

Original Research

A Comprehensive Umbrella Review for Understanding Burnout in Orthopaedic Surgery

Maike van Niekerk, PhD¹; Kali Tileston, MD¹; Maryse Bouchard, MD²; Melissa A. Christino, MD³; Rachel Goldstein, MD⁴; George Gantsoudes, MD⁵; Cordelia Carter, MD⁶; Alfred Atanda, MD⁷

¹Stanford School of Medicine, Pediatric Orthopaedic Surgery, Stanford, CA; ²The Hospital for Sick Children, Division of Orthopaedic Surgery, Toronto, ON; ³Boston Children's Hospital, Department of Orthopedic Surgery, Boston, MA; ⁴Children's Hospital Los Angeles, Los Angeles, CA; ⁵Inova Fairfax Hospital, Department of Orthopedic Surgery, Falls Church, VA; ⁶NYU Langone's Hassenfeld Children's Hospital, Center for Young Athletes, New York, NY; ⁷Nemours Children's Health, Department of Orthopedic Surgery, Wilmington, DE

Correspondence: Maike van Niekerk, PhD, Stanford School of Medicine, Pediatric Orthopaedic Surgery, Stanford University, 453 Quarry Rd., Stanford, CA 94305. E-mail: maikevn@stanford.edu

Received: November 20, 2022; Accepted: January 9, 2023; Published: February 1, 2023

DOI: 10.55275/JPOSNA-2023-619

Abstract

Background: Burnout is characterized by depersonalization, emotional exhaustion, and low personal achievement. Occupational demands can lead to burnout in orthopaedic surgeons, negatively impacting patients and surgeons alike. A high-level overview of burnout is lacking; we therefore aimed to conduct an umbrella review (i.e., review of reviews) summarizing evidence on burnout in orthopaedic surgery, focusing on its rates, associations, prevention, and management.

Methods: We searched Ovid Medline, Ovid PsycINFO, EBSCO CINAHL, and CENTRAL from database inception to 16 July 2022, using the terms “orthopaedic surgery,” “burnout,” and “review.” Quality assessments were conducted using the PASS checklist. An article was considered for inclusion if it was a review, summarized evidence on burnout in orthopaedic surgery, and had a full text available to allow for data extraction. We present the results of our review using narrative syntheses.

Results: We included eight systematic reviews and eight narrative reviews. We found burnout to be common among orthopaedic surgeons, although reviews reported variable rates, thereby precluding definitive conclusions. Residents were found to be particularly at risk of experiencing burnout, with estimates of one in two being affected. Burnout was found to be positively associated with several personal-related factors, including identifying as a female or as a racial minority, experiencing work-life imbalances, and not having spousal support. It was also associated with work-related factors, including working long hours, having stressful work relationships, and experiencing anxiety about one's clinical competence. Literature on interventions for preventing and managing burnout was limited, although there was some evidence supporting work-hour restrictions for residents.

Conclusions: Although burnout is detrimental for orthopaedic surgeons and their patients, high-quality literature in this field is scarce. Future efforts should be dedicated to conducting large-scale, prospective studies to examine burnout rates and associations as well as interventional studies to prevent and manage burnout.

Level of Evidence: Level IV

Key Concepts

- Burnout is a work-related syndrome that negatively impacts orthopaedic surgeons and their patients.
- Burnout is common in orthopaedic surgeons, though rates vary considerably between studies, making definitive conclusions difficult to draw.
- Orthopaedic surgery residents are particularly at risk of experiencing burnout, with estimates of one in two being affected.
- Burnout is positively associated with several personal- and work-related factors.
- Research on interventions for preventing and managing burnout is limited and requires additional inquiry.

Introduction

Burnout is a work-related syndrome characterized by depersonalization, emotional exhaustion, and low personal achievement, secondary to chronic workplace stressors.^{1,2} Depersonalization can be understood as feeling mentally distant or cynical about one's job; emotional exhaustion as feeling overextended and progressively worn out, both physically and mentally; and low personal achievement as feeling less competent in one's job.^{3,4}

Burnout affects physicians at an alarming rate—with documented estimates of more than half experiencing it—and has harmful effects on physicians and patients alike.^{4,5} Orthopaedic surgeons may be particularly vulnerable to developing burnout due to their heavy workloads, long work hours, and challenging training programs.⁶ Clinically significant burnout is most commonly defined as high depersonalization and/or high emotional exhaustion, with low personal achievement not being an obligatory criterion.^{6–8}

Previous reviews of burnout have often been limited in their ability to provide a high-level overview in orthopaedics, specifically, as they only focused on a

specific aspect of burnout, such as its rates, associations, or interventions, without assessment of these three in conjunction, and/or reported on orthopaedic surgery as a subgroup in their analyses. An overview summarizing these reviews' collective results offers a comprehensive understanding of the field as well as highlights areas for further investigation and improvement. It thereby serves as a valuable resource for healthcare policymakers, orthopaedic surgeons, and researchers aiming to improve physician well-being and patient outcomes.

We therefore aimed to conduct an umbrella review (i.e., review of reviews) summarizing evidence on burnout in orthopaedic surgery, focusing on its rates, associations, prevention, and management.

Materials and Methods

We conducted an umbrella review following PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.^{9,10} We identified relevant literature (without any language or publication date restrictions) by searching Ovid Medline, Ovid PsycINFO, EBSCO CINAHL, and Cochrane Central Register of Controlled Trials

(CENTRAL) from database inception to July 2022. Searches were run for a combination of “orthopaedic surgery,” “burnout,” and “review” using standardized subject and free-text terms, including synonyms and alternative spellings (search strategy described in Appendix 1). Additionally, we contacted authors of relevant conference abstracts found through our electronic database search to locate associated publications, conducted manual searches of the reference lists of included reviews for relevant literature, and consulted experts on wellness in orthopaedics to obtain grey literature.

We included articles meeting the following selection criteria:

- (a) the study was a review (“systematic” or “narrative,” defined below);
- (b) the review aimed to summarize evidence of burnout in orthopaedic surgery (or had a clear subgroup on orthopaedic surgeons); and
- (c) the full text was available to allow for data extraction.

We use the term “orthopaedic surgeons” as an all-encompassing term that includes trainees and practicing physicians. Later in this paper, we explicitly state orthopaedic “residents” or “attendings” when information on these subgroups was provided by reviews.

Identified articles were imported into Covidence, an electronic software platform for managing reviews. One reviewer (MvN) screened articles’ titles and abstracts to determine if they met selection criteria, reviewed the full texts of all articles deemed to be potentially relevant, and extracted data from eligible articles.

We performed quality assessments of eligible “systematic reviews” using a newly developed quality measure for systematic reviews: the PASS checklist.¹¹ PASS assesses if a review: was **P**lanned with a clearly stated aim, considered **A**ll relevant literature, used methods for study **S**election that were unbiased and transparent, and conducted **S**ynthesis of data from included studies

in an unbiased and informative way.¹¹ We chose PASS over other available measures, as it was designed for clinicians and healthcare policymakers.¹¹ We defined “systematic reviews” as those with clear objectives, pre-defined selection criteria, explicit methods, and systematic presentations of findings; this definition was informed by the one proposed by The Cochrane Collaboration.¹² We did not conduct quality assessments of reviews that did not meet these criteria, which we describe as “narrative reviews,” as narrative reviews do not aim to summarize all of the literature on a topic and are, therefore, inherently prone to bias.¹³

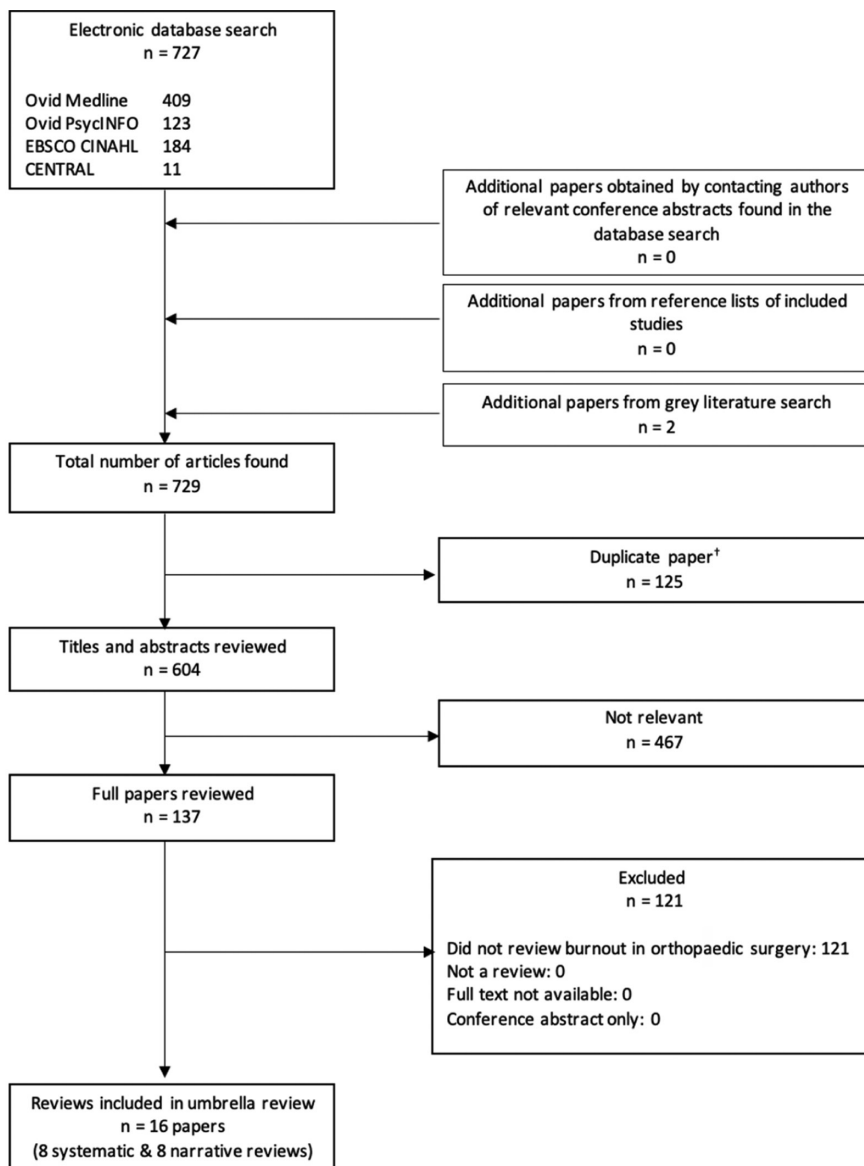
We extracted the following information from systematic reviews: authors, aim(s), selection criteria, database(s) searched, quality assessment(s), method(s) of data analysis, number of relevant primary studies included as well as their characteristics (such as authors, publication dates, and sample sizes), and finding(s). We extracted the following from narrative reviews: authors, aim(s), and finding(s). We resolved queries regarding article inclusion, data extraction, and quality assessments through consensus discussions between all review authors.

Umbrella reviews use reviews as their units of analysis.¹⁴ Because of this, data were extracted from reviews themselves, rather than from the primary studies included in the reviews.¹⁴ We present the findings of our umbrella review using narrative synthesis. We did not conduct meta-analyses, as several reviews included overlapping primary studies.

Results

Overview

We identified 727 articles in our initial database search as well as an additional two articles through supplemental searches. We screened the titles and abstracts of 604 articles (after removing duplicate articles) and performed full-text review of 137 articles. We deemed 16 reviews to be relevant for inclusion, of which eight were systematic reviews^{6,8,15–20} and eight were narrative reviews (Figure 1).^{3,21–27}



† Duplicate of the same paper due to search multiple databases and reference lists.

