burnout decreases. Then, stress builds again during senior residency (PGY-5 to PGY-7) due to increased surgical responsibility, and burnout once again increases. An understanding of this progression through neurosurgical residency may help to identify residents at greatest risk for burnout.

Limitations

This study has several limitations that may prevent the generalization of its findings. First, the results of this study are based on the 9-item aMBI, whereas the results of the comparison control populations were based on the full 22-item MBI.[8,14] The aMBI was used due to its public availability as well as its brevity in an effort to maximize the response rate. The aMBI and the MBI assess the same 3 components of burnout using the same 3-tiered scale; therefore, their results can be used interchangeably for statistical analysis. However, discrepancies may exist between the 2 scales, as no study has directly validated the

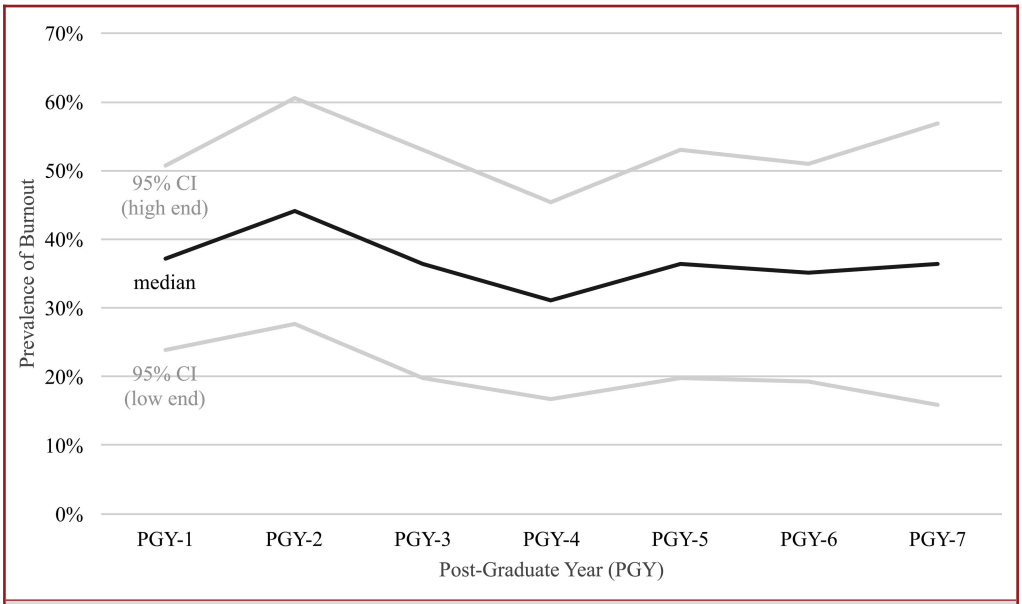

FIGURE. *Prevalence of burnout through neurosurgery residency with 95% CI.*

aMBI against the MBI. Such discrepancies would alter the validity of our result, but the effect is unknown. In addition, a sampling error may be present. The ~20% of neurosurgery residents who volunteered to participate in the study may not accurately represent the general population of neurosurgery residents, as the primary outcome measured, burnout, may affect an individual's likelihood to participate in the study. However, the response rate of this study is comparable to those in the control studies, which varied from 19.2% to 26.7%.[8,14] Additional factors that may contribute to the low response rate include lack of participation by program directors/program coordinators and lack of interest/time by residents. Lastly, there may be a systematic bias because study participants may have been concerned about the anonymity of the survey, which may have affected their responses.

CONCLUSION

Given the evidence of the negative effects of burnout on the quality and safety of patient care, the high prevalence of burnout is a significant problem among US physicians, particularly those in their residency training. Despite the increased stress inherent to their training program, neurosurgery residents have a significantly lower prevalence of burnout than their peers do in other medical specialties.

Disclosure

The authors have no personal, financial, or institutional interest in any of the drugs, materials, or devices described in this article.

