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Levels of burnout and its association with resilience and coping mechanisms among orthopaedic surgery residents: a single institution experience from Singapore

Sean WL Ho[1], MBBS, FRCSEd, Ernest BK Kwek[2], MBBS, FRCSEd

[1]Department of Orthopaedic Surgery, Tan Tock Seng Hospital, Singapore
[2]Department of Orthopaedic Surgery, Woodlands Health Campus, Singapore

Correspondence: Dr Sean WL Ho, Consultant, Department of Orthopaedic Surgery, Tan Tock Seng Hospital, 11 Jalan Tan Tock Seng, Singapore 308433. sean_WL_HO@ttsh.com.sg

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ABSTRACT

Introduction: Burnout has implications for surgeon wellbeing and patient care. We aimed to: (a) describe burnout levels among orthopaedic surgery residents in an Accreditation Council for Graduate Medical Education-International (ACGME-I) accredited programme; and (b) determine associations between burnout levels and resident characteristics, resilience and coping mechanisms.

Methods: This is a grant-funded, cross-sectional questionnaire-based study that included 44 orthopaedic surgery residents. Burnout was measured using Maslach Burnout Inventory and resilience was determined using the Short Grit Scale. Coping mechanisms were determined using the Brief Coping Orientation to Problems Experienced scale.

Results: 20 (45.5%) residents fulfilled the criteria for burnout. High levels of emotional exhaustion (EE) and depersonalisation (DP) correlated with stressors, such as inadequate sleep (EE: $r = 0.43$, $p < 0.01$; DP: $r = 0.33$, $p < 0.05$), conflict between family and work (EE: $r = 0.40$, $p < 0.01$; DP: $r = 0.40$, $p < 0.01$), financial pressure (DP: $r = 0.46$, $p < 0.01$), and conflict with residents (EE: $r = 0.35$, $p < 0.05$; DP: $r = 0.34$, $p < 0.05$) and faculty (EE: $r = 0.44$, $p < 0.01$; DP: $r = 0.35$, $p < 0.05$). Severe burnout was associated with lower grit scores ($p < 0.05$). Coping mechanisms, such as planning and positive reframing, were protective while behavioural disengagement and substance use may increase burnout risk.

Conclusion: Burnout was high in our ACGME-I accredited programme. Stressors associated with higher burnout included feeling of inadequate sleep, poor work-life balance, poor relationships with fellow residents/faculty and financial pressures. Residents should be educated on protective coping mechanisms and regular screening to detect burnout should be performed.

Keywords: burnout, coping, orthopaedic surgery, residents, resilience

INTRODUCTION

Burnout is defined by Maslach and Jackson as a syndrome of emotional exhaustion (EE), depersonalisation (DP) and a reduced sense of personal accomplishment (PA) among individuals who work with people in some capacity.[1] Given the high demands of medical care, it is unsurprising that medical professionals are at significant risk of burnout.[2] Burnout is an important issue to recognise in the healthcare industry, as it has a serious impact on both clinician wellbeing and patient care.[3,4] Burnout is associated with an increased risk of depression and, alarmingly, physician suicide rates have been shown to approximate twice that of the general population.[3,5] Recent literature also suggests that burnout can result in poorer surgical performance and is associated with increased medical error.[3] As such, there is an increasing emphasis on detection and possible prevention of burnout among the various subspecialties of medicine.[6-9]

The rates of burnout in orthopaedic surgery have been shown to be higher than those in the general population and in many other medical subspecialties.[10] Orthopaedic surgery training is demanding due to the simultaneous need for both accruement of knowledge and acquisition of surgical skills. In particular, the residency period can be a stressful time. Residents are often under higher stress levels and, consequently, have demonstrated higher burnout rates than faculty.[11] The Accreditation Council for Graduate Medical Education (ACGME) have explored ways of reducing stress through policy change and greater awareness. To date, there is literature describing the rates of burnout in orthopaedic surgery residents in the ACGME institutions in the United States,[11] but limited data exists on burnout within ACGME-International (ACGME-I) accredited programmes elsewhere.

Central to the development of burnout is the coping ability of the individual. Lazarus and Folkman[12] described various coping strategies that included problem-focused, emotional-focused and meaning-focused coping approaches. To the best of our knowledge, the effects of

these various coping mechanisms on battling burnout in orthopaedic surgery residents is not well established.