Figure 1. Study methodology for umbrella review.

Systematic Reviews

Systematic reviews were conducted between 2013 and 2021,^{6,8,15–20} with the majority being conducted in the past five years (Table 1, Appendix 2). Only two reviews focused specifically on burnout in orthopaedic surgery;^{6,15} the remainder reported on orthopaedic surgery as a subgroup, for example, when summarizing the literature on burnout in surgeons or residents more broadly.^{8,16–20} Additionally, 75% of reviews focused on a specific subsample of orthopaedic surgeons: three

were resident-specific^{8,17,19} and three were region-specific^{16,18,20} (two on the United States^{16,20} and one on the Eastern Mediterranean Region [EMR]¹⁸). Rates of burnout in orthopaedic surgery were summarized in all but one review.^{6,8,15,16,18–20} Literature on its associations and interventions were summarized in two^{6,15} and three reviews, respectively (Table 2, Appendix 2).^{6,15,17}

Reviews included a total of 19 independent primary studies on burnout in orthopaedic surgery, although only

a few studies were typically included in each review (median: 2.5 studies; range: 1 to 12 studies) (Table 2, Appendix 2). About half of the primary studies were included in more than one review and conducted in the United States. Reviews frequently excluded primary studies that (a) did not measure burnout using the Maslach Burnout Inventory (MBI)^{8,16,18,19} or (b) were not published in English.^{6,16,17,19,20} About half the reviews conducted quality assessments,^{8,17–19} with only one using it to inform study inclusion.⁸

Narrative Reviews

Narrative reviews were conducted between 2016 and 2022;^{3,21–27} we present the results of these reviews in Appendix 3. We highlight the results of the systematic reviews in the subsequent sections because, unlike narrative reviews, they aim to present all of the available literature on a topic.

Rates of Burnout

We found seven systematic reviews that reported on the rates of burnout in orthopaedic surgery (Table 1).^{6,8,15,16,18–20}

Two reviews summarized literature on the rates of burnout in orthopaedic surgery broadly, that is, did not solely report region- or resident-specific data.^{6,15} Both reported wide ranges, making it difficult to meaningfully interpret their results. On the whole, findings indicate that between around 10% to 65% experience high depersonalization, 15% to 50% experience high emotional exhaustion, and 15% to 85% may be classified as burnt out. A smaller number of individuals are likely to have low levels of personal achievement, but this number is still considerable (between around 5% to 45%). The heterogeneity in rates reported by studies may have been secondary to including participants at different career stages; we therefore discuss disaggregated data on residents and attendings below.

It is notable that only one review calculated pooled prevalence estimates for burnout in orthopaedic surgery; this review summarized literature conducted in the

EMR.¹⁸ Reviewers estimated that just under half of participants (around 40%) had high depersonalization, high emotional exhaustion, and/or overall clinically significant burnout, and one-quarter had low levels of personal achievement.¹⁸ On the other review, burnout percentages were not reported; instead, the mean MBI score across studies conducted in the United States was calculated.¹⁶ Reviewers estimated that orthopaedic surgeons had average scores that were below the cut off for high depersonalization, high emotional exhaustion, and low levels of personal achievement, suggesting low burnout.¹⁶

Orthopaedic Surgery Residents Versus Attendings

Five reviews discussed levels of burnout in residents,^{6,8,15,19,20} two of which calculated pooled prevalence estimates (Table 1).^{8,19} Both reviews included two primary studies in their analyses, one of which was included in both (Tables 2 and 3, Appendix 2).^{8,19} They similarly estimated that around one in two residents experienced burnout.^{8,19} One of the reviews conducted further analyses, estimating that around one in three residents had high depersonalization, high emotional exhaustion, and/or low personal achievement.⁸ Three of these five reviews discussed levels of burnout in attendings (i.e., practicing surgeons, faculty, chiefs) as well.^{6,15,20} Reviewers noted high levels of emotional exhaustion and depersonalization and relatively preserved levels of personal achievement, suggesting that personal achievement increases with seniority.^{6,15} All three highlighted that residents are more susceptible to burnout than attendings.^{6,15,20}

Orthopaedic Surgeons Versus Other Specialties

Four reviews compared levels of burnout between medical specialties (Table 4, Appendix 2).^{8,16,18,19} All focused on specific subgroups of physicians, such as residents,^{8,19} physicians in the EMR,¹⁸ and surgeons in the United States.¹⁶

Compared with pooled estimates for all specialties, orthopaedic surgeons tended to have similar or lower rates of high depersonalization, high emotional

Table 1. Rates of Burnout in Orthopaedic Surgery Reported by Systematic Reviews Included in Umbrella Review

Systematic Review	Number of Studies	Total Sample Size	Rates of Burnout			
			High Depersonalization (measure)	High Emotional Exhaustion (measure)	Low Personal Achievement (measure)	Overall Clinically Significant Burnout (measure)
Arora (2013)	8 [†]	1,906*	Range: 25% to 65%* (MBI) Pooled Mean (SD) Score: 9.3 (6.0) (MBI) (high DP is > 12)	Range: 28% to 51%* (MBI) Pooled Mean (SD) Score: 20.8 (10.9) (MBI) (high EE is > 30)	Range: 4% to 25%* (MBI) Pooled Mean (SD) Score: 40.4 (5.7) (MBI) (low PA is < 33)	Range: 50% to 60% (MBI)
Bartholomew (2018) (U.S. only)	3	700	Range: 39.44% to 40.20%* (MBI-HSS) Pooled Prevalence: 39.75% (95% CI, 33.80% to 46.03%, I ² =0%) (MBI-HSS)	Range: 34.31% to 50%* (MBI-HSS) Pooled Prevalence: 42.45% (95% CI, 31.96% to 53.68%, I ² =66.2%) (MBI-HSS)		–
Doraiswamy (2021) (EMR only)	2	244*	Range: 11.4% to 59.4% (NR) Pooled Prevalence: 35.3% (95% CI, 25% to 47%, I ² =0%) (MBI)	Range: 16.2% to 50.7% (NR) Pooled Prevalence: 38% (95% CI, 23% to 53%, I ² =47.4%) (MBI)	Range: 11.76% to 39.44%* (MBI-HSS) Pooled Prevalence: 23.15% (95% CI, 8.99% to 47.90%, I ² =90.4%) (MBI-HSS)	Range: 19% to 57% (MBI-HSS) Pooled Prevalence: 38.7% (95% CI, 15.58% to 68.36%, I ² =78.2%, n=149) (MBI-HSS)
Hui (2019)	9	1,753*	Range: 16.2% to 50.7% (NR) Pooled Prevalence: 33.3%* (MBI)	Range: 4% to 43% (NR) Pooled Prevalence: 55.63% (95% CI, 50.93% to 60.28%, I ² =96.3%) (MBI)	Range: 40.7% to 52.9%* (MBI) Pooled Prevalence: 49% (95% CI, 37% to 60%, I ² =7.0%) (MBI)	Range: 16.2% to 85.1%* (NR)
Clear Subgroup: Residents Only[‡]						
Low (2019)	2	435	–	–	–	Range: 53% to 56%* (MBI) Pooled Prevalence: 55.63% (95% CI, 50.93% to 60.28%, I ² =96.3%) (MBI)
Rodrigues (2018)	2	78	Range: 35.3% to 37.0%* (MBI) Pooled Prevalence: 36% (95% CI, 25% to 47%, I ² =0%) (MBI)	Range: 29.6% to 45.1%* (MBI) Pooled Prevalence: 38% (95% CI, 23% to 53%, I ² =47.4%) (MBI)	Range: 26.0% to 33.3%* (MBI) Pooled Prevalence: 30.8% (CI and I ² NR) (MBI)	Range: 40.7% to 52.9%* (MBI) Pooled Prevalence: 49% (95% CI, 37% to 60%, I ² =7.0%) (MBI)

Note: Quantitative data could not be suitably extracted from Pulcrano (2016) for table.

Acronyms: CI = Confidence Interval; DP = Depersonalization; EE = Emotional Exhaustion; EMR = Eastern Mediterranean Region; MBI = Maslach Burnout Inventory; MBI-HSS = Maslach Burnout Inventory – Human Services Survey; NR = Not Reported; PA = Personal Achievement; SD = Standard Deviation; US = United States.

* Calculated using data from paper.

[†] Not all studies reported rates of burnout, some provided qualitative descriptions.

[‡] Arora (2013), Hui (2019), and Pulcrano (2016) described burnout in residents versus attendings, noting residents were at higher risk.

[§] Discrepancies in results were noted between the manuscript's table, figure, and text; data extracted from table.

exhaustion, and low personal achievement.^{8,18} Rates of overall clinically significant burnout were noted to be slightly higher in orthopaedic surgery residents, affecting around one in two residents, compared with 35% to 51% of residents broadly; however, differences between specialties was not found to be statistically significant.^{8,19}

Between reviews, notably high rates of depersonalization were found in cardiology and intensive care; emotional exhaustion in cardiology, dermatology, neurology, otolaryngology, and radiology; low personal achievement in anesthesiology, emergency medicine, intensive care, and plastic surgery; and overall clinically significant burnout in internal medicine and general surgery.^{8,18,19} Family medicine and pediatrics had comparatively lower rates of burnout.^{8,18,19}

Orthopaedic Surgeons in Different Countries

Two reviews observed differences in rates of burnout between countries.^{6,19} In both reviews, countries in Asia and North America were found to have higher burnout rates than those in Europe.^{6,19} One review, however, noted that these differences were statistically insignificant.¹⁹ It was speculated that burnout rates may be higher in countries with long work hours, educational pressures, limited autonomy, and professional uncertainty (such as those in Asia and North America).^{6,19} Comparatively, European countries may have lower risk of burnout due to regulations, such as their work-hour limitations of 48 hours a week and demonstrated adherence to these limits.¹⁹

Factors Associated with Burnout

We found two systematic reviews that reported on the associations of burnout in orthopaedic surgery (Table 2).^{6,15} One review included only one primary study;¹⁵ the other reviewed this as well as eight others.⁶

Personal-Related Factors

Many non-work related factors were found to be linked to burnout. Identifying as a female and as a racial minority, for example, were each associated with higher levels of emotional exhaustion.⁶ Both

groups likely experience greater levels of harassment and discrimination, which were factors also positively associated with burnout.⁶ Burnout was also associated with financial concerns as well as alcohol and drug use.^{6,15}

It is worth noting the mounting evidence of the role of family factors in burnout. Unsurprisingly, work-life conflict, lack of spousal support, and having a significant other in active military duty were positively associated with burnout.^{6,15} Conversely, opposing factors (including work-life balance, perceived support from family, good marital quality, and personal time with one's spouse) appeared protective. Furthermore, orthopaedic surgeons who were parents as well as those whose spouses worked longer hours, were found to have higher levels of personal achievement.^{6,15}

Work-Related Factors

A number of work-related factors were also found to contribute to burnout. Among these factors were sleep deprivation, long work hours, nights on-call, and stressful relationships with colleagues.^{6,15} In contrast, supportive environments (such as those with supportive relationships among colleagues and mentorship opportunities) were negatively associated with burnout.^{6,15} Job satisfaction and research duties on top of clinical duties contributed to lower burnout among orthopaedic surgeons while feelings of regret for choosing a career in medicine were associated with higher emotional exhaustion and lower personal achievement.⁶