REFERENCES

1. Maslach C, Jackson SE. The measurement of experienced burnout. *J Organiz Behav* 1981;2(2):99-113.
2. Maslach C, Schaufeli WB, Leiter MP. Job burnout. *Annu Rev Psychol* 2001;52(1):397-422.
3. Maslach C, Goldberg J. Prevention of burnout: new perspectives. *Appl Prev Psychol* 1998;7(1):63-74.
4. Kahill S. Relationship of burnout among professional psychologists to professional expectations and social support. *Psychol Rep* 1986;59(3):1043-1051.
5. Shanafelt TD, Balch CM, Bechamps G, et al. Burnout and medical errors among American surgeons. *Ann Surg* 2010;251(6):995-1000.
6. Shanafelt TD, Bradley KA, Wipf JE, Back AL. Burnout and self-reported patient care in an internal medicine residency program. *Ann Intern Med* 2002;136(5):358-367.
7. West CP, Huschka MM, Novotny PJ, et al. Association of perceived medical errors with resident distress and empathy. *JAMA* 2006;296(9):1071-1078.
8. Shanafelt TD, Hasan O, Dyrbye LN, et al. Changes in burnout and satisfaction with work-life balance in physicians and the general US working population between 2011 and 2014. *Mayo Clin Proc* 2015;90(12):1600-1613.
9. Balch CM, Shanafelt TD, Sloan JA, Satele DV, Freischlag JA. Distress and career satisfaction among 14 surgical specialties, comparing academic and private practice settings. *Ann Surg* 2011;254(4):558-568.
10. Klimo P, Decuypere M, Ragel BT, Mccartney S, Couldwell WT, Boop FA. Career satisfaction and burnout among U.S. neurosurgeons: a feasibility and pilot study. *World Neurosurg* 2013;80(5):e59-e68.
11. Mcabee JH, Ragel BT, Mccartney S, et al. Factors associated with career satisfaction and burnout among US neurosurgeons: results of a nationwide survey. *J Neurosurg* 2015;123(1):161-173.
12. Gelfand DV, Odnos YD, Carmichael JC, Saltzman DJ, Wilson SE, Williams RA. Effect of the 80-hour workweek on resident burnout. *Arch Surg.* 2004;139(9):933-940.
13. Ishak WW, Lederer S, Mandili C, et al. Burnout during residency training: a literature review. *J Grad Med Educ* 2009;1(2):236-242.
14. Dyrbye LN, West CP, Satele D, et al. Burnout among U.S. medical students, residents, and early career physicians relative to the general U.S. population. *Acad Med* 2014;89(3):443-451.

15. Maslach C, Jackson SE, Leiter MP. *Maslach Burnout Inventory Manual*. 3rd ed: Consulting Psychologists Press; 1996.
16. Mcmanus I, Keeling A, Paice E. Stress, burnout and doctors' attitudes to work are determined by personality and learning style: a twelve year longitudinal study of UK medical graduates. *BMC Med* 2004;2(1):29. Available at: https://bmcmedicine.biomedcentral.com/articles/10.1186/1741-7015-2-29.
17. Mcmanus I, Winder B, Gordon D. The causal links between stress and burnout in a longitudinal study of UK doctors. *The Lancet* 2002;359(9323):2089-2090.
18. Accreditation Council for Graduate Medical Education The ACGME 2011 Duty Hour Standards: Enhancing Quality of Care, Supervision, and Resident Professional Development. 2011. Available at: https://www.acgme.org/Portals/0/PDFs/jgme-monograph[1].pdf. Accessed July 30, 2017.
19. Gundersen L. Physician burnout. *Ann Intern Med* 2001;135(2):145-148.
20. Ulmer C, Wolman DM, Bruno M, Cacace C, Herdman R (eds). *Resident Duty Hours: Enhancing Sleep, Supervision, and Safety*. Washington, DC: National Academies Press; 2008: 428.
21. National Resident Matching Program. *Charting Outcomes in the Match for U.S. Allopathic Seniors: Characteristics of U.S. Allopathic Seniors Who Matched to Their Prefered Specialty in the 2016 Main Residency Match*. 1st ed. Washington, D.C.: NRMP; 2016. Available at: http://www.nrmp.org/wp-content/uploads/2016/09/Charting-Outcomes-US-Allopathic-Seniors-2016.pdf. Accessed January 27, 2017.
22. ACGME. *Policies and Procedures: 22.00 Policy for Granting Duty-Hour Exceptions*. 2017:133. Available at: https://bmcmedicine.biomedcentral.com/articles/10.1186/1741-7015-2-29. Accessed July 30, 2017.
23. Elmore LC, Jeffe DB, Jin L, Awad MM, Turnbull IR. National survey of burnout among US general surgery residents *J Am Coll Surg* 2016;223(3):440-451.
24. Mcabee JH, Ragel BT, Mccartney S, et al. Factors associated with career satisfaction and burnout among US neurosurgeons: results of a nationwide survey. *J Neurosurg* 2015;123(1):161-173.
25. Halbesleben JRB, Rathert C. Linking physician burnout and patient outcomes. *Health Care Manage Rev* 2008;33(1):29-39.
26. Thomas NK. Resident burnout. *JAMA* 2004;292(23):2880-2889.

