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Factors associated with career satisfaction and burnout among US neurosurgeons: results of a nationwide survey

Joseph H. McAbee, BS,[1] Brian T. Ragel, MD,[2] Shirley McCartney, PhD,[2] G. Morgan Jones, PharmD, BCPS,[3,4,5] L. Madison Michael II, MD,[3,6] Michael DeCuypere, MD, PhD,[3] Joseph S. Cheng, MD, MS,[7] Frederick A. Boop, MD,[3,6,8] and Paul Klimo Jr., MD, MPH[3,6,8]

[1]School of Medicine, Wake Forest University, Winston-Salem, North Carolina; [2]Department of Neurological Surgery, Oregon Health & Science University, Portland, Oregon; Departments of [3]Neurosurgery, [4]Neurology, and [5]Clinical Pharmacy, University of Tennessee Health Science Center; [6]Semmes-Murphey Neurologic & Spine Institute; [8]Le Bonheur Neuroscience Institute, Le Bonheur Children's Hospital, Memphis; and [7]Department of Neurosurgery, Vanderbilt University Medical Center, Nashville, Tennessee

OBJECT The object of this study was to identify and quantify predictors of burnout and career satisfaction among US neurosurgeons.

METHODS All US members (3247) of the American Association of Neurological Surgeons (AANS) were invited to participate in a survey between September and December 2012. Responses were evaluated through univariate analysis. Factors independently associated with burnout and career satisfaction were determined using multivariable logistic regression. Subgroup analysis of academic and nonacademic neurosurgeons was performed as well.

RESULTS The survey response rate was 24% (783 members). The majority of respondents were male, 40–60 years old, in a stable relationship, with children, working in a group or university practice, and trained in a subspecialty. More than 80% of respondents reported being at least somewhat satisfied with their career, and 70% would choose a career in neurosurgery again; however, only 26% of neurosurgeons believed their professional lives would improve in the future, and 52% believed it would worsen. The overall burnout rate was 56.7%. Factors independently associated with both burnout and career satisfaction included achieving a balance between work and life outside the hospital (burnout OR 0.45, satisfaction OR 10.0) and anxiety over future earnings and/or health care reform (burnout OR 1.96, satisfaction OR 0.32). While the burnout rate for nonacademic neurosurgeons (62.9%) was higher than that for academic neurosurgeons (47.7%), academicians who had practiced for over 20 years were less likely to be satisfied with their careers.

CONCLUSIONS The rates of burnout and career satisfaction were both high in this survey study of US neurosurgeons. The negative effects of burnout on the lives of surgeons, patients, and their families require further study and probably necessitate the development of interventional programs at local, regional, and even national levels.

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KEY WORDS neurosurgery; burnout; career; satisfaction; survey; health care reform

Medicine combines scientific discovery with the opportunity to care for patients with a diverse range of disease. Physicians, however, are subject to a number of stressors and challenges that may lead to an unhealthy level of dissatisfaction, and even burnout. "Burnout" has been defined as a clinical syndrome characterized by emotional exhaustion, depersonalization, and a decreased sense of accomplishment.[9] A definition of burnout is included in the *International Statistical Classification of Diseases and Related Health Problems 10th Revision* (ICD-10 Version:2010, http://apps.who.int/classifications/icd10) as a drawback related to life-management difficulty combined with a state of vital exhaustion. Symptoms include fatigue, poor judgment, cynicism, guilt, feelings of ineffectiveness, and disconnection with coworkers or patients.[1,9,34] Maslach et al. defined burnout among health care providers as a psychological process whereby human service professionals attempting to positively impact the lives of others become overwhelmed and frustrated by unforeseen stressors related to their jobs.[30]

Burnout and dissatisfaction with one's career are pervasive problems in medicine that can negatively affect a phy-

ABBREVIATIONS AANS = American Association of Neurological Surgeons; AUC = area under the curve; CSNS = Council of State Neurosurgical Societies; MBI = Maslach Burnout Inventory; PPACA = Patient Protection and Affordable Care Act.

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sician's personal, physical, and mental well-being. They are associated with interpersonal relationship dysfunction, substance abuse, suicidal ideation, and a desire by young surgeons to retire early.[2,11,35] More medical errors have also been reported among surgeons who experience higher levels of burnout.[36,47,48] Patients who are treated by physicians suffering from burnout are more often dissatisfied with their level of care and are more likely to participate in malpractice suits.[2]

Many studies have gauged the level of burnout in various medical subspecialties. In a landmark study, Shanafelt and colleagues surveyed 7905 surgeons in an effort to identify personal and professional characteristics that may predict burnout.[37] They found that specialty practice area,[7] number of nights on call per week,[5] hours worked per week,[5] younger age,[25] and compensation based entirely on billing were factors associated with surgeon burnout.[37] Further studies report that surgeons who are female,[16] work in private practice,[7] or report not having enough time for family or personal life[4,38] have higher levels of burnout. Conversely, surgeons who are older,[25] work in academia,[7] have sufficient time for non–patient care activities,[6,25] and spend more time in the operating room[37] are typically more satisfied with their career choice.

While previous studies have included a small sample of neurosurgeons, there is little research dedicated to career satisfaction or burnout in what is arguably one of the most intense fields in medicine. We recently published our results from a pilot study in which 85 neurosurgeons completed a 107-item questionnaire.[23] After partnering with the Council of State Neurosurgical Societies (CSNS), we conducted a nationwide study using a modified and shortened version of our original questionnaire. The primary objective of this study was to better define within neurosurgery the level of burnout and career satisfaction and their predictive factors.

Methods

A shorter, modified online version (SurveyMonkey) of the pilot study questionnaire was used to improve participation *(Appendix).* An e-invitation to complete the survey was sent to all US members of the American Association of Neurological Surgeons (AANS) on behalf of the CSNS on 4 separate occasions between September and December 2012. Electronic communication to potential survey respondents included a link to the survey, as well as a cover letter outlining the purpose of the survey. Participation was voluntary and data were de-identified by the survey administrator (S.M.) prior to analysis. We combined responses from this survey with those from our previous pilot study as we assumed that those neurosurgeons who participated in the pilot survey were not likely to complete the updated survey.