The primary aim of this study was to describe the levels of burnout and psychological morbidity among orthopaedic surgery residents in an ACGME-I accredited programme at a single institution. The secondary aim was to determine the associations between levels of burnout and resident characteristics, resilience and coping mechanisms.

METHODS

This was a cross-sectional grant-funded study. The study group consisted of all orthopaedic surgery residents in a mature ACGME-I accredited programme from a single institute in Singapore. A questionnaire was administered to all eligible participants on a voluntary basis. All replies were anonymous.

The questionnaire consisted of 121 questions and was divided into seven sections: demographics and background; Maslach Burnout Inventory-Human Services Survey (MBI-HSS); General Health Questionnaire-12 (GHQ-12); Brief Coping Orientation to Problems Experienced (Brief COPE) scale; Short Grit Scale (GRIT-S); Revised Dyadic Adjustment Scale (RDAS); and subjective stressors.

Demographics of the study participants were collected and included age, gender and ethnicity. The background assessment collected data regarding medical education, year of residency, orthopaedic experience prior to entering residency, marital status, number of children, family background and academic pursuits.

The MBI-HSS is a validated survey instrument consisting of 22 questions. It is designed to assess three subscales: EE; DP; and PA. These continuous subscales can be used to determine burnout, with norms for medical workers having previously been established.[13] However, there is currently no universal agreement on how to use the MBI-HSS as a

dichotomous variable to determine burnout. This study defined burnout as individuals who scored in the upper one-third of either EE or DP. This was in line with published literature that has shown that high scores in EE and/or DP, but not low scores in PA, can distinguish clinically burned-out individuals.[14] Severe burnout was defined as residents who scored in the upper one-third of both EE and DP, as well as the lower one-third of PA.

The full General Health Questionnaire (GHQ) consists of 60 questions and can be used to identify minor psychiatric disorders in the general population.[15] We opted for the shorter GHQ-12, which has been validated to be able to detect psychological morbidity and depressive disorder.[16-18] A cut-off score ≥ 4 to detect psychological distress was employed for the purposes of this study.[14]

The Brief COPE scale[19] consists of 28 questions on a four-point Likert scale that included 'I haven't been doing this at all', 'I've been doing this a little bit', 'I've been doing this a medium amount' and 'I've been doing this a lot'. The instrument is used to detect coping mechanisms and divides responses into 14 subscales: active coping; planning; positive reframing; acceptance; humour; turning to religion; using emotional support; using instrumental support; self-distraction; denial; venting; substance use; behavioural disengagement; and self-blame.

Grit is defined as the capacity to sustain both effort and interest in projects that take months or even longer to complete.[20] The GRIT-S was developed and validated by Duckworth and Quinn[21] as an eight-question scale to determine grit. We utilised this scale to measure participants' trait-level perseverance and passion for long-term goals, as a reflection of resilience.

The 14-item RDAS is a validated instrument that assesses relationship adjustment, which is the quality of the relationship, as determined by the individual.[22] The RDAS was utilised in this study to determine the presence of a distressed relationship in all residents who

were married or in a committed relationship. Scores < 46 were considered to be indicative of a distressed relationship.[22]

Participants were made to answer 25 questions regarding subjective stressors, which included personal and work-life conflicts, work environment, surgical complications as well as financial and employment prospects. Participants were also asked about their satisfaction with the current training programme.

Descriptive statistics were performed for the demographic and background variables. Univariate comparisons of means were done using the Student's *t*-test. Correlations and its clinical significance were calculated using the Spearman's correlation and Pearson correlation coefficients. A p-value < 0.05 was taken to be statistically significant while p-values in the range 0.05–0.1 were considered to suggest a trend. Data was analysed using correlations and linear regression analysis was performed using Stata version 15 (StataCorp LP, College Station, TX, USA).

RESULTS

Out of a total of 44 orthopaedic surgery residents within the programme, all (100.0%) participated in the study. There were 40 (90.9%) men and 4 (9.1%) women. Mean age was 31.4 ± 2.3 years. 28 (63.6%) residents were married, out of which 16 (36.4%) had children. In terms of medical education, about one-third (34.1%) of all residents had studied in foreign medical schools. At the point of entering residency, our residents had completed a median 2.0 (range 0–12) postings (or six-month rotations) in orthopaedic surgery. The mean reported working hours per week was 69.1 ± 12.7 hours. The mean reported sleeping hours per day was 6.1 ± 0.8 hours, with the mean reported duration of exercise per week being 91.2 ± 128.1 minutes. There was no significant difference between working hours per week, sleeping hours per day

or duration of exercise per week between junior and senior residents. Participant characteristics are summarised in Table I.