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COMMENTS

This report addresses a very timely topic. Discussions about burnout, self-care, work-life balance, and similar issues have become quite popular in virtually all sectors of society. This preoccupation goes beyond the basic human instinct to help others as they struggle with their personal demons. Employers have discovered that it also makes financial sense. Burned-out employees do not perform optimally, and when it comes to health care workers, the consequences of burnout can be far worse than adverse impact to a company's balance sheet.

This article has many limitations. The response rate is low, but still comparable to rates of similar publications. The anonymous nature of the survey prevents detailed analysis of basic demographic factors like gender or postgraduate year. It would also be interesting to know how neurosurgery residents' burnout rates compare to those of other professionals when they are early in their careers, such as lawyers, engineers, software and tech workers, and those in business. Similarly, head-to-head comparisons among residents in different specialties would be of interest.

Despite these imperfections, this manuscript provides an informative snapshot of our current understanding of this important topic. The authors speculate about possible reasons why the burnout rate that they describe for neurosurgery residents is lower than that reported by others. These include high sense of personal accomplishment and high degree of resilience. Similarly, Shanafelt et al[1] report that, of 25 specialties, neurosurgery had the seventh-lowest rate of burnout, yet also had—by a wide margin—the lowest rate of satisfaction with work-life balance. There seems to be something about neurosurgery and its practitioners that allows them to tolerate a highly unsatisfactory work-life balance while suffering a much lower-than-expected rate of burnout. Another likely reason is that those who go into neurosurgery do so with no delusions about the demanding nature of our specialty.

John Reavey-Cantwell
Alex Valadka
Richmond, Virginia

1. Shanafelt TD, Hasan O, Dyrbye LN, et al. Changes in burnout and satisfaction with work-life balance in physicians and the general US working population between 2011 and 2014. *Mayo Clin Proc*. 2015;90:1600-13.

The merit of this study has been to evaluate the prevalence of the burnout phenomenon among the residents in neurosurgery in the US; such a study will be surely of help for dealing with residency programs and work hours. In this study, prevalence was 36.5%, which is a relatively low rate if considering the high level of responsibility of the residents confronted to the frequent high risk situations of the patients in the neurosurgical specialty.

One bias of the study is the weak percentage of responders to the survey: only 21.3%. A reason might be that a majority of those who responded felt themselves potentially little exposed to the phenomenon; … and the burnout rate would be less than the reality. On the contrary, responders could have been mainly those who were themselves potentially concerned; … and consequently burnout rate would be more than the reality. An important limitation of the study is that the causes of burnout, as well as the characteristics of those who experienced burnout from those who did not, have not been explored for reasons of confidentiality. This is comprehensible but diminished the depth of the analysis.

In any case, due to the important harmful consequences both for the patients and the care teams, as well as for the residents themselves, the eventuality of a burnout phenomenon should be taken seriously. Directors of the residency programs should be most attentive to catch the preliminary warning signals in residents. This is the more so important as negligence would (inevitably) open the door for the administrative body to take over decisional power on medical staff working hours.

Such shifts are not only theoretical. For several years in the EU and particularly in France, official rules have been established almost solely from the administrative side, the culture of which is the principle of precaution at almost any cost. The weekly working time in the EU is 48 hours,[1] the day after an on-duty the resident is not covered by law if he keeps working in the hospital. One among several consequences is that the patient and the potential complications are not supposed to be taken in charge by the original surgical team. Also, not infrequently, due to limitations on day working hours, surgeries have to be finished at a fixed hour with subsequent lack of security (or not to be performed at all). This does not fit with patients' and care team's interests.