Definitions and Statistical Analysis

Descriptive summary statistics were used to describe the overall group of respondents. Select survey responses were combined into categories for the purposes of statistical analysis based on previous literature and number of responses within the original selections. All categories were determined prior to completing any statistical analysis. For example, responses to specific questions regarding professional perceptions that were believed to have a large impact on the desired outcome were converted from a Likert-type scale to dichotomous variables. The number of age categories was collapsed from 7 to 3 to approximate the early (up to and including age 45 years), middle (46–55 years), and later (> 55 years) stages of a person's career, with each stage selected to represent an approximate 10-year period.

We decided a priori to identify and quantify predictors of 2 survey outcomes: 1) burnout and 2) career satisfaction. Burnout was measured using the validated Maslach Burnout Inventory (MBI) that assesses emotional exhaustion (9 questions), depersonalization (5 questions), and personal accomplishment (8 questions). Using the same definition as Shanafelt et al. and the cutoff values specific for those who work in medicine as set forth in the MBI manual, burnout was defined as having high scores for emotional exhaustion or depersonalization on the MBI.[30,37] Respondents were classified as being satisfied with their career if they selected "very satisfied" or "somewhat satisfied" on Question 1 of the professional satisfaction section of the survey. Subgroup analysis evaluating the same outcomes in respondents who described their job as "academic" versus those who did not was also performed.

After conducting univariate analysis, forward multivariable logistic regression was undertaken to assess independent associations related to the dichotomous variables of burnout and career satisfaction. Variables with $p < 0.2$ in the univariate analysis were placed in the logistic regression model initially. The same methodology was used for the subgroup analysis of academic and nonacademic neurosurgeons. Two-tailed statistical tests were performed, and $p \leq 0.05$ was determined to represent statistical significance in the univariate and multivariable analysis. The level of statistical significance for multiple comparisons was not adjusted. Results were reported as adjusted odds ratio with corresponding 95% confidence intervals. All data were analyzed using SPSS software (IBM SPSS Statistics for Windows, Version 21.0, Released 2012, IBM Corp.).

Results

Survey Results

Of the 3247 US neurosurgeons invited to complete the survey, 783 responded (24%). Responses from 33 physicians were excluded due to incompleteness on the 22-question MBI, yielding 750 completed surveys.

The majority of respondents were male, between the ages of 40 and 60 years, in a stable relationship with children, and working in a group or university practice with subspecialty training. Most worked more than 50 hours per week, took call 6 or more days per month, and completed over 200 cases annually. Just over half indicated that they had not been involved in any malpractice suits over the last 5 years (2008–2012). A detailed summary of personal and practice characteristics of the 750 survey participants is provided in Table 1.

A breakdown of responses for the survey sections on

TABLE 1. Demographic information on 750 survey respondents

Characteristic	No. (%)
Male	655 (87.3)
Age (yrs)	
≤40	90 (12.0)
41–45	142 (18.9)
46–50	135 (18.0)
51–55	145 (19.3)
56–60	121 (16.1)
61–65	74 (9.9)
>65	43 (5.7)
Relationship status	
Stable partner/married	683 (91.1)
Single	67 (8.9)
Divorced*	68 (9.1)
Children	667 (88.9)
Practice type	
Group	286 (38.1)
University	191 (25.5)
Private w/ academic affiliation	114 (15.2)
Solo	94 (12.5)
Other	42 (5.6)
Health care management organization	12 (1.6)
Veterans Affairs/government	11 (1.5)
Academic/university affiliation	308 (41.1)
Duration of practice (yrs)	
<5	73 (9.7)
5–10	121 (16.1)
11–15	153 (20.4)
16–20	117 (15.6)
20–25	124 (16.5)
>25	162 (21.6)
Any subspecialty training	418 (55.7)
Spine	132 (17.6)
Pediatrics	76 (10.1)
Cerebrovascular	55 (7.3)
Skull base	58 (7.7)
Functional & stereotactic	44 (5.9)
Other	53 (7.1)
Hours worked per week	
<40	15 (2.0)
41–50	83 (11.1)
51–60	202 (26.9)
61–70	242 (32.3)
71–80	106 (14.1)
>80	102 (13.6)
On-call days per month	
<3	60 (8.0)
3–5	129 (17.2)
6–10	333 (44.4)
>10	228 (30.4)
Cases completed annually	
<200	221 (29.5)
201–300	312 (41.6)
301–400	160 (21.3)
>400	57 (7.6)
Malpractice cases over the last 5 yrs (2008–2012)	
0	407 (54.3)
1–5	333 (44.4)
>5	10 (1.3)

* Percentage of total population (n = 750) who stated they had been through a divorce during career.

professional stressors, satisfaction, and quality of life is shown in Figs. 1–3. Too much call (59.2%), uncertainty about future earnings/health care reform (75.2%), inadequate administration time (46.9%), low salary (48.8%), and too little vacation time (43.7%) had at least a moderate impact on neurosurgeons' professional careers (Fig. 1). Participants were satisfied with the location of their practice (75.1%) and their neurosurgical colleagues (65.1%), but were dissatisfied with the time allowed for personal growth/development (44.6%) and believed that reimbursement should be improved (69.6%; Figs. 2 and 3).

Selected questions from each of the 3 sections—professional stressors, satisfaction, and quality of life—and from the general questions section of the survey are shown in Table 2. More than 80% cited that they were satisfied with their career as a neurosurgeon. Strong responses by participants included being intellectually challenged by their work (77.3%), having a spouse that understood their demanding work schedule (73.5%), and being concerned about future earnings and health care reform (53.5%).