Orthopaedic Surgery Residents Versus Attendings

Factors associated with burnout likely vary by level of seniority.^{6,15} Although being a resident was associated with greater burnout (especially in larger residency programs), surgeons with a minimum of 10 years post-residency experience had lower levels of depersonalization and emotional exhaustion.⁶ In contrast to residents, faculty appeared to be uniquely burdened by the threat of competition from the increasing numbers of orthopaedic surgeons.^{6,15} Interestingly, there was evidence to suggest that faculty who worked *longer*

Table 2. Personal- and Work-Related Factors Associated with Burnout In Orthopaedic Surgery Reported by Systematic Reviews Included in Umbrella Review

Negatively Associated with Burnout (“Protective”)		Positively Associated with Burnout (“Risk”)
Personal-Related Factors	High self-efficacy [†] (burnout)	Female [†] (EE)
	Work-life balance [‡] (low PA)	Work-life conflict ^{†, ‡} (EE)
	Time for hobbies [†] (high EE)	Harassment & discrimination [†] (burnout)
	Satisfaction from talking to friends & family ^{†, ‡} (low PA)	Racial minority status [†] (EE)
	Good marital relationship ^{†, ‡} (low PA)	Lack of spousal support [†] (EE)
	Personal time with one’s spouse ^{†, ‡} (high EE)	Poor marital relationship [†] (EE)
	Spouse working long hours [†] (low PA)	Significant other in active military duty [†] (burnout)
	Parenthood ^{†, ‡} (high DP, low PA, burnout)	Financial concerns ^{†, ‡} (EE) & anticipation of debt [‡] (DP)
	Greater number of children [‡] (high DP)	Alcohol & drug use ^{†, ‡} (DP)
	Having a father who is a physician [†] (EE)	
Work-Related Factors	Good relationship with one’s mother ^{†, ‡} (high DP)	
	Standard work hours (residents) [†] (low PA)	Excessive work/long work hours ^{†, ‡} (high DP, burnout)
	Long work hours (faculty) [‡] (high DP)	Nights on-call per week [†] (burnout)
	Perceived support from colleagues ^{†, ‡} (high EE, low PA)	Sleep deprivation [†] (high DP, high EE, low PA)
	Satisfaction from talking with colleagues ^{†, ‡} (high EE, low PA)	Stressful workplace relationships ^{†, ‡} (high DP, high EE)
	Job satisfaction [†] (burnout)	Perception of work as stressful ^{†, ‡} (high EE)
	≥ 10 years of post-residency experience [†] (high DP, high EE)	Regrets in choosing a medical career [†] (high EE, low PA)
	Good quality mentorship [†] (high DP, high EE, low PA)	Current resident status [†] (high DP, high EE, low PA)
	• Senior resident mentor [†] (high EE)	Working in large residency program [†] (high DP, high EE)
	• Faculty mentor [†] (low PA)	Anxiety about clinical competence ^{†, ‡} (high EE)
	Frequent contacts with mentors [†] (high EE, low PA)	Worry about competition from other orthopaedic surgeons ^{†, ‡} (high EE)
	Research duties on top of clinical duties [†] (burnout)	Credentialing [†] (high EE)
		Tenure & promotion [†] (high EE)
		Increasing overhead, department, and hospital budget deficits [†] (high EE)
		Staff dismissal [†] (high EE)

Acronyms: DP = Depersonalization; EE = Emotional Exhaustion; PA = Personal Achievement.

[†] Hui (2019) included nine studies. [‡] Arora (2013) included one study. Reviews included overlapping study.

hours experienced lower levels of depersonalization.¹⁵ It was also found that senior surgeons in administrative positions faced distinctive challenges related to credentialing, tenure and promotion, budget deficits, and staff dismissals.⁶ Although a surgeon's level of seniority may play a role in burnout, it is noteworthy that several factors appear to be universally related to burnout, such as having anxiety about one's clinical competence, experiencing work-life imbalances, and having stressful relationships at work.

Interventions to Prevent or Manage Burnout

Three systematic reviews aimed to summarize literature on interventions to prevent or manage burnout in orthopaedic surgery.^{6,15,17} Two of these reviews reported finding no studies.^{6,15} The third review described a pre- and post-study evaluating changes in burnout rates following the implementation of the 2003 ACGME (Accreditation Council for Graduate Medical Education) work-hour restrictions in the United States.¹⁷ Following the implementation of these restrictions, orthopaedic surgery residents were found to have improved personal achievement scores, but faculty burnout rates did not change.¹⁷

It is worth noting that the majority of narrative reviews also suggested useful strategies for improving wellness and addressing burnout in the profession, though most suggestions were not based on orthopaedic literature. One of these reviews proposed using a top-down approach to addressing burnout, highlighting the importance of buy-in from all stakeholders (Figure 2).²⁷ We summarize the remainder of strategies in Appendix 3 and wrote a dedicated paper describing these further and proposing new ones based on expert opinion.

Quality Assessments

We summarize the results of our quality assessments in Table 3. All reviews had clearly stated aims, detailed search strategies, as well as clear selection criteria. However, about half did not clearly describe how studies were selected for inclusion in their review or

the characteristics of the primary studies they included. Moreover, half did not perform quality assessments of included studies and therefore also did not adequately discuss the possible effects of study quality on their findings.

Discussion

This umbrella review summarized reviews of burnout in orthopaedic surgery. We identified eight systematic reviews;^{6,8,15–20} all but one summarized literature on rates of burnout,^{6,8,15,16,18–20} and a minority described its associations or interventions.^{6,15,17} There were only two reviews that exclusively summarized evidence on orthopaedic surgery,^{6,15} while the remainder discussed orthopaedic surgery as a subgroup in their analyses.^{8,16–20} We also found eight narrative reviews on the topic.^{3,21–27}

Although literature revealed high rates of burnout in orthopaedic surgery, the wide range of estimates preclude definitive conclusions on its prevalence. Evidence suggests residents may be particularly susceptible to burnout: just under half were estimated to have high depersonalization, high emotional exhaustion, and clinically significant burnout, and one-quarter to have low personal achievement. Compared with other specialties, orthopaedic surgeons had similar or lower levels of high depersonalization, high emotional exhaustion, and low personal achievement, with slightly higher (though statistically insignificant) levels of clinically significant burnout amongst residents.

Burnout was found to be associated with a variety of personal- and work-related factors. Personal factors positively associated with burnout included: identifying as a female or a racial minority; experiencing harassment, discrimination, or financial concerns; using alcohol and drugs; and experiencing negative family factors (including work-life imbalances and lack of spousal support). Conversely, good marital status and parenthood appeared protective. Stressful workplaces (including those where surgeons work long hours, are constantly on-call, and have stressful relationships with colleagues) contributed to burnout. On the other hand, supportive

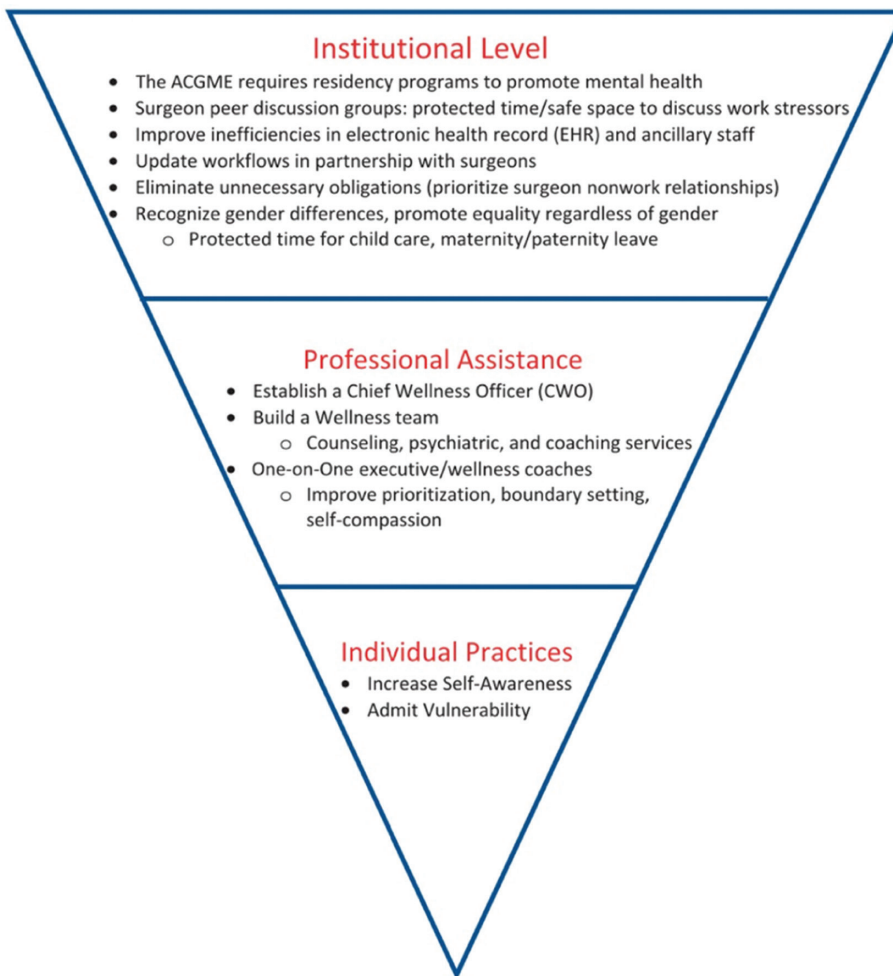


Figure 2. Top-down model to addressing burnout in orthopaedic surgery.
Figure reproduced with permission from: Jennings JM, Gold PA, Nellans K, Boraiah S. Orthopaedic surgeons have a high prevalence of burnout, depression, and suicide: Review of factors which contribute or reduce further harm. *J Am Acad Orthop Surg.* 2022;30(5):e528-e535.

environments, job satisfaction, and research duties were negatively associated with burnout. Orthopaedic surgeons at different stages of their career were found to experience unique burnout associations.

Interventions for preventing or managing burnout in orthopaedic surgery are sparse. While there is some evidence that work-hour restrictions improve residents' outcomes, a consensus across reviewers was the need for additional research on individual- and institutional-level interventions to address burnout.