Further, last but not least, the climate created by the administrative rules, under the guidance of so-called specialist-counsellors (in sociology,

psychology, etc.) has become such that nowadays the involvement of neurosurgery candidates has changed. Not only do neurosurgery trainees have a deficit in training due to lack of active time, but also they tend to have a different profile with an inclination to "haggle" over professional matters.

No doubt, taking care of avoiding burnout occurrence is of paramount importance to prevent damage to patients and damage for medical teams. If we think it is valuable to keep the younger generation enthusiastic and generous, and not let them sink into the bureaucratic life-style, directors of training programs should keep control of training conditions including working hours, preferably through speciality Colleges. The price to pay for those in charge is to settle guidelines for the prevention of burnout situations and to be attentive to preliminary warning signals in the residents' generation.

A well-balanced organisation is not an excessive amount of tedious work, rather it should provide at the same time an intensive and stimulating program to maintain the expertise and a generous mentality.

Marc Sindou
Lyon, France

1. DIRECTIVE 2003/88/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 4 November 2003 concerning certain aspects of the organisation of working time.

The authors provide important observations as to the rate of burnout in neurosurgical residents - an understudied topic that is of relevance given its association with adverse patient outcomes and rates of physician depression and substance abuse. Interestingly, neurosurgery residents appear to have substantially lower burnout rates compared to other medical and surgical specialities. A number of potential reasons for this were raised; however, the study was not designed to address the issue of "why" and therefore additional research will be needed. Another line of future inquiry that will be important is the manner in which burnout in neurosurgery residents (and faculty) is identified and managed. I congratulate the authors on shedding light on an important topic - one I'm sure we will be hearing more about in future studies.

Gregory Joseph Zipfel
St. Louis, Missouri

The authors have produced an interesting study of residents and found a surprising lack of burnout in neurosurgery residents. This apparent resilience is unique compared to the residents in general surgery, early career physicians, and even those in mid career. The discussion acknowledges the possibility of sampling errors and other factors which could have influenced the findings. Nevertheless, this study does demonstrate the unique qualities of the neurosurgery resident, especially the sense of personal achievement that comes from learning and practicing the most demanding and life-enhancing surgical discipline.

Ann Marie Flannery
Lafayette, Louisiana

Even though burnout may have a lower prevalence amongst neurosurgeons than other specialist and general physicians, it remains a serious challenge.[1,2] While certainly not a new problem, it is far from being solved.[3,4] Can it be prevented?[5] Can it be managed?[6] Can it be avoided by screening?[7,8] What is the relationship of burnout to depression?[9]

The problem of burnout is not restricted to physicians.[10] Other healthcare care providers may be even more vulnerable, with potentially serious institutional consequences. The Council on Surgical and Perioperative Safety (CSPS: http://www.cspsteam.org/), representing a wide range of professionals involved in perioperative care, has expressed concerns about the potential for burnout to threaten patient safety. Intensive Care Unit personnel have been identified as particularly vulnerable.[11] The correlation between physician burnout specifically and patient risk has not proven as dramatic as feared.[12] Nevertheless, burnout is a widespread problem that contributes both systematic and non-systematic risks to patient care.

Burnout is sometimes referred to and equated with emotional exhaustion.[12] Whether this is a reasonable simplification or overly reductionist is open to discussion. More conventionally, burnout is framed in terms of 3 dimensions: emotional exhaustion, depersonalization, and an impaired sense of personal accomplishment (as discussed in this paper). Assessment instruments for burnout, exemplified by the Maslach Burnout Inventory (MBI) and the abbreviated Maslach Burnout Inventory (aMBI), as described by the authors of this article, have been utilized effectively and supplemented with others.[13] Another element, often captioned "compassion fatigue, " has recently been added to the mix.[11] While compassion fatigue, emotional exhaustion, and depersonalization are inextricably related, it may be worth calling out this concept if only for its narrative impact and opportunity for research. In small studies, female physicians have been shown to be at particular risk for burnout.[14]

Depression is classically described in terms of 4 dimensions: feelings of despondency, loss of self-worth, feelings of abandonment, and anger. Many depression assessment instruments have been developed in an attempt to create objective diagnostic criteria.[15,16,17,18,19,20] Anger is probably as important an emotion in burnout as it is in depression, but has not received as much attention in understanding burnout.[21,22,23]