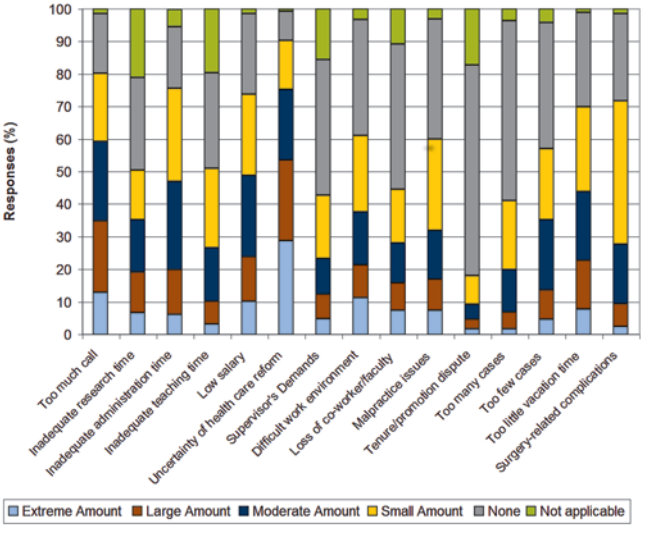

FIG. 1. Response to questions for Professional Stressors (*Appendix*, Section 2). Figure is available in color online only.

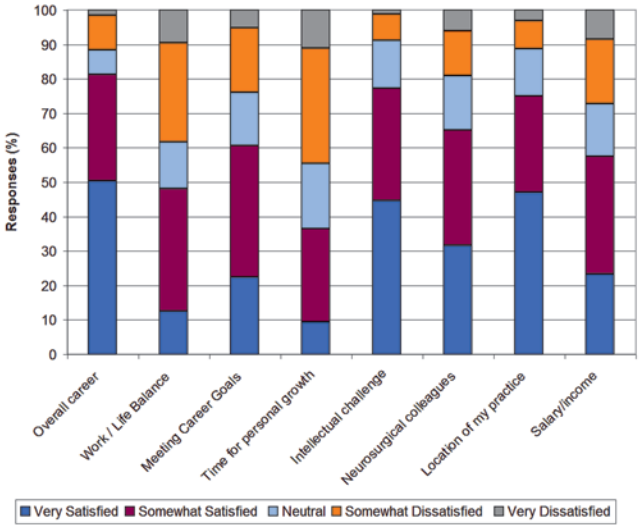

FIG. 2. Response to questions for Professional Satisfaction (*Appendix*, Section 3). Figure is available in color online only.

Only 36.5% believed that they had adequate time for personal growth/development, and 48.1% had achieved a balance between work and life. Although almost 70% of respondents would choose a career in neurosurgery again, only 35.5% would recommend neurosurgery as a career to their children.

When asked if they felt their professional life would improve, only 26% of neurosurgeons agreed. Moreover, when asked if they felt their professional life would worsen, 52% agreed, whereas only 24.8% did not. The direction neurosurgeons believe their careers will take in the future is depicted graphically in Fig. 4.

The burnout rate overall was 56.7% (Table 3). High emotional exhaustion was reported in 35.1% of neurosurgeons, high depersonalization in 31.3%, and a low sense of personal accomplishment in 28.4%.

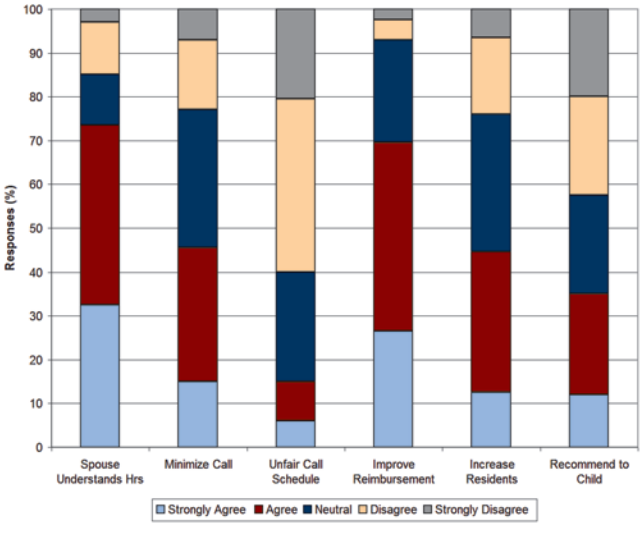

FIG. 3. Response to questions for Quality of Professional Life (*Appendix*, Section 4). Figure is available in color online only.

TABLE 2. Professional perceptions among surveyed neurosurgeons

Perception	No. (%)
Satisfied w/ career as a neurosurgeon*	609 (81.2)
Adequate time for personal development†	274 (36.5)
Challenged at work†	580 (77.3)
Good work/life balance†	361 (48.1)
Spouse understands when they work extra hours†	551 (73.5)
Would choose to be a neurosurgeon again†	512 (68.3)
Would recommend neurosurgery as a career to their children†	266 (35.5)
Uncertain of future earnings/health care reform‡	401 (53.5)

* Respondents answered "very satisfied" or "somewhat satisfied" with the factors surveyed.
† Respondents answered "strongly agree" or "agree" that they were satisfied with the factors surveyed.
‡ Respondents answered that the factors surveyed impact their practice to an "extreme amount" or a "large amount."

Predictors of Satisfaction and Burnout

The results of univariate analysis are shown in Table 4. Factors that were independently associated with career satisfaction and burnout are listed in Table 5. Six factors were predictive of burnout and 7 for career satisfaction. Being accused of malpractice (OR 1.6) and having uncertainty regarding future earnings/health care reform (OR 1.96) significantly increased the odds of being burned out, while 4 other practice characteristics or perceptions were protective. Four of the 7 factors independently associated with career satisfaction were positive correlations, including having children (OR 2.4) and a good work/life balance (OR 10.0). Achieving a balance between work and life and anxiety over future earnings/health care reform were factors shown to significantly impact the odds of both outcomes. The presence of burnout reduced the odds of being satisfied with one's career almost 6-fold (OR 0.17).

Academic Versus Nonacademic Neurosurgeons

Characteristics of academic and nonacademic neurosurgeons are shown in Table 6. Variables that were independently associated with career satisfaction and burnout among academic and nonacademic neurosurgeons are shown in Tables 7 and 8, respectively.

