

Running Head: CORRELATES OF BURNOUT IN MEDICAL TRAINEES

What extinguishes the flame? A meta-analytic investigation of correlates of burnout in medical
trainees

Shaun M. L. Prentice

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University of Adelaide

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Abstract

Background: Burnout, a work-related psychological syndrome, is highly prevalent in medical trainees. Burnout is associated with deleterious outcomes for the individual practitioner; their colleagues, patients and workplace; and broader society. Designing burnout prevention and reduction interventions for this population is therefore critical. However, burnout research with medical trainees is characterised by different conceptualisations and operationalisations of this complex construct, producing inconsistent findings. *Aims:* To examine individual and work-related correlates of burnout, as defined by the Maslach Burnout Inventory, in medical trainees. *Methods:* Thirty-three studies, comprising a pooled sample of 7,229 trainees, were identified from a systematic search of the Embase, PsycInfo, Medline, ERIC and Cochrane Library databases. Study reporting quality was examined using the QualSyst tool and Pearson's r correlations calculated, in addition to 95% confidence intervals, p -values, heterogeneity statistics and fail-safe N s. These analyses used a random-effects model. Training level (intern, resident, registrar) and specialty (surgical, non-surgical) were examined as potential moderators. *Results:* Variables with the strongest relationships across burnout dimensions included poor mental health; conflict between individual and organisational values; low job reward; and high workloads. Subgroup analyses identified emotional intelligence, specialty satisfaction, and income satisfaction as significant correlates specifically for surgical registrars. *Conclusions:* Interventions targeting burnout in medical trainees should focus on a combination of individual (e.g. improving mental health) and work variables (e.g. reduced workload) for maximum benefits. Observed differences between surgical and non-surgical registrars require further examination, as they may compromise transferability of interventions.

Dissemination of Results

Prentice, S., Dorstyn, D., Benson, J., & Elliott, T. (2018). *Characteristics of Burnout in Medical Trainees: A Meta-Analysis*. Paper presented at GPTEC 2018, Adelaide, Australia.

Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any University, and, to the best of my knowledge, this thesis contains no material previously published except where due reference is made. I give permission for the digital version of this thesis to be made available on the web, via the University of Adelaide's digital thesis repository, the Library Search and through web search engines, unless permission has been granted by the School to restrict access for a period of time.

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Chapter 1

Introduction

1.1 Overview of Burnout

1.1.1 Definitions of burnout

The phenomenon of burnout has a considerable history, with records of the concept dating back to The Old Testament (1 Kings 19:3-5 New International Version). However, burnout did not begin to be formally acknowledged in Western medicine until Beard (1879) described the condition of ‘neurasthenia’, characterised by fatigue and emotional disturbance. Nearly a century later, the phrase ‘burnout’ was introduced to the psychological literature by Freudenberger (1974), who described the emotional and physical strain experienced by human service professions. According to Freudenberger (1974), burnout involved a state of fatigue or frustration regarding one’s job. However, rather than providing a specific definition of burnout, Freudenberger (1974) relied on a broad dictionary definition focusing on strain. Various definitions of burnout have since been proposed, including those considering its progression (Cherniss, 1980) and causes (Pines, Aronson, & Kafry, 1981). Although the definition of burnout, including whether it should be recognised in the Diagnostic and Statistical Manual of Mental Disorders, remains disputed (American Psychiatric Association, 2013; Bährer-Kohler, 2013; Manzano-García & Ayala-Calvo, 2013), the most commonly used definition today (Schaufeli & Buunk, 2005) is from the American social psychologist Christina Maslach.

Maslach elaborated on Freudenberger’s (1974) unidimensional definition, identifying burnout as a psychological, pathologic syndrome comprising three dimensions: *emotional exhaustion* – feeling “...emotionally overextended and exhausted by one’s work...”; *depersonalisation* – having “...unfeeling and impersonal [responses] toward recipients of one’s

care or service ...”; and a lack of *personal accomplishment* – “...feelings of competence and successful achievement in one’s work with people...” (Maslach, Jackson, & Leiter, 1996; Maslach, Leiter, & Schaufeli, 2009, pp. 93 - 94). Maslach and Jackson (1981) also focused on the measurement of burnout, developing the Maslach Burnout Inventory (MBI), an instrument based on comprehensive psychometric research. The MBI has had many developments, including versions focussing on specific professions (e.g. human services), and continues to dominate the burnout literature (Schaufeli & Buunk, 2005).