Table I. Demographics of orthopaedic surgery residents (n = 44).

Demographic	No. (%)
Gender	
Men	40 (90.9)
Women	4 (9.1)
Age (yr)†	31.4 ± 2.3
≤ 30	18 (40.9)
> 30	26 (59.1)
Family status	
Single	16 (36.4)
Married	28 (63.6)
Children	16 (36.4)
Medical education	
Local education	29 (65.9)
Foreign education	15 (34.1)
Postgraduate year*	6.0 (4–15)
No. of non-trainee postings (6 mth) prior to acceptance in programme*	2.0 (0–12)
Working hours per wk†	69.1 ± 12.7
Junior residents	69.0 ± 7.8
Senior residents	69.2 ± 16.0
Sleeping hours per day†	6.1 ± 0.8
Exercise (min/wk)†	91.2 ± 128.1

*Data presented as *median (range) and †mean ± standard deviation.*

Using MBI-HSS, there was a total of 20 (45.5%) participants who scored in the upper one-third of either the EE or DP subscale. Out of the 20 participants, 8 (40.0%) fulfilled the criteria for burnout in one subscale and 12 (60.0%) participants fulfilled the criteria for burnout in both EE and DP. 10 (50.0%) residents fulfilled the criteria for severe burnout. Assessing the subscales individually, 14 (31.8%) participants scored high in the EE subscale with 18 (40.9%) participants and 12 (27.3%) participants scoring moderate and low in the subscale, respectively. In the DP subscale, 18 (40.9%) participants scored high while 18 (40.9%) participants and 8 (18.2%) participants scored moderate and low in the subscale, respectively. In the PA subscale, 25 (56.8%) participants scored low while 14 (31.8%) participants and 5

(11.4%) participants scored moderate and high in the subscale, respectively. The mean scores of the individual burnout subscales are presented in Table II.

Table II. Burnout subscales of orthopaedic surgery residents based on the MBI-HSS.

Variable	Norm*	Resident	p-value
Emotional exhaustion	22 ± 9.5	23.0 ± 9.48	0.51
Depersonalisation	7.1 ± 5.22	11.3 ± 5.35	< 0.0001†
Personal achievement	36.5 ± 7.3	30.9 ± 5.56	< 0.0001†

**Based on norms established previously for doctors and nurses.*[13] †*p < 0.05 was considered statistically significant. MBI-HSS: Maslach Burnout Inventory-Human Services Survey*

17 (38.6%) residents scored ≥ 4 on the GHQ-12 questionnaire, which reflects psychological morbidity. There was no significant association between psychological morbidity and the level of burnout. 38 (86.4%) residents reported that they were married or in a committed relationship. 11 of these 38 (28.9%) residents scored < 46 points on the RDAS, reflecting a distressed relationship. There was no significant association between a distressed relationship and the development of burnout.

There was no difference in demographics, such as age, gender, marital status and having children, between residents with high levels of emotional exhaustion and those with moderate or low levels of the same. Place of medical education, number of medical officer postings completed and postgraduate years of study did not correlate significantly with the levels of emotional exhaustion.

High levels of EE correlated with external stressors, such as inadequate sleep ($r = 0.43$, $p < 0.01$), feeling conflict between family and work ($r = 0.40$, $p < 0.01$) and conflicts with fellow residents ($r = 0.35$, $p < 0.05$) and faculty ($r = 0.44$, $p < 0.01$). Residents in the upper one-third of the EE subscale were also significantly less satisfied in the residency programme ($p < 0.01$). As such, they were also less likely to choose the orthopaedic surgery residency programme again ($p < 0.01$).

Residents who reported high levels of EE did not have significantly higher psychological morbidity, as determined by the GHQ-12, nor did they report higher relationship issues, as per the RDAS. GRIT-S score was not significantly lower in residents with high levels of EE. There were no specific coping strategies associated with high EE, although residents with high levels of EE were more likely to utilise substance use as a form of coping ($p = 0.06$).

Similar to EE, there was no difference in demographics, such as age, gender, marital status and having children, between residents with high levels of DP and those with moderate or low levels of DP. Place of medical education, number of medical officer postings done and postgraduate years of study did not correlate significantly with the levels of DP.