Discussion

Study Findings

Neurosurgery has been—and will remain—a stressful yet rewarding profession. This survey study represents the most comprehensive attempt to identify and quantify sources of satisfaction and burnout in neurosurgeons. Among all survey participants, factors shown to independently increase the odds of being satisfied with a career in neurosurgery included being surgically productive, having children, being intellectually stimulated, and achieving balance between career and life outside of work. The burnout rate overall was 56.7% (35.1% emotional exhaustion and 31.3% depersonalization), which is

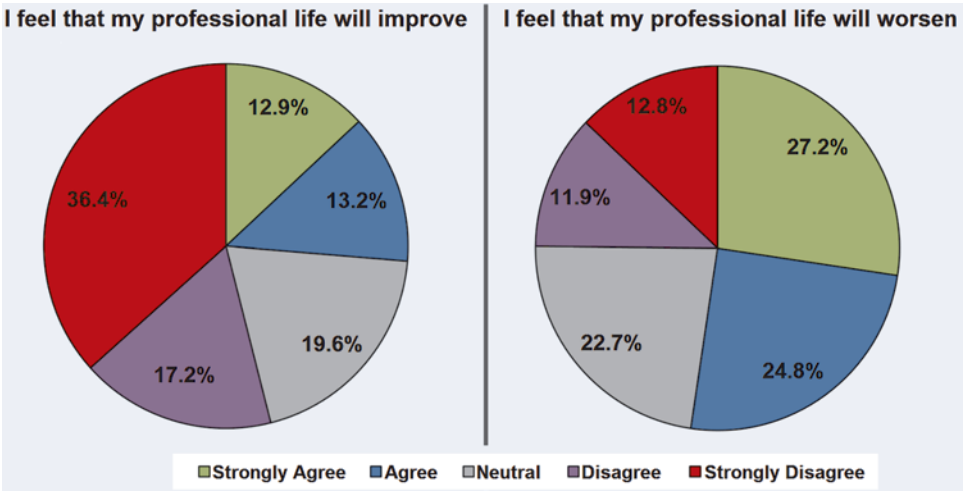

FIG. 4. Perceptions among neurosurgeons on the future direction of their career. Figure is available in color online only.

one of the highest reported rates among surgical[8,25,33,37,44,45] and nonsurgical specialties,[10,13,14,26,27,31,32,40] including those in previously published reports for neurosurgeons (Table 9).[7,23,37] Burnout was associated with malpractice litigation and uncertainty regarding future earnings and health care reform, which was also shown to decrease the odds of being satisfied with neurosurgery.

Burnout

The study of burnout and career satisfaction is immensely important in today's health care system with effects that permeate many different aspects of health care delivery. Physician burnout has been shown to lead to medical errors,[19,36,39,47,48] early retirement,[11,22,43] diminished patient satisfaction with care,[20,28] and increased malpractice suits.[21] Surgeons from every specialty are at very high risk for burnout.[7,37] The current study and prior pilot study are the only studies, to our knowledge, that have been designed specifically to garner feedback from neurosurgeons. Despite a high burnout rate among the neurosurgeons who participated in the survey, the overall career satisfaction response rate was 81.2%. Similar studies have found this seemingly paradoxical finding,[7,25] which supports the innate subjectivity of burnout assessment. Burnout can occur in transient or periodic episodes, thus causing physicians to suffer from burnout at some point in their career while still being satisfied overall. Interestingly, a physician's perception of his or her own life seems to play a significant role in the relative impact of burnout on career satisfaction.

Sources of Satisfaction and Dissatisfaction

In almost all models for satisfaction and burnout, neurosurgeons have indicated that they enjoy being challenged at work. The data presented suggest that neurosurgeons are content when they are in the early-to-middle portion of their career, are consistently challenged, and spend considerable time in the operating room. In a previous cross-sectional study, Dyrbye and colleagues examined how the stage in a physician's career affects burnout and satisfaction.[17] Physicians from all specialties in the US were analyzed and showed that the lowest satisfaction occurs at 2 times during their careers. First, during the early stages of their careers, physicians were dissatisfied with their overall career choice (that is, being a physician) because of work/home conflicts and feelings of depersonalization. Second, during the midstages of their careers, they were dissatisfied with their specialty career choice because of excessive work demands (that is, working long hours and taking overnight call).[17] This finding is contrary to data in the current study. We hypothesize that the typical neurosurgeon experiences excitement and energy in practicing independently during the early part of their career and then may achieve a "professional peak" in terms of skill level, experience, or impact during the middle portion of their career. It is reasonable to infer that the latter stage of their career may be negatively affected by greater admin-

TABLE 3. Burnout indices among 750 neurosurgeons*

Burnout Indices	Median Score (IQR)	No. (%)
Emotional exhaustion	21 (11–31)	—
Low score (≤18)	—	322 (42.9)
Moderate score	—	165 (22.0)
High score (≥27)	—	263 (35.1)
Depersonalization	6 (3–11)	—
Low score (≤5)	—	349 (46.5)
Moderate score	—	166 (22.1)
High score (≥10)	—	235 (31.3)
Personal accomplishment	38 (31–43)	—
Low score (≤33)	—	312 (28.4)
Moderate score	—	201 (26.8)
High score (≥40)	—	336 (44.8)
Burned out†	—	425 (56.7)

* All data are listed as median (25%–75% interquartile range [IQR]) unless otherwise noted.

† High score on emotional exhaustion and/or depersonalization subscales (see *Methods*).