Rates of Burnout

Although research suggests burnout is common in orthopaedic surgery it is unclear why estimates are so variable. Much like our review, a review of burnout in physicians of all specialties similarly reported substantially variable estimates ranging from 0% to 80.5%.²⁸ Its authors attributed the heterogeneity to the lack of consensus on how burnout is measured and operationalized in the literature, noting at least 142 definitions.²⁸ Without negating the importance of burnout in medicine, reviewers called into question the validity

Table 3. PASS Quality Assessments of Systematic Reviews Included in Umbrella Review[†]

	Arora (2013)	Bartholomew (2018)	Busireddy (2017)	Doraiswamy (2021)	Hui (2019)	Low (2019)	Pulcrano (2016)	Rodrigues (2018)
P – Planned with a clearly stated aim	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
A – All the relevant literature was considered	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
S – Selection of included studies was unbiased and transparent	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	No/ Unclear	Yes	Yes	No/ Unclear	Yes	Yes	No/ Unclear	Yes
	No/ Unclear	No/ Unclear	No/ Unclear	Yes	Yes	Yes	No/ Unclear	Yes
S – Synthesis of data from included studies was unbiased and informative	No/ Unclear	Yes	No/ Unclear	No/ Unclear	No/ Unclear	Yes	No/ Unclear	Yes
	No/ Unclear	No/ Unclear	Yes	Yes	No/ Unclear	Yes	No/ Unclear	Yes
	No/ Unclear	No/ Unclear [§]	Yes	Yes	No/ Unclear	Yes	No/ Unclear	No/ Unclear [¶]
	No/ Unclear	No/ Unclear	Yes	Yes	No/ Unclear	Yes	No/ Unclear	Yes

[†]Removed specification of prevalence from measure to be more widely applicable for this umbrella review. [‡]Rated as no/unclear if no PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) diagram with reasons for exclusion of full texts (or similar description in text). [§]Did not report MBI (Maslach Burnout Inventory) values for individual studies despite conducting mean aggregate estimates across studies. [¶]Discrepancy noted between manuscript, table, and figure in reporting of personal achievement outcome. [#]Rated as no/unclear if no quality assessment done.

of frequently cited prevalence estimates (such as 50% of physicians experiencing burnout) considering the heterogeneity between studies.²⁸ Researchers found significant differences in rates of burnout when applying different definitions, with studies applying standard cut-off scores reporting significantly higher rates than those that did not.¹⁸ Even amongst studies that applied similar definitions, substantial heterogeneity was found between them.¹⁸ Researchers attributed this to study-related factors as well as differences in health systems, types of training, and salaries.¹⁸ To meaningfully quantify burnout, we advocate for more consistent reporting of burnout as other review authors have stated.²⁸ In the absence of an agreed-upon definition, researchers may consider (a) reporting burnout as a continuous outcome and/or (b) reporting multiple estimates using a range of cut-off scores until consensus is achieved.²⁸

Factors Associated with Burnout

Despite our inclusion of only two reviews summarizing evidence of burnout in orthopaedic surgery,^{6,15} many more reviews have included orthopaedic literature in analyses of burnout among physicians, surgeons, or residents generally. Most of these were excluded due to the lack of an explicit subgroup of orthopaedic surgeons in their results.^{7,29–32} By and large, similar associations of burnout were noted by these reviews. Interestingly, one review highlighted evidence that certain personality traits (such as extraversion, agreeableness, conscientiousness, and grit) are associated with less burnout among surgeons.²⁹

Unlike most reviews in our umbrella review, others have summarized evidence on the effects of burnout on patient outcomes. In one such review, researchers examined the relationship between surgeon burnout, patient safety, and professionalism.⁵ They found burnout was associated with increased odds of medical mistakes (2.5-fold increase) and poorer professionalism (such as loss of temper and poorer empathy).⁵ It is worth noting that the only study that attempted to investigate burnout exclusively in orthopaedic surgeons found that those with greater emotional exhaustion lost their tempers

more frequently.⁶ According to reviewers, their findings mirrored those of reviews on physicians and healthcare providers generally and that associations are likely bidirectional.⁵

Interventions to Prevent or Manage Burnout

Given that one point increases in depersonalization and emotional exhaustion have been associated with 11% and 5% increases in medical error rates, respectively,³³ it is important that we intervene. Despite there being limited literature on interventions targeting burnout in orthopaedic surgery, we can use insights from reviews on interventions for physicians in general to inform how to address burnout in orthopaedics. High-quality reviews have found evidence to support both individual- and institutional-level interventions.^{34,35}

A number of individual-level interventions, such as mindfulness, stress management, and small group discussions, have been found to reduce levels of depersonalization and emotional exhaustion.³⁴ It should be noted, however, that pooled analyses of these interventions failed to demonstrate significant reductions in rates of overall clinically significant burnout, high depersonalization, or high emotional exhaustion.³⁴

It is therefore clear that burnout cannot be addressed at the individual-level alone: institutional changes are needed as well.⁴ In fact, institutional-level interventions have been demonstrated to be more effective than individual-level interventions in improving outcomes, further highlighting their importance.³⁵ In a review of institutional-level interventions for physician burnout, the most promising results were found for interventions that improved workflows and teamwork (such as using scribes or medical assistants to assist with electronic health record documentation, implementing team-based care models, and improving communication between physicians).³⁶ Despite there being evidence to support work-hour restrictions, particularly for residents,^{17,34} researchers have pointed out the variability of this evidence and cautioned against implementing such restrictions as the sole means of addressing burnout,

particularly if institutional factors are not addressed to reduce workload in a manner that reflects reductions in work hours.^{16,31,36,37} For residents, adapting burdensome work schedules, increasing autonomy and recognition, and defining clear role divisions may be particularly helpful.¹⁷

Future Clinical and Research Recommendations

Numerous clinical and research recommendations were made in the systematic reviews included in our umbrella review, collectively summarized below:

- The profession must acknowledge burnout as well as its harmful effects;
- Institutions should implement early detection programs; and
- Institutions and professional societies – such as the Pediatric Orthopaedic Society of North America (POSNA) – must provide guidance on ways to improve surgeon well-being and pioneer evidence-based programs for preventative and therapeutic strategies.

These studies also highlighted the importance of developing a unified definition for burnout and measuring it using a validated, standardized measure to allow for cross-study comparisons. Several research recommendations were also made, including conducting (a) large, multi-center prospective studies examining burnout rates and associations that allow for multivariate analyses and stratification by level of training, and (b) interventional studies that address burnout in orthopaedics with long follow-up periods.

Strengths and Limitations of the Current Manuscript

This umbrella review has several strengths which include (a) using a comprehensive search strategy to find all relevant published literature; (b) searching for grey literature; (c) not applying language or publication date restrictions; and (d) conducting quality assessments of all included reviews. Additionally, umbrella reviews are

useful because they provide a comprehensive overview of key literature in a field, which allows busy clinicians and policymakers to quickly gain a broad understanding of the state of research in an area without having to read multiple individual systematic reviews and primary studies. This saves time and allows for more efficient decision-making.

It also has several limitations, including (a) one researcher performing study selection, data extraction, and quality assessments; (b) inclusion of reviews deemed to be of relatively low quality; (c) inability to conduct statistical analyses due to overlapping primary studies and heterogeneity; and (d) limited evidence on interventions for preventing or managing burnout in orthopaedics. It is also important to note that umbrella reviews have the inherent limitation that they summarize only published systematic reviews. For this reason, recent primary studies may be overlooked if they have not already been included in a systematic review. Many of the primary studies included in the systematic reviews also had important limitations, including (a) having small sample sizes; (b) being conducted in single centers (mainly in the United States); (c) being cross-sectional and conducting bivariate analyses of associations; (d) having low response rates; and (e) using various burnout definitions.

Conclusion/Call to Action

One of the reviews included in our umbrella review compared orthopaedic surgeons to canaries in a coal mine: surgeons (like canaries) are strong and resilient, but if the workplace (coal mine) becomes too toxic for them to function, institutions must take this as a warning sign and respond accordingly.²³ We therefore put forth a call to action to address burnout in orthopaedic surgery through clinical and research efforts, particularly on the institutional level. Future efforts should be dedicated to developing a unified definition of burnout; conducting large-scale, prospective studies to examine burnout rates and associations; and conducting interventional studies to prevent and manage burnout.

Additional Links

- JPOSNA® Current Concept Review: [Surgeon Wellness and Burnout](#)
- American Academy of Orthopaedic Surgeons (AAOS) Orthopaedic Video Theatre: [Drivers of Burnout Among Orthopaedic Surgeons](#)

Acknowledgement

The authors wish to recognize and acknowledge the valuable contributions of all past and present members of the POSNA Wellness Committee, which will continue its efforts to optimize the professional well-being of its members.

Disclaimer

The authors have no conflicts of interest to report.

References

- World Health Organization. ICD-11: International Classification of Diseases (11th Revision). World Health Organization; 2019. Available at: <https://icd.who.int/browse11>
- Maslach C, Jackson S, Letter M. Maslach Burnout Inventory Manual. 3rd ed. Consulting Psychologists Press; 1996.
- Travers V. Burnout in orthopedic surgeons. *Orthop Traumatol Surg Res*. 2020;106(1 Suppl):S7-S12.
- Lancet T. Physician burnout: a global crisis. *Lancet*. 2019;394(10193):93.
- Al-Ghunaim TA, Johnson J, Biyani CS, et al. Surgeon burnout, impact on patient safety and professionalism: a systematic review and meta-analysis. *Am J Surg*. 2022;224(1 Part A):228-238.
- Hui RWH, Leung KC, Ge S, et al. Burnout in orthopaedic surgeons: a systematic review. *J Clin Orthop Trauma*. 2019;10:S47-S52.
- Thomas NK. Resident burnout. *JAMA*. 2004;292(23):2880-2889.
- Rodrigues H, Cobucci R, Oliveira A, et al. Burnout syndrome among medical residents: a systematic review and meta-analysis. *PLoS One*. 2018;13(11):e0206840.
- Moher D, Liberati A, Tetzlaff J, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ*. 2009;339(jul21 1):b2535-b2535.
- Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. *BMJ*. 2009;339(jul21 1):b2700-b2700.
- Walker J, Hobbs H, Magill N, et al. PASS: a checklist for assessing the quality of systematic reviews of prevalence studies. *Gen Hosp Psychiatry*. 2022;74:133-134.
- Higgins J, Thomas J, Chandler J, et al. eds. Cochrane Handbook for Systematic Reviews of Interventions Version 6.3 (Updated February 2022). The Cochrane Collaboration; 2022. Available at: <http://www.handbook.cochrane.org>.
- Grant MJ, Booth A. A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Info Libr J*. 2009;26(2):91-108.
- Aromataris E, Fernandez R, Godfrey CM, et al. Summarizing systematic reviews: methodological development, conduct and reporting of an umbrella review approach. *Int J Evid Based Healthc*. 2015;13(3):132-140.
- Arora M, Diwan AD, Harris IA. Burnout in orthopaedic surgeons: a review. *ANZ J Surg*. 2013;83(7-8):512-515.
- Bartholomew AJ, Houk AK, Pulcrano M, et al. Meta-analysis of surgeon burnout syndrome and specialty differences. *J Surg Educ*. 2018;75(5):1256-1263.
- Busireddy KR, Miller JA, Ellison K, et al. Efficacy of interventions to reduce resident physician burnout: a systematic review. *J Grad Med Educ*. 2017;9(3):294-301.
- Doraiswamy S, Chaabna K, Jithesh A, et al. Physician burnout in the Eastern Mediterranean region: influence of gender and related factors – systematic review and meta-analysis. *J Glob Health*. 2021;11:04043.
- Low ZX, Yeo KA, Sharma VK, et al. Prevalence of burnout in medical and surgical residents: a meta-analysis. *Int J Environ Res Public Health*. 2019;16(9):1479.
- Pulcrano M, Evans SRT, Sosin M. Quality of life and burnout rates across surgical specialties: a systematic review. *JAMA Surg*. 2016;151(10):970-978.
- Ames SE, Cowan JB, Kenter K, et al. Burnout in orthopaedic surgeons: a challenge for leaders, learners, and colleagues: AOA critical issues. *J Bone Joint Surg Am*. 2017;99(14):e78.
- Daniels AH, DePasse JM, Kamal RN. Orthopaedic surgeon burnout: diagnosis, treatment, and prevention. *J Am Acad Orthop Surg*. 2016;24(4):213-219.
- Goldstein RY, Weiss JM. The canary in the coal mine: wellness among pediatric orthopedic surgeons. *Orthop Clin North Am*. 2019;50(3):327-330.
- Talwalkar VR, Weiss J. Wellness and drivers of burnout. *J Pediatr Orthop*. 2020;40:S1.
- Smith JM, Boe EA, Will R. Physician wellness in orthopedic surgery: challenges and solutions. *Orthop Clin North Am*. Published online January 2021:41-52. doi:10.1016/j.ocl.2020.08.004.
- Walker S, Goldstein R. Surgeon wellness and burnout. *JPOSNA*. 2019;1(1).
- Jennings JM, Gold PA, Nellans K, et al. Orthopaedic surgeons have a high prevalence of burnout, depression, and suicide: Review of factors which contribute or reduce further harm. *J Am Acad Orthop Surg*. 2022;30(5):e528-e535.
- Rotenstein LS, Torre M, Ramos MA, et al. Prevalence of burnout among physicians: a systematic review. *JAMA*. 2018;320(11):1131-1150.
- Galaiya R, Kinross J, Arulampalam T. Factors associated with burnout syndrome in surgeons: a systematic review. *Ann R Coll Surg Engl*. 2020;102(6):401-407.
- Dimou FM, Eckelbarger D, Riall TS. Surgeon burnout: a systematic review. *J Am Coll Surg*. 2016;222(6):1230-1239.
- Prins JT, Gazendam-Donofrio SM, Tubben BJ, et al. Burnout in medical residents: a review. *Med Educ*. 2007;41(8):788-800.
- Raj KS. Well-Being in residency: a systematic review. *J Grad Med Educ*. 2016;8(5):674-684.
- Shanafelt TD, Balch CM, Bechamps G, et al. Burnout and medical errors among American surgeons. *Ann Surg*. 2010;251(6):995-1000.
- West CP, Dyrbye LN, Erwin PJ, et al. Interventions to prevent and reduce physician burnout: a systematic review and meta-analysis. *Lancet*. 2016;388(10057):2272-2281.
- Panagioti M, Panagopoulou E, Bower P, et al. Controlled interventions to reduce burnout in physicians: a systematic review and meta-analysis. *JAMA Intern Med*. 2017;177(2):195.
- DeChant PF, Acs A, Rhee KB, et al. Effect of organization-directed workplace interventions on physician burnout: a systematic review. *Mayo Clin Proc Innov Qual Outcomes*. 2019;3(4):384-408.
- 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(3):349-363.