There were several subjective stressors that correlated positively with higher levels of DP (Table III). High levels of DP correlated with feeling conflict between family and work ($r = 0.40$, $p < 0.01$), concern regarding financial pressures ($r = 0.46$, $p < 0.01$) as well as conflicts with fellow residents ($r = 0.34$, $p < 0.05$) and faculty ($r = 0.35$ $p < 0.05$).

Table III. Correlation of external stressors with the subscales of the MBI-HSS.

Variable	Correlation coefficient (rho, p-value)		
	Emotional exhaustion	**Depersonalisation**	**Personal achievement**
Inadequate sleep	0.43, < 0.01	0.33, < 0.05	−0.39, < 0.01
Conflict between work and family	0.40, < 0.01	0.40, < 0.01	0.11, 0.47
Conflicts with residents	0.35, < 0.05	0.34, < 0.05	0.10, 0.51
Conflicts with faculty	0.44, < 0.01	0.35, < 0.05	0.07, 0.66
Financial pressure	0.17, 0.27	0.46, < 0.01	0.17, 0.28

MBI-HSS: Maslach Burnout Inventory-Human Services Survey

With regard to coping mechanisms, higher DP scores correlated with emotional-focused coping mechanisms, such as substance use ($r = 0.45$, $p < 0.01$) and behavioural disengagement ($r = 0.31$, $p < 0.05$). There was a positive correlation between levels of DP and

the GRIT-S score ($r = 0.44$, $p < 0.01$), although DP did not correlate significantly with the RDAS or GHQ-12 scores.

Levels of PA did not correlate significantly with demographics, such as age, gender, marital status and having children. In addition, there were no significant stressors that predisposed residents to low PA.

Low levels of personal achievement correlated with inadequate sleep ($r = -0.39$, $p < 0.01$). There were no significant correlations with other external stressors, GRIT-S score, RDAS or GHQ-12 scores. In terms of coping mechanisms, there was a positive correlation between levels of PA and positive reframing ($r = 0.32$, $p < 0.05$) as well as a negative correlation between levels of PA and behavioural disengagement ($r = -0.38$, $p < 0.05$).

Residents who suffered from severe burnout were more likely to feel that they had inadequate sleep ($p < 0.05$), feel conflicted between work and personal time ($p < 0.05$), feel stressed by research requirements ($p < 0.05$), have poor relationships with the faculty ($p < 0.05$) and suffer from financial pressures ($p < 0.01$). There was no significant difference in demographics, education and clinical experience between residents with and without severe burnout. In terms of resident resilience, there was a significant difference in the GRIT-S score between residents suffering from severe burnout and those without severe burnout ($p < 0.05$). Residents that did not suffer from severe burnout were more likely to use planning as a coping mechanism ($p < 0.05$). Residents who suffered from severe burnout tended towards using behavioural disengagement ($p = 0.06$) and substance use ($p = 0.07$) as coping mechanisms. Residents with severe burnout were less likely to choose orthopaedic surgery residency again ($p < 0.01$).

DISCUSSION

Surgical training is a challenging and stressful endeavour, with residents expected to improve surgical skills and sharpen their theoretical knowledge concurrently. Training programmes have implemented various surgical training techniques, such as directly observed procedures, in a bid to improve surgical training. However, while it is important to maximise surgical training and improve outcomes, it is of equal importance to monitor residents' mental health and prevent psychological morbidity.

In our study, we reviewed orthopaedic surgical residents under an ACGME-I accredited programme. Our results showed 31.8% of residents scoring high for EE, 40.9% scoring high for DP and 56.8% scoring low for PA. Our results are similar to U.S. data that reported 32% of residents scoring highly for EE and 56% for DP.[11] However, a majority of our residents had lower scores in PA (56.8% vs. 18%). There were no significant differences in demographics between burnout and non-burnout residents. The burnout rates, in the present study, are comparable with that of U.S. data, reflecting that burnout is a pressing problem that goes beyond cultural milieus. Given this high rate of burnout, the authors suggest that periodic screening to detect burnout should be implemented, although we do recognise that without anonymity, residents may be reluctant to reveal their stressors and exhaustion levels.