TABLE 4. Univariate analysis of burnout and satisfaction among neurosurgeons

Characteristic	No. (%)					
	Satisfied			Burned Out		
	No	Yes	p Value	No	Yes	p Value
No. of respondents	141	609		325	425	
Age (yrs)						
<45	48 (34.0)	184 (30.2)	0.38	96 (29.5)	136 (32.0)	0.47
46–55	48 (34.0)	232 (38.1)	0.37	130 (40.0)	150 (35.3)	0.19
>55	45 (31.9)	193 (31.7)	0.96	99 (30.5)	139 (32.7)	0.51
Female	26 (18.4)	68 (11.2)	0.019	32 (9.8)	62 (14.6)	0.052
Relationship status						
Stable relationship/married	—	—	—	299 (92.0)	384 (90.4)	0.43
Single	—	—	—	26 (8.0)	41 (9.6)	0.43
Children	116 (82.3)	551 (90.5)	0.005	295 (90.8)	372 (87.5)	0.16
Academic affiliation	41 (29.1)	267 (43.8)	0.001	161 (49.5)	147 (34.6)	<0.001
Career duration						
≤10 yrs	32 (22.7)	162 (26.6)	0.34	82 (25.2)	112 (26.4)	0.73
11–20 yrs	44 (31.2)	226 (37.1)	0.19	120 (36.9)	150 (35.3)	0.65
>20 yrs	65 (46.1)	221 (36.3)	0.03	123 (37.8)	163 (38.4)	0.89
Subspecialty training	66 (46.8)	353 (58.0)	0.02	190 (58.5)	229 (53.9)	0.21
Cerebrovascular	7 (5.0)	47 (7.7)	0.25	25 (7.7)	29 (6.8)	0.65
Functional/stereotactic	7 (5.0)	37 (6.1)	0.61	24 (7.4)	20 (4.7)	0.12
Pediatrics	7 (5.0)	69 (11.3)	0.02	37 (11.4)	39 (9.2)	0.32
Spine	24 (17.0)	109 (17.9)	0.81	56 (17.2)	77 (18.1)	0.75
Skull base	12 (8.5)	46 (7.6)	0.70	26 (8.0)	32 (7.5)	0.81
Other	9 (6.4)	45 (7.4)	0.26	22 (6.8)	31 (7.3)	0.77
Productivity						
On call >10 days/mo	48 (34.0)	180 (29.6)	0.30	92 (28.3)	136 (32.0)	0.28
Performs >300 cases/yr	29 (20.6)	188 (30.9)	0.015	100 (30.8)	117 (27.5)	0.33
Work >70 hrs/wk	36 (25.5)	173 (28.4)	0.49	89 (27.4)	120 (28.2)	0.80
Accused of malpractice	70 (49.6)	273 (44.8)	0.30	121 (37.2)	222 (52.2)	<0.001
Professional perceptions						
Adequate time for personal development	7 (5.0)	267 (43.8)	<0.001	174 (53.5)	100 (23.5)	<0.001
Challenged at work	62 (44.0)	518 (85.1)	<0.001	284 (87.4)	296 (69.6)	<0.001
Good work/life balance	10 (7.1)	351 (57.6)	<0.001	216 (66.5)	145 (34.1)	<0.001
Spouse understands extra work hrs	91 (64.5)	460 (75.5)	0.008	259 (79.7)	292 (68.7)	0.001
Uncertain of future earnings/health care reform	114 (81.4)	287 (47.4)	<0.001	128 (39.5)	273 (64.8)	<0.001
Would choose neurosurgery again	33 (23.6)	479 (79.2)	<0.001	284 (87.9)	228 (54.0)	<0.001

istrative duties, less operating room time, and increased physical fatigue or personal health issues. Such challenges may contribute to the pessimistic and unfavorable outlook held by some neurosurgeons regarding their future career (Fig. 4). Age, by itself, was not predictive of burnout or achieving career satisfaction.

It is equally clear that neurosurgeons desire a good work/life balance. The professional perception of a good work/life balance was significant in all multivariable analyses. The long hours and hard work required of a neurosurgeon make it difficult to achieve a satisfactory balance. Numerous studies have addressed the impact of work/home conflicts on medical professionals and have shown that physicians with career and family imbalance, recent work/home conflicts, and recent conflicts resolved in favor of work typically have higher rates of burnout.[11,16,18] However, if a neurosurgeon perceives a good balance between work and personal life, then career satisfaction may be higher and risk of burnout may be lower.

Neurosurgeons, as with all health care workers, have been impacted in recent years by health care reform. As new measures of the Patient Protection and Affordable Care Act (PPACA) continue to be unveiled, uncertainty about the impact of health care reform may have adverse effects on the well-being of physicians. It has been suggested that health care reform poses an increased risk for burnout by augmenting physician workload, decreasing autonomy, and potentially disrupting physician work/life

TABLE 5. Multivariable logistic regression analysis of 750 survey respondents

Characteristic	OR	95% CI	p Value
Burnout*			
Accused of malpractice	1.60	1.16–2.20	0.004
Academic affiliation	0.69	0.49–0.96	0.03
Professional perceptions			
Uncertain of future earnings/ health care reform	1.96	1.41–2.72	<0.001
Challenged at work	0.60	0.39–0.93	0.02
Good work/life balance	0.45	0.31–0.65	<0.001
Adequate time for personal development	0.57	0.39–0.84	0.005
Satisfaction†			
Having children	2.4	1.2–4.8	0.01
Completing >300 cases/yr	1.77	1.03–3.03	0.04
Professional perceptions			
Uncertain of future earnings/ health care reform	0.32	0.19–0.55	<0.001
Challenged at work	4.6	2.9–7.4	<0.001
Good work/life balance	10.0	4.9–20.3	<0.001
Burned out	0.17	0.08–0.32	<0.001
Practiced for >20 yrs	0.61	0.38–0.97	0.04

* The sex of the respondent and the perception of having a spouse who understands the need for expanded work hours did not predict outcome. The area under the receiver operating characteristic curve (AUC) = 0.89 (95% CI 0.87–0.92).

† The sex of the respondent, specialty training, academic affiliation, perception of adequate time for development or a spouse who understands the need for expanded work hours did not predict outcome. The AUC = 0.74 (95% CI 0.71–0.78).

balance.[15] The economic implications of health care reform on a neurosurgeon's practice should also be considered as a source of anxiety. To our knowledge, no previous study has assessed this issue despite the potential for changes in the US health care system to exacerbate burnout. Our data revealed that career satisfaction among US neurosurgeons is strongly impacted by the uncertainty of future earnings and health care reform. More importantly, those who feel this uncertainty in their practice have an increased risk for burnout.

Medical malpractice was another important characteristic associated with burnout. Malpractice, which was not addressed by the PPACA, has been shown to strongly influence physician burnout, depression, and suicidal ideation among surgeons.[3] Physicians who had experienced medical malpractice were more likely to score a higher burnout level in all 3 domains assessed by the MBI.[12] Even though less than half of the polled neurosurgeons were involved in malpractice suits over a 5-year period (2008–2012), malpractice was still found to be associated with an increased risk of burnout and can affect patient care.