Burnout may lead to depression. These conditions overlap clinically.[14,24] Depression and burnout both result in diminished engagement and context sensitivity. Patient care may suffer. Whether the effects on patient care are the result of depression-associated cognitive impairment or for other reasons has not been adequately explored.[25,26]

The influence of personality factors on stress management, career choice, and burnout has been studied for decades.[23,27,26,28] A recent review identified more than 2617 pertinent studies including 15 randomized trials.[29] While traits such as confidence, resilience, and "grit" have been shown to be important, burnout should not be dismissed as failure, and especially not as failure of character.[12] Appropriate interventions including both structural (organizational changes) and personal support have been shown to have measurable effects in reducing burnout.[5,6,23,29,30,31,32,33] It is fairly clear that focus on 1 target alone results in only small improvement.[32,34] How to optimize a balance between the 2 remains to be determined. In any case, suicide may pose an important risk in the absence of appropriate intervention.[32,33,34,35,36,37]

Burnout is a serious problem for neurosurgeons even if less prevalent than in other specialties. Further studies are indicated to determine what measures might be implemented to reduce the problem even further, for

the sake of the trainee and the practicing neurosurgeon, for the sake of the profession, and for the sake of the patient.[4]

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1. Pulcrano M, Evans SR, Sosin M. Quality of Life and Burnout Rates Across Surgical Specialties: A Systematic Review. *JAMA surgery*. 2016;151(10):970-978.
2. Dewa CS, Loong D, Bonato S, Thanh NX, Jacobs P. How does burnout affect physician productivity? A systematic literature review. *BMC Health Serv Res*. 2014;14:325.
3. Vinson DC. Physician burnout. The Pharos of Alpha Omega Alpha-Honor Medical Society. *Alpha Omega Alpha*. 1988;51(3):42.
4. Thomas NK. Resident burnout. *Jama*. 2004;292(23):2880-2889.
5. Ey S, Moffit M, Kinzie JM, Brunett PH. Feasibility of a Comprehensive Wellness and Suicide Prevention Program: A Decade of Caring for Physicians in Training and Practice. *Journal of graduate medical education*. 2016;8(5):747-753.
6. Williams D, Tricomi G, Gupta J, Janise A. Efficacy of burnout interventions in the medical education pipeline. *Academic psychiatry: the journal of the American Association of Directors of Psychiatric Residency Training and the Association for Academic Psychiatry*. 2015;39(1):47-54.
7. Lin DT, Liebert CA, Tran J, Lau JN, Salles A. Emotional Intelligence as a Predictor of Resident Well-Being. *Journal of the American College of Surgeons*. 2016;223(2):352-358.
8. Salles A, Cohen GL, Mueller CM. The relationship between grit and resident well-being. *American journal of surgery*. 2014;207(2):251-254.
9. Raj KS. Well-Being in Residency: A Systematic Review. *Journal of graduate medical education*. 2016;8(5):674-684.
10. Hall LH, Johnson J, Watt I, Tsipa A, O'Connor DB. Healthcare Staff Wellbeing, Burnout, and Patient Safety: A Systematic Review. *PLoS One*. 2016;11(7):e0159015.
11. van Mol MM, Kompanje EJ, Benoit DD, Bakker J, Nijkamp MD. The Prevalence of Compassion Fatigue and Burnout among Healthcare Professionals in Intensive Care Units: A Systematic Review. *PLoS One*. 2015;10(8):e0136955.
12. Welp A, Meier LL, Manser T. Emotional exhaustion and workload predict clinician-rated and objective patient safety. *Frontiers in psychology*. 2015;5:1573.
13. West CP, Dyrbye LN, Satele DV, Sloan JA, Shanafelt TD. Concurrent validity of single-item measures of emotional exhaustion and depersonalization in burnout assessment. *Journal of general internal medicine*. 2012;27(11):1445-1452.
14. Spataro BM, Tilstra SA, Rubio DM, McNeil MA. The Toxicity of Self-Blame: Sex Differences in Burnout and Coping in Internal Medicine Trainees. *Journal of women's health (2002)*. 2016;25(11):1147-1152.