Appendix 1

1.0 Search Strategy

1.1 Database 1: Ovid Medline

Search terms	1 Physicians/ 2 Physician*.ti. 3 Attending*.ti. 4 Doctor*.ti. 5 Surgeon*.ti. 6 Intern*.ti. 7 Residen*.ti. 8 Orthopedics/ 9 Orthop*.ti. 10 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 11 Burnout, professional/ 12 Burnout*.ti. 13 Exhaust*.ti. 14 Depersonali*.ti. 15 MBI.ti. 16 MasLach Burnout Inventory.ti. 17 11 or 12 or 13 or 14 or 15 or 16 18 Review.pt. 19 Review*.ti,ab. 20 Overview*.ti,ab. 21 Meta-analy*.ti,ab. 22 Metaanaly*.ti,ab. 23 18 or 19 or 20 or 21 or 22 24 10 and 17 and 23
Publication date restrictions	None (database inception to 16 July 2022)
Language restrictions	None

1.2 Database 2: Ovid PsycINFO

Search terms	1 Physicians/ 2 Physician*.ti. 3 Attending*.ti. 4 Doctor*.ti. 5 Surgeon*.ti. 6 Intern*.ti. 7 Residen*.ti. 8 Orthopedic/ 9 Orthop*.ti. 10 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 11 Burnout/ 12 Burnout*.ti. 13 Exhaust*.ti. 14 Depersonali*.ti. 15 MBI.ti. 16 MasLach Burnout Inventory.ti. 17 11 or 12 or 13 or 14 or 15 or 16 18 Review*.ti,ab. 19 Overview*.ti,ab. 20 Meta-analy*.ti,ab. 21 Metaanaly*.ti,ab. 22 18 or 19 or 20 or 21 23 10 and 17 and 22
Publication date restrictions	None (database inception to 16 July 2022)
Language restrictions	None

1.3 Database 3: EBSCO CINAHL

Search terms	S1	(MH "Physicians")
	S2	TI (physician* or attending* or doctor* or surgeon* or intern* or resident*)
	S3	(MH "Orthopedic Surgery")
	S4	TI (orthop*)
	S5	(MH "Burnout, Professional")
	S6	TI (burnout* OR exhaust* OR depersonali* OR MBI OR "MasLach Burnout Inventory")
	S7	(MH "Systematic Review")
	S8	TI (review* OR overview* OR meta-analy* OR metaanaly*) OR AB (review* OR overview* OR meta-analy* OR metaanaly*)
	S9	S1 OR S2 OR S3 OR S4
	S10	S5 OR S6
	S11	S7 OR S8
	S12	S9 AND S10 AND S11
Publication date restrictions	None (database inception to 16 July 2022)	
Language restrictions	None	

1.4 Database 4: Cochrane Central Register of Controlled Trials (CENTRAL)

Search terms	#1 MeSH descriptor: [Physicians] explode all trees #2 (Physician*):ti #3 (Attending*):ti #4 (Doctor*):ti #5 (Surgeon*):ti #6 (Intern*):ti #7 (Residen*):ti #8 MeSH descriptor: [Orthopedics] explode all trees #9 (Orthop*):ti #10 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 #11 MeSH descriptor: [Burnout, Professional] explode all trees #12 (Burnout*):ti #13 (Exhaust*):ti #14 (Depersonali*):ti #15 (MBI):ti #16 (MasLach Burnout Inventory):ti #17 #11 or #12 or #13 or #14 or #15 or #16 #18 MeSH descriptor: [Systematic Review] explode all trees #19 MeSH descriptor: [Meta-Analysis] explode all trees #20 (Review*):ti,ab,kw #21 (Overview*):ti,ab,kw #22 (Meta-analy*):ti,ab,kw #23 (Metaanaly*):ti,ab,kw #24 (Meta analy*):ti,ab,kw #25 #18 or #19 or #20 or #21 or #22 or #23 or #24 #26 #10 and #17 and #25
Publication date restrictions	None (database inception to 16 July 2022)
Language restrictions	None

Appendix 2

Table 1. Characteristics of Systematic Reviews on Burnout in Orthopaedic Surgeons Included in Umbrella Review

Systematic Review	Aim(s)	Selection Criteria	Database(s) Searched	Population(s) of Interest	Studies of Burnout in Orthopaedic Surgeons			
					Number of Studies	Outcome(s) of Interest	Quality Assessment(s)	Method(s) of Analyzing
Arora (2013) <i>Burnout in orthopaedic surgeons: A review</i>	To summarize available literature on burnout among orthopaedic surgeons and provide recommendations for future work in the field.	1. Measured burnout 2. Used validated burnout measure 3. Participants were primarily orthopaedic surgeons	Database(s): EMBASE, MedLine, Google Scholar (supplemental) Dates: Database inception to 'present'	Orthopaedic Surgeons	8 studies (all orthopaedic)	Rates (8 studies) Associations (1 study) Interventions (0 studies)	None	Narrative synthesis
Bartholomew (2018) <i>Meta-analysis of surgeon burnout syndrome and specialty differences</i>	To quantify the presence of burnout syndrome among surgeons and to compare scores on burnout subscales among different specialties.	1. Participants were surgeons (residents or attendings) 2. Reported specialty-specific data 3. Used MBI to measure burnout 4. Conducted in the United States 5. Written in English 6. Excluded if participants were medical students or other health professionals	Database(s): EMBASE, MedLine, PsycINFO Dates: January 1980 to July 2015	Surgeons (United States)	Subgroup 16 studies (3 orthopaedic)	Rates (3 studies)	None	Narrative synthesis Meta-analysis of mean subscale scores
Busireddy (2017) <i>Efficacy of interventions to reduce resident physician burnout: A systematic review</i>	To summarize current evidence and systematically review various interventions and their effect on burnout rates among residents.	1. Peer-reviewed 2. Participants were residents 3. Studied efficacy of burnout intervention with follow-up results 4. Written in English 5. Excluded if abstract only, review article, editorial, or letter	Database(s): EMBASE, PubMed, WOS Dates: Database inception to unclear end date	Residents	Subgroup 19 studies (1 orthopaedic)	Interventions (1 study)	Newcastle-Ottawa Scale for cohort studies & Jadad scale for RCTs (orthopaedic study had Newcastle-Ottawa score of 4 [low quality])	Narrative synthesis for orthopaedic subgroup
Doraiswamy (2021) <i>Physician burnout in the Eastern Mediterranean Region: Influence of gender and related factors – Systematic review and meta-analysis</i>	To synthesize available evidence on the prevalence of physician burnout and its relationship to gender, physician specialties, and age, in the World Health Organization Eastern Mediterranean Region (EMR).	1. Participants (or a clear subgroup) were physicians from the EMR 2. Measured burnout prevalence 3. Used MBI-HSS to measure burnout 4. Cross-sectional, case-control, or cohort study design 5. English, Arabic, or French abstract 6. Excluded if experimental, interventional, qualitative study, or review	Database(s): EMBASE, Google Scholar, PsycINFO, PubMed Al Manhal (supplemental) Dates: Database inception to June 2020	Physicians (EMR)	Subgroup 78 studies (2 orthopaedic)	Rates (2 studies)	National Health, Lung, and Blood Institute (NHLBI)-Recommended Quality Assessment Tools (2 orthopaedic studies rated as poor quality)	Narrative synthesis Meta-analysis using random effects model (studies with $n \geq 20$) Heterogeneity I^2 statistic

Table 1. Continued

Hui (2019) <i>Burnout in orthopaedic surgeons: A systematic review</i>	To summarize and discuss the evidence of the prevalence, determinants, outcomes, and management of burnout in orthopaedic surgeons.	1. Peer-reviewed 2. Measured burnout 3. Used validated burnout measure 4. Participants were orthopaedic surgeons 5. Written in English	Database(s): PubMed Dates: Database inception to March 2018	Orthopaedic Surgeons	14 articles of 12 studies (all orthopaedic)	Rates (9 studies) Associations (9 [†] studies) Interventions (0 studies)	None	Narrative synthesis
Low (2019) <i>Prevalence of burnout in medical and surgical residents: A meta-analysis</i>	To quantitatively summarize the global prevalence rates of burnout among residents, by specialty, and its contributing factors.	1. Cohort or cross-sectional study design 2. Measured prevalence of burnout 3. Participants were medical residents 4. Used MBI to measure burnout 5. Written in English 6. Excluded if: participants were senior physicians, chiropractors, or medical students; missing or unavailable data; or review, commentary, or editorial	Database(s): EMBASE, PsycINFO, PubMed, WOS Dates: Database inception to March 2018	Residents	Subgroup 47 studies (2 orthopaedic)	Rates (2 studies)	National Institutes of Health's Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies (NIH-QAT) (no quality score calculated)	Narrative synthesis Meta-analysis using random effects Heterogeneity I ² statistic
Pulcrano (2016) <i>Quality of life and burnout rates across surgical specialties: A systematic review</i>	To systematically review the literature across multiple surgical specialties and provide a comprehensive understanding of quality of life (QoL) and burnout among all surgeons, to delineate variation in rates of burnout and poor QoL, and to elucidate factors that are commonly implicated in these outcomes.	1. Participants were surgical specialists practicing in the United States 2. Used questionnaire(s) with ≥ 1 QoL question 3. Written in English 4. Excluded if participants were medical students or non-surgical health care professionals 5. Excluded reviews	Database(s): EMBASE, Medline, PsycINFO Dates: January 1980 to June 2015	Surgeons (United States)	Subgroup 41 studies (6 orthopaedic)	Rates (6 studies)	None	Narrative synthesis
Rodrigues (2018) <i>Burnout syndrome among medical residents: A systematic review and meta-analysis</i>	To summarize the published studies and to estimate burnout syndrome prevalence among different medical resident specialties and point to medical specialties most affected by the syndrome.	1. Cross-sectional study design 2. Participants were medical residents 3. Used 22-item MBI to measure burnout 4. "Excellent" or "good" according to quality checklist (see column 9) 5. Approved by ethics 6. Excluded if: longitudinal or interventional study; not stratified by individual specialty; or focused on subgroup of residents (e.g., females only)	Database(s): EMBASE, Google Scholar, PubMed, Scopus, WOS Dates: January 1974 to March 2018	Residents	Subgroup 26 studies (2 orthopaedic)	Rates (2 studies)	Agency for Healthcare Research and Quality (AHRQ) Methodology Checklist for Cross-sectional/Prevalence Study Methodology Checklist for Cross-sectional Study/Prevalence (2 orthopaedic studies met quality criterion to be included in review)	Narrative synthesis Meta-analysis using random effects Heterogeneity I ² statistic

Acronyms: AHRQ = Agency for Healthcare Research and Quality; EMBASE = Excerpta Medica dataBASE; EMR = Eastern Mediterranean Region; MBI = Maslach Burnout Inventory; MBI-HSS = Maslach Burnout Inventory – Human Services Survey; MEDLINE = Online counterpart to MEDLARS (MEDical Literature Analysis and Retrieval System); NHLBI = National Heart, Lung, and Blood Institute; NIH-QAT = National Institutes of Health's Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies; QoL = Quality of Life; RCTs = Randomized Controlled Trials; WOS = Web of Science.