Academic Versus Nonacademic Neurosurgeons

Another intriguing aspect of the present study was our comparison of academic and nonacademic neurosurgeons. Many of the predictors of satisfaction and burnout were shared between the 2 groups. Both were more likely to be satisfied if they felt challenged at work and perceived themselves as having a good work/life balance. They were less likely to be satisfied if they were considered burned out. Academic neurosurgery had a lower rate of burnout than nonacademic neurosurgery (47.7% vs 62.9%). These results were similar to those in previous studies in which private-practice general surgeons and oncologists had a greater burnout risk and lower career satisfaction rate.[7,40] Previous research has suggested that nonacademic surgeons may be at greater risk because of the higher average number of call days, the longer hours worked per week, or earnings based entirely on billing.[37] In contrast to their academic colleagues, who are more likely to be salaried, nonacademic neurosurgeons in our study also had lower levels of career satisfaction when they reported uncertainty about future earnings and health care reform.

Interestingly, academic neurosurgeons were less likely to be satisfied with their careers if they had practiced as a neurosurgeon for more than 20 years. This finding suggests that while burnout may be an overall problem for nonacademic neurosurgeons, it may be a bigger problem for more senior academicians. Academia presents unique stressors, such as administrative and teaching responsibilities, tenure applications, and research requirements. These additional obligations may promote burnout as the number of years that such stressors are experienced increases and by leaving inadequate time for personal development, which, as found in our study, decreases satisfaction. It is also possible that more specialized academic neurosurgeons may be at an increased risk of burnout given the impact of repetition and decreased operative variability.[40]

Study Limitations

Our response rate of 24% was reasonable but on the lower end of the spectrum compared with the rates in other studies listed in Table 9. We did not offer any incentive(s) to participate as others have, although doing so may have improved our response rate. This study may suffer from selection bias whereby individuals who completed the survey may be different as a group compared with those who did not complete the survey. For example, those who currently suffer from burnout or career dissatisfaction may be less likely to take the time to complete a voluntary survey, which would underestimate the prevalence of both outcomes, or vice versa.[23] Another example of selection bias relates to the results of our earlier pilot study. That study had 85 respondents, most of whom were in academics or had an academic affiliation (73%). The senior author (P.K.) personally asked many of them to participate in the pilot study, resulting in a higher response rate (50%). On virtually all measures, the pilot study respondents seemed to be a "happier" group than the 750 neurosurgeons in the present study (which includes the 85 in the pilot study). For example, the neurosurgeons in the pilot study had a lower burnout rate (27% vs 57%), higher overall satisfaction (96% vs 81.2%), greater work/life balance (74% vs 48.1), and greater likelihood of choosing neurosurgery again as a career (88% vs 68.3%). While results of the present study

TABLE 6. Univariate analysis of burnout and satisfaction among academic versus nonacademic neurosurgeons*

Characteristic	Academic Neurosurgeons				Nonacademic Neurosurgeons			
	Satisfied		Burned Out		Satisfied		Burned Out	
	No	Yes	No	Yes	No	Yes	No	Yes
No. of neurosurgeons	41	267	161	147	100	342	164	278
Age in yrs								
≤45	15 (36.6)	107 (40.1)	61 (37.9)	61 (41.5)	33 (33)†	77 (22.5)†	35 (21.3)†	75 (27)†
46–55	14 (34.1)	92 (34.5)	58 (36.0)	48 (32.7)	34 (34)†	140 (40.9)†	72 (43.9)	102 (36.7)
>55	12 (29.3)	68 (25.5)	42 (26.1)	38 (25.9)	33 (33)	125 (36.5)	57 (34.8)	101 (36.3)
Female	7 (17.1)	38 (14.2)	19 (11.8)†	26 (17.7)†	19 (19.0)†	30 (8.8)†	13 (7.9)†	36 (12.9)†
Relationship status								
Stable relationship/married	38 (92.7)	242 (90.6)	147 (91.3)	133 (90.5)	90 (90)	313 (91.5)	152 (92.7)	251 (90.3)
Single	3 (7.3)	25 (9.4)	14 (8.7)	14 (9.5)	10 (10)	29 (8.5)	12 (7.3)	27 (9.7)
Children	33 (80.5)	233 (87.3)	144 (89.4)†	122 (83.0)†	83 (83)†	318 (93.0)†	151 (92.1)	250 (89.9)
Career duration								
≤10 yrs	10 (24.4)	74 (27.7)	45 (48)	39 (26.5)	22 (22)	88 (25.7)	37 (22.6)	73 (26.3)
11–20 yrs	11 (26.8)	108 (40.4)	64 (39.8)	55 (37.4)	33 (33.0)	118 (34.5)	56 (34.1)	95 (34.2)
>20 yrs	42 (48.8)†	85 (31.8)†	52 (32.3)	53 (36.1)	45 (45)	136 (39.8)	71 (43.3)	110 (39.6)
Subspecialty training	27 (65.9)	206 (77.2)	119 (73.9)	114 (77.6)	39 (39)	147 (43)	71 (43.3)	115 (41.4)
Productivity								
On call >10 days/mo	11 (26.8)	57 (21.3)	34 (21.1)	34 (23.1)	37 (37)	123 (36)	58 (35.4)	102 (36.7)
Performs >300 cases/yr	6 (14.6)†	73 (27.3)†	46 (28.6)	33 (22.4)	23 (23)†	115 (33.6)†	54 (32.9)	84 (30.2)
Work >70 hrs/wk	15 (36.6)	85 (31.8)	47 (29.2)†	53 (36.1)†	21 (21)	88 (25.7)	42 (25.6)	67 (24.1)
Accused of malpractice	17 (41.5)	115 (43.1)	57 (35.4)†	75 (51.0)†	53 (53)	158 (46.2)	64 (39)†	147 (52.9)†
Professional perceptions								
Adequate time for personal development	2 (4.9)†	125 (46.8)†	93 (57.8)†	34 (23.1)†	5 (5)†	142 (41.5)†	81 (49.4)†	66 (23.7)†
Challenged at work	23 (56.1)†	245 (91.8)†	148 (91.9)†	120 (81.6)†	39 (39)†	273 (79.8)†	136 (82.9)†	176 (63.3)†
Good work/life balance	4 (9.8)†	157 (58.8)†	108 (67.1)†	53 (36.1)†	6 (6)†	194 (56.7)†	108 (65.9)†	92 (33.1)†
Spouse understands extra work hours	30 (73.2)	201 (75.3)	124 (77)	107 (72.8)	61 (61)†	259 (75.7)†	135 (82.3)†	185 (66.5)†
Uncertain of future earnings/ health care reform	26 (65.0)†	104 (39.1)†	50 (31.3)†	80 (54.8)†	88 (88)†	183 (54)†	78 (47.6)†	193 (70.2)†