The ACGME has moved forward to implement duty hour restrictions, in part, to improve work-life balance among residents. Reduction in working hours is intended to improve the work-life balance and, consequently, reduce the risk of burnout. Indeed, Barrack et al found that after the implementation of resident duty hour restrictions, there was an improvement in objective measures of burnout.[23] However, there are constraints to limiting duty hours. Firstly, there are concerns that duty hour restriction reduces the opportunity for residents to learn, resulting in a negative impact on resident education.[24,25] In addition, there is a high financial cost per resident hour reduction and places financial limits on how strictly duty hour restrictions

can be enforced.[26] In our study, we found that the self-reported working hours per week was 69.1 ± 12.7 hours, which complied with the 80-hour work week restriction. Interestingly, we found no significant difference in working hours per week between residents suffering from burnout and those who did not. Likewise, there was no significant difference in sleeping hours per day between residents with high EE or DP and residents with moderate/low EE or DP. Despite this, we did find that there was a positive correlation between higher levels of both EE ($r = 0.43$, $p < 0.01$) and DP ($r = 0.33$, $p < 0.05$) with the feeling of inadequate sleep. This finding suggests that despite similar amounts of sleep, residents suffering from burnout were more likely to feel that they had inadequate sleep. Although it is difficult to determine the exact relationship, it appears that the quality, rather than the quantity, of time made available to a resident is more important for his/her mental wellbeing. This may explain why some studies have demonstrated that focusing on duty hours alone does not result in improvements in resident wellbeing.[24,27] A targeted approach at alleviating stress and improving quality of both training hours and off-duty hours may be more effective than merely increasing the number of off-duty hours.

Despite different cultural milieus, we found similar stressors associated with burnout in this study and our western ACGME counterparts.[28] The factors associated with burnout were conflict between work and family, stress in relationships with other residents/faculty, stress from research requirements and financial pressures. Clearly, the ability to strike a balance between work and family life is important. As a resident, this can be challenging, as there may be little control over daily schedules and task deadlines. Relationships between working colleagues with both fellow residents and faculty are important and have been shown to affect resident wellness.[29] This may be even more relevant in the Asian culture, where hospital surgical practice tends to be more hierarchal in nature. Thus, it is important for programmes to take into consideration the social belonging of residents. Finally, one of the key external

stressors was that of financial pressure. The cost of living in Singapore is high. Coupled with increasing medical school fees and potential difficulties in obtaining a permanent faculty position after residency, many residents are concerned about their financial wellbeing. These external stressors appear to be consistent with the findings of several studies investigating burnout.[11,23] It is thus important to proactively address these concerns for residents. While some of these stressors may be difficult to mitigate, the ACGME programme places importance on the collegiality and professionalism of both the resident and faculty. Anonymous feedback on faculty allows programmes to place greater emphasis on the teaching environment created by the faculty, which is a confluence of both the faculty's ability to teach and his/her approachability. Peer reviews between residents allow programmes to detect residents who may be facing stress in their relationships with other residents. With this information, programmes can identify residents at risk for burnout.

Burnout is likely influenced by a combination of personal stressors, resilience, personality and coping mechanisms. Resilience is particularly important in orthopaedic surgical training, where residents are constantly challenged by surgical tasks that may exceed their current abilities. Our study quantified resilience using the GRIT-S. As expected, residents who suffered from severe burnout had significantly lower GRIT-S scores. This strengthens the need for resilience education for junior residents as part of burnout prevention. While Walker et al[30] demonstrated that faculty had higher GRIT-S scores compared to their more junior counterparts, it is uncertain if surgical training itself can improve grit. It may be impractical to employ methods to improve grit and resilience during a resident's training, where there can often be overwhelming work demands. The role of determining resilience may lie in pre-residency selection, where GRIT-S score has been found to be predictive of resident attrition in a non-orthopaedic programme.[31] Programmes should consider assessing potential residents' resilience prior to entry into it.