[†] Stated inclusion of 10 papers in manuscript but cited nine references.

Table 2. Primary Studies on Burnout Rates, Associations, and Interventions in Orthopaedic Surgery Cited by Systematic Reviews Included in Umbrella Review

Primary Study [†]	Systematic Review								Number of Times Cited				
	Arora (2013)	Bartholomew (2018)	Busireddy (2017)	Doraiswamy (2021)	Hui (2019)	Low (2019)	Pulcrano (2016)	Rodrigues (2018)					
Rates (R)	8 studies	3 studies	–	2 studies	9 studies	2 studies	6 studies	2 studies					
Associations (A)	1 study	–	–	–	9 [‡] studies	–	–	–					
Interventions (I)	0 studies	–	1 study	–	0 studies	–	–	–					
									R	A	I		
1 Alsheikh (2019) Saudi Arabia				R					1	0	0		
2 Arora (2014) Australia					R	R		R	3	0	0		
3 Barrack (2006) US			I		A				0	1	1		
4 Balch (2011) US					R		R		2	0	0		
5 Leigh (2002) US							R		1	0	0		
6 Lesić (2009) Serbia	R				R				2	0	0		
7 Sadat-Ali (2005) Saudi Arabia	R			R	R				3	0	0		
8 Saleh (2007) US	R	R [§]			R	A	R		4	1	0		
9 Saleh (2009) US	R				A				1	1	0		
10 Salles (2014) US							R		1	0	0		
11 Sánchez-Madrid (2005) Spain	R								1	0	0		
12 Sargent (2004) US	R	A	R		A		R		3	2	0		
13 Sargent (2009) US	R	R			R	A	R		5	1	0		
14 Sargent (2011) NR					A				0	1	0		
15 Shanafelt (2012) US	R								1	0	0		
16 Simons (2016) US					R	A		R	2	1	0		
17 van Vendeloo (2014) Netherlands					R				1	0	0		
18 van Wulfften Palthe (2016) NR					A				0	1	0		
19 Zheng (2018) China					R	A			1	1	0		

Note: Hui (2019) categorized study by Barrack (2006) as being an association analysis, while Busireddy (2017) categorized it as interventional.

Acronyms: A = Associations; I = Interventions; NR = Not Reported; R = Rates, US = United States.

[†] See Table 3 for full references.

[‡] Stated inclusion of 10 papers in manuscript but cited nine references.

[§] Reported Saleh (2009) in manuscript but Saleh (2007) in reference list.

Table 3. Full References for Primary Studies on Burnout Rates, Associations, and Interventions in Orthopaedic Surgery Cited by Systematic Reviews Included in Umbrella Review

1 Alsheikh (2019)	Alsheikh KA, Alhabradi FA, Almalik FF, Alsalam AA, Ahmed FE, Alhandi AA. Burnout syndrome among orthopaedic surgery residents in Saudi Arabia: A multicenter study. <i>Journal of Musculoskeletal Surgery and Research.</i> 2019 ;3:184.
2 Arora (2014)	Arora M, Diwan AD, Harris IA. Prevalence and factors of burnout among Australian orthopaedic trainees: A cross-sectional study. <i>J Orthop Surg (Hong Kong).</i> 2014 Dec;22(3):374-7. doi: 10.1177/230949901402200322.
3 Barrack (2006)	Barrack RL, Miller LS, Sotile WM, Sotile MO, Rubash HE. Effect of duty hour standards on burnout among orthopaedic surgery residents. <i>Clin Orthop Relat Res.</i> 2006 Aug;449:134-7. doi: 10.1097/01.blo.0000224030.78108.58.
4 Balch (2011)	Balch CM, Shanafelt TD, Sloan JA, Satele DV, Freischlag JA. Distress and career satisfaction among 14 surgical specialties, comparing academic and private practice settings. <i>Ann Surg.</i> 2011 Oct;254(4):558-68. doi: 10.1097/SLA.0b013e318230097e.
5 Leigh (2002)	Leigh JP, Kravitz RL, Schembri M, Samuels SJ, Mobley S. Physician career satisfaction across specialties. <i>Arch Intern Med.</i> 2002 Jul 22;162(14):1577-84. doi: 10.1001/archinte.
6 Lesić (2009)	Lesić AR, Stefanovic NP, Perunić I, Milenković P, Tosevski DL, Bumbasirević MZ. Burnout in Belgrade orthopaedic surgeons and general practitioners, a preliminary report. <i>Acta Chir Jugosl.</i> 2009 ;56(2):53-9. doi: 10.2298/aci0902053l.
7 Sadat-Ali (2005)	Sadat-Ali M, Al-Habdan IM, Al-Dakheel DA, Shriyan D. Are orthopedic surgeons prone to burnout? <i>Saudi Med J.</i> 2005 Aug;26(8):1180-2.
8 Saleh (2007)	Saleh KJ, Quick JC, Conaway M, Sime WE, Martin W, Hurwitz S, Einhorn TA. The prevalence and severity of burnout among academic orthopaedic departmental leaders. <i>J Bone Joint Surg Am.</i> 2007 Apr;89(4):896-903. doi: 10.2106/JBJS.F.00987.
9 Saleh (2009)	Saleh KJ, Quick JC, Sime WE, Novicoff WM, Einhorn TA. Recognizing and preventing burnout among orthopaedic leaders. <i>Clin Orthop Relat Res.</i> 2009 Feb;467(2):558-65. doi: 10.1007/s11999-008-0622-8.
10 Salles (2014)	Salles A, Cohen GL, Mueller CM. The relationship between grit and resident well-being. <i>Am J Surg.</i> 2014 Feb;207(2):251-4. doi: 10.1016/j.amjsurg.2013.09.006.
11 Sánchez-Madrid (2005)	Sánchez-Madrid MA, Delgado-Martínez AD, Alcalde-Pérez D. Prevalence of burnout syndrome in orthopaedic surgeons in Spain. <i>Archiv Ortop Traumatol.</i> 2005 ;49:364-367.
12 Sargent (2004)	Sargent MC, Sotile W, Sotile MO, Rubash H, Barrack RL. Stress and coping among orthopaedic surgery residents and faculty. <i>J Bone Joint Surg Am.</i> 2004 Jul;86(7):1579-86. doi: 10.2106/00004623-200407000-00032.

Table 3. Continued

13 Sargent (2009)	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. <i>J Bone Joint Surg Am.</i> 2009 Oct;91(10):2395-405. doi: 10.2106/JBJS.H.00665.
14 Sargent (2011)	Sargent MC, Sotile W, Sotile MO, Rubash H, Vezeridis PS, Harmon L, Barrack RL. Managing stress in the orthopaedic family: avoiding burnout, achieving resilience. <i>J Bone Joint Surg Am.</i> 2011 Apr 20;93(8):e40. doi: 10.2106/JBJS.J.01252.
15 Shanafelt (2012)	Shanafelt TD, Boone S, Tan L, Dyrbye LN, Sotile W, Satele D, West CP, Sloan J, Oreskovich MR. Burnout and satisfaction with work-life balance among US physicians relative to the general US population. <i>Arch Intern Med.</i> 2012 Oct 8;172(18):1377-85. doi: 10.1001/archinternmed.2012.3199.
16 Simons (2016)	Simons BS, Foltz PA, Chalupa RL, Hylden CM, Dowd TC, Johnson AF. Burnout in U.S. military orthopaedic residents and staff physicians. <i>Mil Med.</i> 2016 Aug;181(8):835-9. doi: 10.7205/MILMED-D-15-00325.
17 van Vendeloo (2014)	van Vendeloo SN, Brand PL, Verheyen CC. Burnout and quality of life among orthopaedic trainees in a modern educational programme: Importance of the learning climate. <i>Bone Joint J.</i> 2014 Aug;96-B(8):1133-8. doi: 10.1302/0301-620X.96B8.33609.
18 van Wulfften Palthe (2016)	van Wulfften Palthe OD, Neuhaus V, Janssen SJ, Guitton TG, Ring D; Science of Variation Group. Among musculoskeletal surgeons, job dissatisfaction is associated with burnout. <i>Clin Orthop Relat Res.</i> 2016 Aug;474(8):1857-63. doi: 10.1007/s11999-016-4848-6.
19 Zheng (2018)	Zheng H, Shao H, Zhou Y. Burnout among Chinese adult reconstructive surgeons: Incidence, risk factors, and relationship with intraoperative irritability. <i>J Arthroplasty.</i> 2018 Apr;33(4):1253-1257. doi: 10.1016/j.arth.2017.10.049.

Table 4. Subgroup Analyses Comparing Rates of Burnout in Orthopaedic Surgery Versus Other Specialties in Systematic Reviews Included in Umbrella Review

	High Depersonalization (%)		High Emotional Exhaustion (%)		Low Personal Achievement (%)		Overall Clinically Significant Burnout (%)	
Systematic Review	Doraiswamy (2021) Physicians (EMR)	Rodrigues (2018) Residents	Doraiswamy (2021) Physicians (EMR)	Rodrigues (2018) Residents	Doraiswamy (2021) Physicians (EMR)	Rodrigues (2018) Residents	Doraiswamy (2021) Physicians (EMR)	Rodrigues (2018) Residents
Population(s) of Interest								
<i>Burnout Measure(s)</i>								
Specialties of Interest	Anesthesiology	–	39.46%	–	46.21%	–	24.68%	41%
	Cardiology	–	72%	68%	–	10.5%	–	–
	Dermatology	55.56%	–	76.54%	13.58%	–	–	51.89%
	Emergency Medicine	32.26%	39%	59.26%	32.59%	46.1%	36.57%	–
	Family Medicine	–	24%	–	–	–	–	35.97%
	General Surgery	44.64%	50%	58.26%	18.41%	22.3%	67.9%	58.39%
	Intensive Care	70.07%	–	37.74%	51.02%	–	58.29%	–
	Internal Medicine	40.74%	45%	60.30%	14.72%	62.3%	64.18%	30%
	Neurology	50.62%	–	85.19%	4.94%	–	–	18%
	Neurosurgery	–	–	–	–	–	–	–
	Obstetrics/Gynaecology	–	51%	–	–	25.3%	–	40%
	Oncology	37.06%	–	57.53%	25.11%	–	18.11%	–
	Ophthalmology	37.92%	–	58.94%	42.13%	–	41.03%	–
	Orthopaedic Surgery	39.75%	36%	42.45%	23.15%	30.8%	38.7%	49%
	Otolaryngology	50.12%	53%	70.32%	15.14%	26.5%	25.87%	27%
	Pediatrics	–	25%	–	–	6.49%	–	29%
	Plastic Surgery	46.73%	25%	69.57%	36.64%	46.1%	32.99%	29%
	Psychiatry	–	–	–	–	–	–	–
	Radiation Oncology	–	27%	–	–	13.3%	–	–
	Radiology	45.26%	49%	64.74%	5.79%	–	15%	–
	Overall	37.83%	43.6%	44.26%	36.57%	28.05%	24.5%	35.1%
Significant Difference?	Yes	NR	Yes	NR	Yes	NR	No	No

Note: Reviews reported 95% confidence intervals and I^2 statistics; not reported here for simplicity. Bartholomew (2018) compared mean MBI scores across studies conducted in the United States for orthopaedics, obstetrics/gynaecology, and otolaryngology; orthopaedics had significantly higher depersonalization, emotional exhaustion, and personal achievement scores when compared with otolaryngology & significantly lower emotional exhaustion than obstetrics/gynaecology.