* Values expressed as number (%).
† Included in multivariable logistic regression due to p value < 0.2.

are internally valid, the results may not be completely generalizable to surgeons who did not complete the survey. Nonetheless, we think that the 750 survey respondents in the current study are probably a more representative sample of US neurosurgeons than the 85 participants in the pilot study, and thus the full sample provides a more accurate assessment of burnout and job satisfaction.

Neurosurgeons are constantly asked to participate in various surveys, which leads to apathy or "survey fatigue," making it difficult to conduct such studies. The results may not be applicable to neurosurgeons outside the US, although it is reasonable to assume that there is some degree of universality in terms of sources of stress and satisfaction among all neurosurgeons, regardless of practice location. As with any survey study, some of the questions may not have been clearly understood by all participants. For example, the divorce rate of the neurosurgeons sampled was only 9.1%. This is significantly lower than previously published rates, suggesting that miscommunication probably occurred at some level of survey administration.[16,37] Shortening the survey was necessary to improve our response rate; however, doing so resulted in less information in comparison with that in the pilot study. Nonetheless, we believe that the shortened survey was able to capture the important aspects of a career that have direct relevance on satisfaction, stress, and burnout.

Future Studies

To safely and reliably provide for the needs of the increasing patient population in the US, it is essential that individual and organizational interventions be created to diminish the potency of potential stressors in all medical specialties that can lead to unhealthy levels of stress and burnout.[29,41,42] Such programs could be tailored to practice types (for example, academic vs private vs hospital based) based on research that would further clarify predictors of

TABLE 7. Multivariable logistic regression analysis of 308 academic neurosurgeons

Characteristic	OR	95% CI	p Value
Burnout*			
Professional perceptions			
Uncertain of future earnings/ health care reform	2.03	1.23–3.34	0.005
Adequate time for personal development	0.37	0.20–0.68	0.001
Good work/life balance	0.55	0.30–0.99	0.04
Satisfaction†			
Professional perceptions			
Good work/life balance	7.47	2.4–23.7	0.001
Challenged at work	5.68	2.3–14.0	<0.001
Practiced >20 yrs	0.34	0.15–0.78	0.01
Burned out	0.074	0.02–0.26	<0.001

* The sex of the respondent, having children, working more than 70 hours/ week, being accused of malpractice, and being challenged at work did not predict outcome. The AUC = 0.73 (95% CI 0.67–0.78).
† Caseload, uncertainty about future earning potential due to health care reform, the perception of having adequate time for personal growth, and subspecialty training did not predict outcome. The AUC = 0.89 (95% CI 0.85–0.94).

TABLE 8. Multivariable logistic regression analysis of 442 nonacademic neurosurgeons

Characteristic	OR	95% CI	p Value
Burnout*			
Accused of malpractice	1.69	1.11–2.58	0.15
Professional perceptions			
Good work/life balance	0.34	0.22–0.52	<0.001
Challenged at work	0.49	0.29–0.81	0.005
Uncertain of future earnings/ health care reform	1.96	1.28–3.02	0.002
Satisfaction†			
Having children	4.75	1.91–11.82	0.001
Professional perceptions			
Good work/life balance	11.99	4.80–29.93	<0.001
Challenged at work	4.70	2.63–8.37	<0.001
Uncertain of future earnings/ health care reform	0.19	0.86–0.41	<0.001
Burned out	0.23	0.10–0.53	0.001

* The sex of the respondent, working more than 70 hours/week, an age < 46 years, the perception of having adequate time for personal growth, and the perception of having a spouse who understands extra work hours did not predict outcome. The AUC = 0.73 (95% CI 0.68–0.78).
† Caseload, the perception of having adequate time for personal growth, an age < 46 years, the sex of the respondent, and the perception of having a spouse who understands the need for expanded work hours did not predict outcome. The AUC = 0.88 (95% CI 0.85–0.91).

TABLE 9. Burnout rates for various surgical and nonsurgical specialties

Specialty	Burnout Rate (%)	No. of Participants (Response Rate)
Neurosurgery (current)	57	783 (24%)
Neurosurgery (pilot)[23]	27	85 (50%)
Plastic surgery[45]	29	505 (71%)*
Orthopedic surgery[33]	28	264 (24%)
Surgical oncology[25]	28	549 (36%)
British colorectal and vascular surgeons[44]	32	501 (59%)†
Transplant surgery[8]	38	259 (35%)
American surgeons[37]	40	7905 (32%)
Clinical oncology[40]	45	1490 (50%)‡
NICU physicians[32]	15	204 (not given)§
Switzerland ICU physicians[31]	31	465 (69%)
Italian psychiatrists[10]	49	81 (70%)
Emergency medicine[26]	32	193 (43%)
New Zealand public hospital radiologists[27]	23	136 (51%)
Ophthalmology chairs[13]	9	101 (77%)
Infectious disease[14]	44	1840 (46%)

ICU = intensive care unit; NICU = neonatal ICU.
* Participants were offered a cash gift for completion.
† Response rate was 55.6% for colorectal surgeons and 62.3% for vascular surgeons.
‡ Participants were offered a free American Society of Clinical Oncology educational product for completion.
§ Response rate only given for entire study population, of which NICU physicians accounted for only 10%.

job satisfaction and burnout. Some researchers have already begun work on programs to reduce stress and burnout.[24,46] An intervention involving facilitated physician discussion groups around mindfulness, reflection, shared experience, and small-group learning has shown increased empowerment and engagement at work, decreased rates of depersonalization, and decreased overall burnout among participating physicians.[46] Another intervention that offered an educational course on mindfulness meditation, self-awareness, and meaningful clinical narratives was shown to improve scores for mindfulness, burnout, depersonalization, personal accomplishment, and empathy.[24] Finally, it would be interesting to repeat this study in the future to ascertain the full impact of health care reform.