Coping mechanisms are employed in times of stress and may contribute to the development of burnout.[32] Various coping mechanisms exist but optimal coping mechanisms have yet to be defined. There is paucity of literature on the optimal coping mechanism for surgeons. Among physicians, it has been shown that emotion-focused coping is associated with job stress and burnout.[33,34] Pinto et al found that surgeons who used self-distraction (emotion-focused coping) as a coping strategy were at higher risk of experiencing acute traumatic stress after serious surgical complications.[35] These findings are consistent with our study, which found that emotion-focused coping mechanisms, such as substance use (turning to the use of alcohol or other drugs as a way of disengaging from the stressor) and behavioural disengagement (giving up or withdrawing effort from the attempt to attain the goal with which the stressor is interfering) led to higher rates of burnout. Planning (e.g. thinking about how to confront the stressor or planning one's active coping efforts) as a coping mechanism appeared to be protective against severe burnout while positive reframing (making the best of the situation by growing from it, or viewing it in a more favourable light) was associated with higher levels of PA. Given our findings, we suggest that programmes educate residents on the various coping mechanisms and, in particular, encourage planning as a coping mechanism while highlighting that substance use and behavioural disengagement should be avoided as main coping strategies.

The main limitation of this study was that as a cross-sectional study, cause-effect relationships could not be established. However, the strength of the study was that our participation rate was high when compared with participation rates of 22%–67% in other similar studies.[36-38] In addition, our study was one of the few to determine the burnout rate and its associated factors in an ACGME-I accredited Asian orthopaedic surgery training programme, where a difference in cultural milieu may have impacted the stress experienced by

residents. Further studies should be conducted nationwide and across different specialties to potentially identify factors that can positively or negatively affect burnout.

In conclusion, there is a high level of burnout in our ACGME-I accredited orthopaedic surgery residency programme. Stressors that resulted in higher burnout included the feeling of inadequate sleep, conflict between work and personal time, stress from research requirements, poor relationships with fellow residents/faculty and financial pressures. Residents with lower resilience were at risk of burnout. Protective coping mechanisms against burnout included planning and positive reframing, while behavioural disengagement and substance use may likely increase the risk of burnout. Regular screening to detect burnout among at-risk orthopaedic surgery residents should be performed and residents should be educated on protective coping mechanisms against burnout. There is a role for assessment of resilience prior to resident selection.

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REFERENCES

1. Maslach C, Jackson SE. The measurement of experienced burnout. J Organ Behav 1981; 2:99-113.
2. Bruce SM, Conaglen HM, Conaglen JV. Burnout in physicians: a case for peer-support. Intern Med J 2005; 35:272-8.
3. Ramirez AJ, Graham J, Richards MA, Cull A, Gregory WM. Mental health of hospital consultants: the effects of stress and satisfaction at work. Lancet 1996; 347:724-8.

4. Shanafelt TD, Balch CM, Bechamps G, et al. Burnout and medical errors among American surgeons. Ann Surg 2010; 251:995-1000.
5. Baer TE, Feraco AM, Tuysuzoglu Sagalowsky S, et al. Pediatric resident burnout and attitudes toward patients. Pediatrics 2017; 139. pii:e20162163.
6. Streu R, Hansen J, Abrahamse P, Alderman AK. Professional burnout among US plastic surgeons: results of a national survey. Ann Plast Surg 2014; 72:346-50.
7. Vijendren A, Yung M, Shiralkar U. Are ENT surgeons in the UK at risk of stress, psychological morbidities and burnout? A national questionnaire survey. Surgeon 2018; 16:12-9.
8. Jesse MT, Abouljoud M, Eshelman A. Determinants of burnout among transplant surgeons: a national survey in the United States. Am J Transplant 2015; 15:772-8.
9. Zha N, Patlas MN, Neuheimer N, Duszak R Jr. Prevalence of burnout among Canadian radiologists and radiology trainees. Can Assoc Radiol J 2018; 69:367-72.
10. Daniels AH, DePasse JM, Kamal RN. Orthopaedic surgeon burnout: diagnosis, treatment, and prevention. J Am Acad Orthop Surg 2016; 24:213-9.
11. Sargent MC, Sotile W, Sotile MO, Rubash H, Barrack RL. Quality of life during orthopaedic training and academic practice. Part 1: orthopaedic surgery residents and faculty. J Bone Joint Surg Am 2009; 91:2395-405.
12. Folkman S, Lazarus RS. An analysis of coping in a middle-aged community sample. J. Health Soc. Behav. 1980; 21: 219–239.
13. Maslach C, Jackson SE, Leiter MP. Maslach Burnout Inventory Manual. 3rd ed. Palo Alto, CA: Consulting Psychologists Press, 1996.
14. Schaufeli WB, Bakker AB, Hoogduin K, Schaap C, Kladler A. On the clinical validity of the Maslach burnout inventory and burnout measure. Psychol Health 2001; 16:565-82.