15. Schulte-van Maaren YW, Carlier IV, Zitman FG, et al. Reference values for major depression questionnaires: the Leiden Routine Outcome Monitoring Study. *J Affect Disord*. Amsterdam: Elsevier/North-Holland Biomedical Press; 2013; 149(1-3):342-349.
16. Spangenberg L, Brahler E, Glaesmer H. [Identifying depression in the general population - a comparison of PHQ-9, PHQ-8 and PHQ-2]. *Z Psychosom Med Psychother*. 2012;58(1):3-10.
17. Van Den Eede F, Van den Bossche B, Hulstijn W, Sabbe BG, Cosyns P, Claes SJ. Combined dexamethasone/CRF test in remitted outpatients with recurrent major depressive disorder. *J Affect Disord*. 2006;93(1-3):259-263.
18. Zimmerman M, Martinez J, Attiullah N, et al. Further evidence that the cutoff to define remission on the 17-item Hamilton Depression Rating Scale should be lowered. *Depress Anxiety*. 2012;29(2):159-165.
19. Zimmerman M, Martinez JH, Friedman M, Boerescu DA, Attiullah N, Toba C. Speaking a more consistent language when discussing severe depression: a calibration study of 3 self-report measures of depressive symptoms. J Clin Psychiatry. 2014;75(2):141-146.
20. Carmody TJ, Rush AJ, Bernstein I, et al. The Montgomery Asberg and the Hamilton ratings of depression: a comparison of measures. *Eur Neuropsychopharmacol*. 2006;16(8):601-611.
21. Rakovec-Felser Z. Professional burnout as the state and process–what to do? *Collegium antropologicum*. 2011;35(2):577-585.
22. Muscatello MR, Bruno A, Carroccio C, et al. Association between burnout and anger in oncology versus ophthalmology health care professionals. *Psychol Rep*. 2006;99(2):641-650.
23. Satterfield JM, Becerra C. Developmental challenges, stressors and coping strategies in medical residents: a qualitative analysis of support groups. *Medical education*. 2010;44(9):908-916.
24. Govardhan LM, Pinelli V, Schnatz PF. Burnout, depression and job satisfaction in obstetrics and gynecology residents. *Connecticut medicine*. 2012;76(7):389-395.
25. Halvorsen M, Hoifodt RS, Myrbakk IN, et al. Cognitive function in unipolar major depression: a comparison of currently depressed, previously depressed, and never depressed individuals. *J Clin Exp Neuropsychol*. 2012;34(7): 782-790.
26. Shanafelt TD, Bradley KA, Wipf JE, Back AL. Burnout and self-reported patient care in an internal medicine residency program. Annals of internal medicine. 2002;136(5):358-367.
27. Linn BS, Zeppa R. Stress in junior medical students: relationship to personality and performance. *Journal of medical education*. 1984;59(1):7-12.
28. Linn BS, Zeppa R. Does surgery attract students who are more resistant to stress? *Ann Surg*. 1984;200(5):638-643.
29. West CP, Dyrbye LN, Erwin PJ, Shanafelt TD. Interventions to prevent and reduce physician burnout: a systematic review and meta-analysis. *Lancet (London, England)*. 2016;388(10 057):2272-2281.
30. Balch CM, Shanafelt T. Combating stress and burnout in surgical practice: a review. *Advances in surgery*. 2010;44:29-47.
31. Salles A, Liebert CA, Esquivel M, Greco RS, Henry R, Mueller C. Perceived Value of a Program to Promote Surgical Resident Well-being. *Journal of surgical education*. 2017.
32. Lacy BE, Chan JL. Physician Burnout: The Hidden Health Care Crisis. *Clin Gastroenterol Hepatol*. 2017.
33. Dyrbye LN, Varkey P, Boone SL, Satele DV, Sloan JA, Shanafelt TD. Physician satisfaction and burnout at different career stages. *Mayo Clinic proceedings*. 2013;88(12):1358-1367.
34. Panagioti M, Panagopoulou E, Bower P, et al. Controlled Interventions to Reduce Burnout in Physicians: A Systematic Review and Meta-analysis. *JAMA internal medicine*. 2017;177(2):195-205.
35. Ross M. Suicide among physicians. *Psychiatry in medicine*. 1971;2(3):189-198.
36. Roy A. Suicide in doctors. *The Psychiatric clinics of North America*. 1985;8(2):377-387.
37. The Lancet. Suicide among health-care workers: time to act. *Lancet (London, England)*. 2017;389(10 064):2.