Conclusions

Neurosurgery is a rewarding career choice, but there are many challenges and stressors that can lead to lower levels of satisfaction and dangerously increased levels of burnout. This may translate into negative medical experiences for surgeons, patients, and their families. Factors independently associated with burnout and career satisfaction were identified for all study participants, including academic and nonacademic neurosurgeons. Neurosurgeons desire intellectual and technical challenges and a positive balance between work and life. Uncertainty regarding future earnings and health care reform are major sources of discontent and burnout. We hope these results will generate discussion, raise awareness, stimulate further studies,

and lead to programs designed to mitigate excessive stress and burnout within neurosurgery.

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Author Contributions

Conception and design: Klimo, Ragel, McCartney, DeCuypere, Cheng, Boop. Acquisition of data: McCartney. Analysis and interpretation of data: Klimo. Drafting the article: Klimo, McAbee. Critically revising the article: Klimo, McAbee. Reviewed submitted version of manuscript: Klimo, McAbee, Jones, Michael, DeCuypere, Boop. Approved the final version of the manuscript on behalf of all authors: Klimo. Statistical analysis: Jones. Administrative/technical/material support: McCartney, Cheng. Study supervision: Klimo.

Correspondence

Paul Klimo Jr., Department of Neurosurgery, Le Bonheur Children's Hospital, 50 N. Dunlap St., Memphis, TN 38103. email: pklimo@semmes-murphey.com.

Appendix

Neurosurgeon Career and Lifestyle Satisfaction Survey

Section 1: Demographic Questions

Question	Survey Response Categories	Categories Analyzed*
What is your age (years)?	<40 41–45	<46
	46–50 51–55	46–55
	56–60 61–65 >65	>55
What is your gender?	Male Female	No change
What is your marital status?	Married Stable partner Divorced and remarried	Currently married or in a stable relationship
	Separated Divorced Single	Currently single
What is your practice type?	Group University Private with academic affiliation Solo	No change
	Health management organization VA/government hospital City/county hospital Other	Other
How many years have you been in practice?	<5 5–10	≤10
	11–15 16–20	11–20
	21–25 >25	>20
Have you received formal subspecialty training?	None Cerebrovascular Functional/stereotactic Pediatrics Spine Skull base	No change
	Endovascular Neurotrauma Other	Other
On average, how many hours do you work per week?	<30 30–40 41–50 51–60 61–70	≤70
	71–80 >80	>70

(continued)

Section 1: Demographic Questions *(continued)*

Question	Survey Response Categories	Categories Analyzed*
How many days of call do you take per month?	<3 3–5 6–10	<10
	>10	No change
On average, how many operative cases do you perform annually?	<100 100–150 151–200 201–250 251–300	≤300
	301–350 350–400 >400	>300
Over the last 5 years, how many times have you been named in a malpractice lawsuit?	None	No change
	1–5	At least once

VA = Veterans Affairs.
* Survey response categories were combined into categories for the purposes of statistical analysis based on previously published literature and the number of responses by persons completing the survey. All categories were determined prior to completion of any statistical analysis.

Section 2: Professional Stressors

Question	To what extent have the following factors affected you in your practice over the last 12–24 months?	
Factors	Too much call	Sexual harassment
	Inadequate research time	Malpractice issues
	Inadequate administration time	Too many cases
	Inadequate teaching time	Too few cases
	Low salary/income	Too little vacation time
	Chairman's/Senior Partner's demands	Surgery-related complications
	Hostile or difficult work environment	Loss of coworker/faculty
	Tenure/promotion issues	Uncertainty of future earnings/health care reform*
Answers	Not at all Small amount Moderate amount	Large amount Extreme amount Not applicable

* Respondents selecting "large amount" or "extreme amount" were classified on a dichotomous scale as having the factor of interest (yes) for the purposes of statistical analysis.

Section 3: Professional Satisfaction

Question	In relation to your practice, how satisfied are you with the factors listed below?	
Factors	Overall career as a neurosurgeon*	Intellectually challenged at work*
	Balance between professional and personal life*	Neurosurgical colleagues
	Meeting your career expectations/goals	Location of practice
	Time for personal growth/development*	Salary/income
Answers	Very satisfied Somewhat satisfied Neutral	Somewhat dissatisfied Very dissatisfied Not applicable

* Respondents selecting "very satisfied" or "somewhat satisfied" were classified on a dichotomous scale as having the factor of interest (yes) for the purposes of statistical analysis.

Section 4: Quality of Life

Question	Please respond to the following statements below:	
Factors	My spouse/partner understands when I have to work extra hours	My practice should improve its reimbursement
	My practice should minimize emergency call	My practice should work harder to diminish litigation
	My practice has an unfair call schedule	I would recommend neurosurgery to my child as a career
	My practice/program should increase the number of residents/physician extenders	
Answers	Strongly agree Agree Neutral	Disagree Strongly disagree Not applicable

Section 5: Maslach Burnout Inventory*

Question	How often do you experience the following?	
Factors	1. I feel emotionally drained from my work	
	2. I feel used up at the end of the day	
	3. I feel fatigued when I get up in the morning to face another workday	
Answers	Never Few times a year Monthly Few times a month	Weekly Few times a week Daily

* Sample of first 3 questions; the inventory consists of 22 questions total.

Section 6: General Questions

Question	Answer
If you were a 4th year medical student, would you still choose to pursue neurosurgery as a career?	Yes No
How likely do you feel that your professional life will improve?*	Likely Somewhat likely Not sure Somewhat unlikely Unlikely
How likely do you feel that your professional life will worsen?*	Likely Somewhat likely Not sure Somewhat unlikely Unlikely
Please provide the most rewarding aspect of your career.	Written answer
Please provide the most frustrating aspect of your career.	Written answer

* Respondents selecting "likely" or "somewhat likely" were classified on a dichotomous scale as having the factor of interest (yes) for the purposes of statistical analysis.