Acronyms: EMR = Eastern Mediterranean Region; MBI = Maslach Burnout Inventory; NR = Not Reported.

† Discrepancies in results were noted between the manuscript's table, figure, and text; data extracted from table.

‡ Surgical residents (53.27%) versus medical residents (50.13%); no significant difference.

Appendix 3

Table 1. Characteristics of Narrative Reviews on Burnout In Orthopaedic Surgeons Included in Umbrella Review

Narrative Review	Aim(s)	Summary
Ames (2017) <i>Burnout in orthopaedic surgeons: A challenge for leaders, learners, and colleagues</i>	1. To review burnout in the medical profession. 2. To demonstrate that burnout begins during medical education and affects all parts of a surgeon's career. 3. To explore suggestions and interventions to address issues inherent to prevent burnout, specifically in orthopaedic surgeons.	Aim 1: Review burnout in medical profession • Symptoms: Characterized by high depersonalization, high emotional exhaustion, and low personal achievement. • Prevalence: Higher than in general population; steadily increases during medical education and continues through physicians' careers, affecting about one in two physicians; particularly common in orthopaedic surgery, emergency medicine, general internal medicine, and family medicine. • Associations: Higher staff turnover, absenteeism, and early retirement; lower quality of care and patient safety; greater medical errors. Also associated with substance abuse and depression. • Contributing factors: Work overload, lack of control, sense of unfairness, lack of community. • Burnout measure: 22-item MBI. Aim 2: Demonstrate burnout begins during medical education and affects all parts of a surgeon's career • Medical students: Burnout worsens during medical school; schools now required to have wellness programs. • Residents (highest risk group): Substantial risk for burnout, depression, and suicidal ideation, with higher levels than age-matched comparisons; ACGME has active interest in improving well-being; work-hour regulations have not improved rates. • Physicians: Early career physicians at higher risk than experienced peers; burnout notable irrespective of setting (urban or rural). • Chairs and program directors: Continue to experience burnout, with increases in proportion dissatisfied with career; related to excessive workload, budget deficits, tenure and promotion, and loss of key staff. Aim 3: Suggestions and interventions to address burnout • No interventions found specifically for orthopaedics. ◦ Mindfulness training found to improve burnout in trial of physicians. ◦ Resilience training not found to be efficacious among residents. • General recommendations to address burnout in medical community: ◦ Measuring well-being; ◦ Offering education on burnout, substance abuse, and suicidal ideation; ◦ Developing structured interventions to improve workflow and management; and ◦ Building a culture of appreciation.

Table 1. Continued

Narrative Review	Aim(s)	Summary
Daniels (2016) <i>Orthopaedic surgeon burnout: Diagnosis, treatment, and prevention</i>	1. To describe burnout in orthopaedic surgery, including its effects and risk factors. 2. To describe diagnosis of burnout. 3. To describe the treatment and prevention of burnout.	Aim 1a: Describe burnout in orthopaedic surgeons • Symptoms: Characterized by high emotional exhaustion, high depersonalization, and low personal achievement. • Prevalence: Between 40% to 60%; more common than in many other subspecialties. • Distribution: Trainees, surgeons, and faculty leaders have different types of burnout: ○ <u>Practicing surgeons:</u> High levels of emotional exhaustion and depersonalization, with preserved personal achievement; less experienced have higher emotional exhaustion and depersonalization; faculty at larger programs more likely to be lonely and irritable. ○ <u>Faculty leaders (chairs and chiefs):</u> Similar pattern as surgeons with higher emotional exhaustion. ○ <u>Residents:</u> High levels of emotional exhaustion, very high depersonalization, and low personal achievement; work hour restrictions improve emotional exhaustion and personal achievement, with limited impact on depersonalization. • Countries have different rates of burnout: ○ Higher in United States; trainees elsewhere work fewer hours and report lower burnout, including depersonalization; work-hour restrictions in United States did not impact depersonalization score therefore unrelated work factors may influence depersonalization rates. Aim 1b: Effects of burnout • Personal: Reduced quality of life; physical exhaustion; poor judgment; cynicism; impaired relationships with patients and colleagues; decreased productivity; poor mental and physical health outcomes (e.g., depression, alcohol and drug use, cardiovascular disease). • Institutional: Poorer performance; higher staff turnover and absenteeism; greater medical errors; lower compassion at work; greater sub-optimal patient care experiences. Aim 1c: Risk factors for burnout • Faculty: Anxiety regarding clinical competence; concerns about growing number of orthopaedic surgeons; stressful relationships with staff, spouse, and family members; financial concerns; increased stress at work; increased conflict between work-home life; greater number of work hours; increased alcohol use. • Residents: Anxiety regarding clinical competence; stressful relationships with other staff; increased stress at work; increased conflict between work-home life; increased anticipation of debt. • Irritability and social withdrawal are early warning signs of burnout; families and colleagues should be aware of these to help with screening efforts. Aim 2: Describe diagnosis of burnout • Measures: 22-item MBI. Reviewers recommend performing focused burnout screening efforts (e.g., on those with multiple risk factors or with symptoms) and adding screening to standard residency surveillance activities. Aim 3: Describe treatment and prevention of burnout • Minimal evidence-based literature exists; cited below strategies for treatment and prevention of burnout:

Table 1. Continued

Narrative Review	Aim(s)	Summary		
		Intervention	Description	Evidence
		Mindfulness-based interventions	Increased physical and emotional self-awareness, including via breathing and yoga.	Cited two studies noting improvements in burnout symptoms across three domains of MBI among physicians of different specialties; neither had control group.
		Counseling sessions and workshops	Stress management and coping education; group discussions of burnout.	Cited two studies noting improvements in emotional exhaustion and depersonalization among physicians and pediatric residents respectively; further research required.
		Maximizing protective factors	Protective factors include support at work and home; having a mentor; being part of a national specialty organization; separating personal and professional life; meditating, exercising, and hobbies; limiting alcohol intake; maintaining strong family relationships.	Cited two studies finding consistent protective factors among orthopaedic surgeons.
		Institutional adjustments	Interventions focused on increasing physician autonomy, work efficacy, and satisfaction; encouraging participating in leadership opportunities; improving fairness; and streamlining workflow.	Cited study noting improvements in burnout among physicians after institutions changes.

Table 1. Continued

Narrative Review	Aim(s)	Summary												
Goldstein & Weiss (2019) <i>The canary in the coal mine: Wellness among pediatric orthopaedic surgeons</i>	To describe wellness among pediatric orthopaedic surgeons.	Aim 1: To describe wellness among pediatric orthopaedic surgeons - Occupational burnout is a problem in pediatric orthopaedics. - POSNA created a task force in 2018 to address burnout among its members. - It administered a survey (nearly 50% response rate), confirming high prevalences of burnout:												
		<table><thead><tr><th>Question</th><th>Response</th></tr></thead><tbody><tr><td><i>"I enjoy my work. I have symptoms of burnout."</i></td><td>1 in 7 (15.38%)</td></tr><tr><td><i>"Occasionally I am under stress, and I don't always have as much energy as I once did, but I don't feel burned out."</i></td><td>1 in 2 (46.85%)</td></tr><tr><td><i>"I am definitely burning out and have one or more symptoms of burnout, such as physical and emotional exhaustion."</i></td><td>1 in 4 (26.92%)</td></tr><tr><td><i>"The symptoms of burnout that I'm experiencing won't go away. I think my frustration at work a lot."</i></td><td>1 in 10 (7.34%)</td></tr><tr><td><i>"I feel completely burned out and often wonder if I can go on. I am at the point where I may need some changes or may need to seek some sort of help."</i></td><td>1 in 30 (3.50%)</td></tr></tbody></table>	Question	Response	<i>"I enjoy my work. I have symptoms of burnout."</i>	1 in 7 (15.38%)	<i>"Occasionally I am under stress, and I don't always have as much energy as I once did, but I don't feel burned out."</i>	1 in 2 (46.85%)	<i>"I am definitely burning out and have one or more symptoms of burnout, such as physical and emotional exhaustion."</i>	1 in 4 (26.92%)	<i>"The symptoms of burnout that I'm experiencing won't go away. I think my frustration at work a lot."</i>	1 in 10 (7.34%)	<i>"I feel completely burned out and often wonder if I can go on. I am at the point where I may need some changes or may need to seek some sort of help."</i>	1 in 30 (3.50%)
		Question	Response											
		<i>"I enjoy my work. I have symptoms of burnout."</i>	1 in 7 (15.38%)											
		<i>"Occasionally I am under stress, and I don't always have as much energy as I once did, but I don't feel burned out."</i>	1 in 2 (46.85%)											
		<i>"I am definitely burning out and have one or more symptoms of burnout, such as physical and emotional exhaustion."</i>	1 in 4 (26.92%)											
		<i>"The symptoms of burnout that I'm experiencing won't go away. I think my frustration at work a lot."</i>	1 in 10 (7.34%)											
<i>"I feel completely burned out and often wonder if I can go on. I am at the point where I may need some changes or may need to seek some sort of help."</i>	1 in 30 (3.50%)													
- POSNA has highest percentage of women among orthopaedic societies (around one in two in 2016). - Survey found female surgeons were more likely to report burnout than male surgeons; females also more likely to experience bullying, harassment, sexual harassment, pay disparity, and implicit bias against them. - Article compared orthopaedic surgeons to canaries in the coal mine, wherein canaries (like surgeons) are strong and resilient, but if the coal mines (workplaces) become too toxic, we must change the coal mine (workplace) rather than strengthen the canary (surgeon). - POSNA is therefore taking on <i>both</i> individual well-being efforts ("canary strengthening") and institutional cultural changes ("coal mine changing"). "Canary strengthening" interventions: normalize and promote self-care; implement mindfulness interventions (e.g., pediatric orthopaedic surgeons can take opportunities for mindful practice during natural pauses). "Coal mine changing" interventions: future efforts should be directed here, for example in topics on: call ratios, scribes and advanced practitioner assistance, and trauma room access.														