15. Goldberg D, Williams P. A User's Guide to the General Health Questionnaire. Berkshire, UK: NFER-Nelson Publishing; 1988.
16. Whitley TW, Allison EJ Jr, Gallery ME, et al. Work-related stress and depression among practicing emergency physicians: an international study. Ann Emerg Med 1994; 23:1068-71.
17. Hankins M. The reliability of the twelve-item general health questionnaire (GHQ-12) under realistic assumptions. BMC Public Health 2008; 8:355.
18. Werneke U, Goldberg DP, Yalcin I, Ustün BT. The stability of the factor structure of the General Health Questionnaire. Psychol Med 2000; 30:823-9.
19. Carver CS. You want to measure coping but your protocol's too long: consider the brief COPE. Int J Behav Med 1997; 4:92-100.
20. Duckworth AL, Peterson C, Matthews MD, Kelly DR. Grit: perseverance and passion for long-term goals. J Pers Soc Psychol 2007; 92:1087-101.
21. Duckworth AL, Quinn PD. Development and validation of the Short Grit Scale (Grit-S). J Pers Assess 2009; 91:166-74.
22. Busby DM, Christensen C, Crane DR, Larson JH. A revision of the dyadic adjustment scale for use with distressed and nondistressed couples: construct hierarchy and multidimensional scales. J Marital Fam Ther 1995; 21:289-308.
23. Barrack RL, Miller LS, Sotile WM, Sotile MO, Rubash HE. Effect of duty hour standards on burnout among orthopaedic surgery residents. Clin Orthop Relat Res 2006; 449:134-7.
24. Bolster L, Rourke L. The effect of restricting residents' duty hours on patient safety, resident well-being, and resident education: an updated systematic review. J Grad Med Educ 2015; 7:349-63.

25. Fitzgibbons SC, Chen J, Jagsi R, Weinstein D. Long-term follow-up on the educational impact of ACGME duty hour limits: a pre-post survey study. Ann Surg 2012; 256:1108-12.
26. Kamath AF, Baldwin K, Meade LK, Powell AC, Mehta S. The increased financial burden of further proposed orthopaedic resident work-hour reductions. J Bone Joint Surg Am 2011; 93:e31.
27. Gefland DV, Podnos YD, Carmichael JC, et al. Effect of the 80-hour workweek on resident burnout. Arch Surg 2004; 139:933-40.
28. Sargent MC, Sotile W, Sotile MO, Rubash H, Barrack RL. Stress and coping among orthopaedic surgery residents and faculty. J Bone Joint Surg Am 2004; 86:1579-86.
29. Law M, Lam M, Wu D, Veinot P, Mylopoulos M. Changes in personal relationships during residency and their effects on resident wellness: a qualitative study. Acad Med 2017; 92:1601-6.
30. Walker A, Hines J, Brecknell J. Survival of the grittiest? Consultant surgeons are significantly grittier than their junior trainees. J Surg Educ 2016; 73:730-4.
31. Salles A, Lin D, Liebert C, et al. Grit as a predictor of risk of attrition in surgical residency. Am J Surg 2017; 213:288-91.
32. Maslach C, Schaufeli WB, Leiter MP. Job burnout. Annu Rev Psychol 2001; 52:397-422.
33. Deary IJ, Blenkin H, Agius RM, et al. Models of job-related stress and personal achievement among consultant doctors. Br J Psychol 1996; 87(Pt 1):3-29.
34. Sharma A, Sharp DM, Walker LG, Monson JR. Stress and burnout in colorectal and vascular surgical consultants working in the UK National Health Service. Psychooncology 2008; 17:570-6.
35. Pinto A, Faiz O, Bicknell C, Vincent C. Acute traumatic stress among surgeons after major surgical complications. Am J Surg 2014; 208:642-7.

36. Faivre G, Kielwasser H, Bourgeois M, et al. Burnout syndrome in orthopaedic and trauma surgery residents in France: a nationwide survey. Orthop Traumatol Surg Res 2018; 104:1291-5.
37. Arora M, Diwan AD, Harris IA. Prevalence and factors of burnout among Australian orthopaedic trainees: a cross-sectional study. J Orthop Surg (Hong Kong) 2014; 22:374-7.
38. Simons BS, Foltz PA, Chalupa RL, et al. Burnout in U.S. military orthopaedic residents and staff physicians. Mil Med 2016; 181:835-9.