Table 1. Continued

Narrative Review	Aim(s)	Summary
Talwalkar & Weiss (2020) <i>Wellness and drivers of burnout</i>	To review relevant literature and work of the POSNA wellness committee.	Brief supplementary article outlining work of the POSNA wellness committee as well as recommendations for approaching burnout, including “canary strengthening” interventions (e.g., mindfulness and self-care) and “coal mine changing” interventionists (e.g., addressing time spent documenting and stigmatization of mental health and treatment for physicians).
Jennings (2022) <i>Orthopaedic surgeons have a high prevalence of burnout, and depression, and suicide: Review of factors which contribute or reduce further harm</i>	To describe the issue of physician burnout and depression and make recommendations regarding necessary changes to counteract mental illness in orthopaedic surgeons. Information on depression and suicide not summarized here; please see review.	Section 1: Burnout - Characterized by high depersonalization, high emotional exhaustion, and low personal achievement. - Rates in orthopaedic surgery range from 40% to 60%; particularly high in residents. - Workload, decreased job control, excessive charting, and verbal abuse are associated with burnout. - High burnout may lead to mental health concerns (e.g., suicide and depression). Section 2: Barriers to seeking mental health treatment - Stigma; fear of punitive actions, such as loss of staffing privileges and negative effects on licensure; concerns around loss of confidentiality. Section 3: Top-down approach to physician wellness - There must be buy-in from all parties.
	Institutional level	- The ACGME requires residency programs to promote mental health - Surgeon peer discussion groups (protected time/safe space to discuss work stressors) - Improve inefficiencies in electronic health record and ancillary staff - Update workplaces in partnership with surgeons - Eliminate unnecessary obligations (prioritize surgeon nonwork relationships) - Recognize gender differences, promote equality regardless of gender (protected time for childcare, maternity/paternity leave)
	Professional assistance	- Establish a Chief of Wellness Officer (CWO) to oversee counseling services - Build a Wellness Team (counseling, psychiatric, and coaching services) - Implement proactive counseling programs - One-on-one executive/wellness coaches (improve prioritization, boundary setting, self-compassion)

Table 1. Continued

Narrative Review	Aim(s)	Summary
		Individual practices • Increase self-awareness • Practice mindfulness (see table below) Meditation or wellness applications “Waking Up”, “Headspace”, “UCLA Mindful”, “Calm”, “Insight Timer”, “Koa Health”, “Real”, “Smiling Mind”, “Mindfulness Coach” Mindfulness practices Journaling, Yoga, Breathwork, Retreats with like-minded communities, Exercise routines, Hiking/walking
		Section 4: Current research by orthopaedic societies • American Society for Surgery of the Hand: ◦ Found around one in two hand surgeons reported burnout. Factors negatively associated with burnout: ≥ 65 years, working in outpatient setting, performing hand-specific surgeries only, low commute times, and performing ≤ 10 surgeries per month; sex and compensation did not have an effect. • POSNA: ◦ Established a Mental Health and Wellness Charter in 2018. Charter plans to redesign fellowship training (e.g., promote compassionate connection between patients and families, promote fellow autonomy); healthcare delivery (e.g., optimize care systems including electronic health record, documentation burdens, and reimbursement); and research prioritization (e.g., understand interventions that help improve surgeon health, culture, and clinical outcomes).
Smith (2021) <i>Physician wellbeing in orthopaedic surgery: Challenges and solutions</i>	To define four main components of wellness (physical, mental, emotional, and spiritual) and offer potential solutions for readers on how to apply these to their own lives.	Aim 1: Define four components of wellness and offer solutions for achieving each • Article focuses on wellness broadly, rather than specifically burnout, although the two are intertwined. Component of Wellness Physical wellness Potential Solution <u>Physical activity</u> • > 150 minutes of moderate-intensity or > 75 minutes of vigorous intensity aerobic exercise per week • Active additionally for 1 hour daily • Cross-training • Strengthening, stretching, and balance exercises <u>Sleep</u> • Ideally 7 to 9 hours • Power naps 15 to 30 minutes in length • Avoid caffeine, alcohol, and nicotine before sleep • Minimize blue light before sleep

Table 1. Continued

Narrative Review	Aim(s)	Summary
		<u>Eating habits</u> • Reduce sodium, fat • Eat a balanced diet • Increase healthy options • Hydration: 2.7 liters per day for women; 3.7 liters per day for men <u>Acute/chronic musculoskeletal injuries</u> • Achieve optimum patient table height • Surgeon posture: neck flexion ≤ 25 degrees, lumbar spine neutral flexion • Anti-fatigue mats • Intra-operative targeted stretch microbreaks
		<u>Mental wellness</u> <u>Visualization</u> • Mentally rehearse complex scenarios beforehand, such as operations and difficult conversations <u>Meditation and mindfulness</u> • Do deliberate exercises focused on senses, such as breaths, physical sensations, or repetition of words <u>Resiliency training</u> • Obtain training focused on unlearning negative drivers of resilience • Learn strategies to adapt to stress, maintain positively, and become flexible with unknown
		<u>Emotional wellness</u> <u>Cognitive reframing</u> • Cultivate an optimistic attitude by reframing challenges as opportunities <u>Self-compassion</u> • Positive self-talk • Allowing self-acceptance <u>Peer support, community, and connection</u> • Connect with colleagues to build supportive network
		<u>Spiritual wellness</u> • Aligning values, beliefs, and purpose

Table 1. Continued

Narrative Review	Aim(s)	Summary
Travers (2020) <i>Burnout in orthopaedic surgeons</i>	1. To define burnout. 2. To describe the frequency of burnout and its risk factors. 3. To describe how burnout impacts orthopaedic and trauma surgery specifically. 4. To describe how burnout can be prevented and treated.	Aim 1: Define burnout • Concept introduced in 1961. • Characterized by high depersonalization, high emotional exhaustion, and low personal achievement. • Symptoms can be emotional, psychological, and physical: ◦ Emotional (e.g., anxiety, sadness, irritability) ◦ Cognitive (e.g., memory, attention, concentration problems) ◦ Behavioral (e.g., withdrawal, reduced empathy, cynicism) ◦ Motivational (e.g., progressive disengagement, reduced motivation) ◦ Physical (e.g., trouble sleeping, headaches, back pain) • Six psychosocial risk factors:
		Risk Factors
		Examples
		Intensity and complexity of work • Work schedule constraints • Adequacy of means
		Difficult work schedules • Work overload • Atypical work schedule
		Significant emotional requirements • Tension with public • Being face-to-face with suffering of others • Difficulty controlling emotions
		Lack of autonomy at work • Lack of task & time autonomy (e.g., having to do administrative tasks)
		Deterioration in social interactions at work • Lack of support from colleagues and superiors • Internal violence • Lack of recognition at work
		Conflicted values • Quality prevented • Useless work
		Job and work insecurity • Socioeconomic insecurity
		Aim 2: Describe frequency of burnout and its risk factors • About one in two surgeons experience burnout; often emotional exhaustion and depersonalization increase, but personal achievement remains intact. • Burnout affects all age groups, practice types, and countries; higher in women and residents. • Mean suicide rate is double that of general population. • Primary risk factors are physical and emotional overload, growing bureaucracy, and fear of being sued.

Table 1. Continued

Narrative Review	Aim(s)	Summary
		Aim 3: Describe how burnout impacts orthopaedic and trauma surgery specifically - Rates of burnout in orthopaedic surgery are between 30% and 40%, with over 50% in residents. - Orthopaedic surgeons noted the below challenges: Operating room challenges - Administrative burdens with scheduling time slots - Growing bureaucracy - Conflictual relationships with operating room staff Clinic challenges - Patient demands - Fatigue after consultations - Delays/cancellations - Malpractice lawsuits Organizational challenges - Difficult relationships with administration - Not being consulted in decision-making - Financial charges being high Other notable stressors - Apprehension about workload and seeing patients - Lack of pleasure seeing colleagues - Lack of desire going to work - Insufficient sleep - Unable to disconnect from work - Extreme fatigue at end of work shift - Anxiety over financial requirements
		Aim 4: Describe how burnout can be prevented and treated - Paper outlined prevention strategies. Detecting burnout - Individual detection: systematic analysis of clinical signs and susceptibility risk factors. - Group detection: assessment by occupational health team and using data on operating room performance (e.g., absenteeism, high turnover). Addressing workload & schedule - Reduce work time - Engage in personal and recreational activities Managing “difficult” patient encounters - Recognize only small proportion are “difficult” - Develop strategies to approach patients differently Managing malpractice lawsuits - Implement strategies to reduce lawsuits - Acknowledge opportunities for improvement - Place lawsuits into perspective, recognize most patients are grateful for care

Table 1. Continued

Narrative Review	Aim(s)	Summary
		- Managing administration conflicts - Develop strategies to adapt to different administration - For example: step back when necessary and define negotiation boundaries - Recapturing purpose and values of profession - Recapture purposes and values of profession by engaging in community efforts - Improving interprofessional communication - Debrief & share information in a timely manner with colleagues to decrease likelihood of negative interactions - Self-awareness - Recognize when things are not going well and tangible ways to address them - Personal (medication, relaxation, therapy) or group (e.g., stress management weekends) self-help strategies
		- Paper outlined treatment strategies: Personal: Sick leave +/- non-pharmacological strategies (e.g., psychotherapy with psychologist; discussion with occupational health team) Institutional: Analysis of workplace conditions by occupational health team
Walker & Goldstein (2019) <i>Current concept review: Surgeon wellness and burnout</i>	1. To describe burnout. 2. To describe the effects of burnout. 3. To describe risk factors for burnout. 4. To describe detection of burnout. 5. To describe how to prevent and treat burnout.	Aim 1: Describe burnout - Characterized by high depersonalization, high emotional exhaustion, and low personal achievement. - Associated with negative personal and professional outcomes. - Prevalence of 40% to 60% in orthopaedics; more common in women. - Factors may differ between sexes due to gender roles, hierarchical structures, and power imbalances. Aim 2: Describe the effects of burnout Professional: medical errors, reduced patient satisfaction, reduced productivity, increased job turnover. Personal: decreased fulfillment, conflict with colleagues, cynicism, substance use, physical and mental illness, suicidal ideation. Aim 3: Describe risk factors for burnout - Residents particularly at risk for high emotional exhaustion, high depersonalization, and low personal achievement; attendings and faculty at risk for high emotional exhaustion and high depersonalization, with personal achievement preserved; surgeons with > 10 years' experience have lower rates. - Factors associated include difficult relationships with other faculty; increased conflict between home and work life; greater number of work hours/call shifts; increased stress at work; anxiety over clinical competence; increased alcohol use. - Despite number of work hours being associated with burnout, rates did not uniformly improve after implementation of 80-hour work-week restrictions in United States.

Table 1. Continued

Narrative Review	Aim(s)	Summary
		Aim 4: Describe detection of burnout - Co-workers and family members should look for warning signs, which include failing relationships at work and home; withdrawal; exhaustion that does not respond to adequate rest; cynicism; lack of efficacy; desperation; internalization; overworking; increased alcohol use, disruptive or dangerous behaviors; changes in appetite or sleep habits; irritability; muscle spasms; back pain; headaches. Aim 5: Describe how to prevent and treat burnout - Multi-faceted approach is required. - Individual-level interventions: mindfulness interventions - Institutional-level interventions: addressing stigma around seeking professional help; implementing practice management changes to increase physician autonomy, work efficiency, and satisfaction (e.g., customizable work options, group meetings to discuss concerns, streamlining workflow); clarifying guidelines for advancement and encouraging participation in leadership opportunities; offering mentorship and partnership opportunities POSNA has taken large steps to combat burnout.

Acronyms: ACGME = Accreditation Council for Graduate Medical Education; MBI = Maslach Burnout Inventory; POSNA = Pediatric Orthopaedic Society of North America.