1.1.2 Leiter and Maslach’s model of burnout development

Leiter and Maslach (1982) proposed a tripartite model of burnout (refer Figure 1), theorising that chronic excessive job demands lead to emotional exhaustion. To cope with emotional exhaustion, individuals adopt a strategy of depersonalisation. Given that depersonalisation conflicts with one’s professional ethics, an individual’s sense of personal accomplishment is diminished.

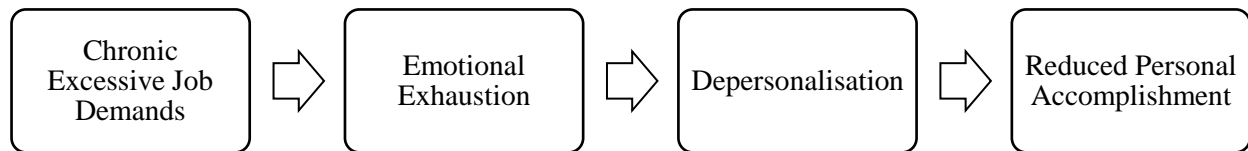


Figure 1. Leiter and Maslach’s (1982) model of burnout development

Factor analysis has strongly supported the existence of Leiter and Maslach's (1982) three dimensional model (cf. Worley, Vassar, Wheeler, & Barnes, 2008). However, weak correlations between personal accomplishment and the other two dimensions have raised questions concerning the proposed *development* of burnout (Leiter, 1988). This led to a revision of the model (refer Figure 2) whereby reduced personal accomplishment develops *alongside* emotional exhaustion and depersonalisation (Leiter, 1991).

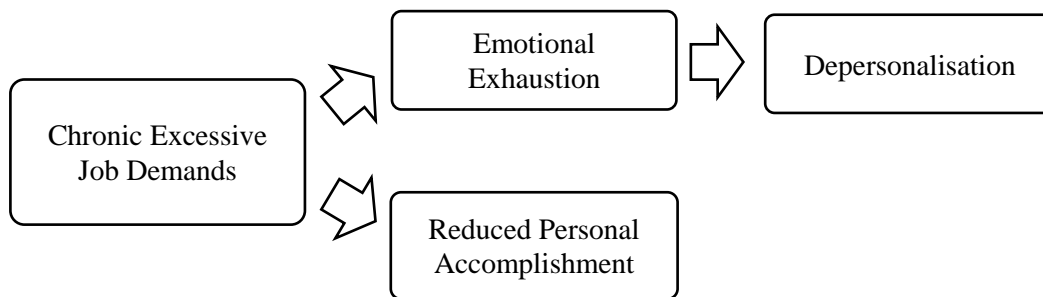


Figure 2. Leiter's revised model of burnout development (adapted from Leiter, 1991, p. 551)

Although this revised model focuses on how burnout progresses, it remains somewhat vague about the causes beyond a list of six job demands identified by Maslach and Leiter (1997). These negative job demands relate to *community* (where work relationships are characterised by a lack of support and trust); *control* (a lack of professional autonomy and limited resources to do an effective job); insufficient *rewards* for one's efforts (both financial and social); *value conflicts*; a lack of *fairness* (e.g. discrepancies in the treatment of different employees); and excessive *workloads*, which can arise from an individual being unsuitable for a job due to their skills, endurance or preference. Although these organisational variables are important, Leiter and Maslach (1982) emphasise them to the detriment of individual variables. This includes the potential contribution of factors such as younger age, which are also known to exacerbate the stress associated with chronic excessive job demands (Brewer & Shapard, 2004). For this

reason, the revised Leiter and Maslach (1982, 1991) model will form the framework for the present paper, however individual non-work variables will also be considered.

1.2 Burnout in Medical Trainees

1.2.1 Definition of medical trainees

For the purposes of the present paper, ‘medical vocational trainees’ (hereafter ‘medical trainees’) will refer to all people being trained to practise medicine who have completed a medical degree, that is, medical interns, residents and registrars (refer Figure 3). Medical interns are those gaining experience in multiple medical specialties (e.g. paediatrics, otolaryngology etc.) immediately following completion of medical school, but not specialising in an area of practise (Australian Medical Association (AMA), N.D.). Medical residents are those who continue working in the public hospital system after completing the intern year but before commencing vocational training (AMA, N.D.). Medical registrars are those who are undergoing vocational training to specialise in an area of medicine (i.e. a specialty; AMA, N.D.).

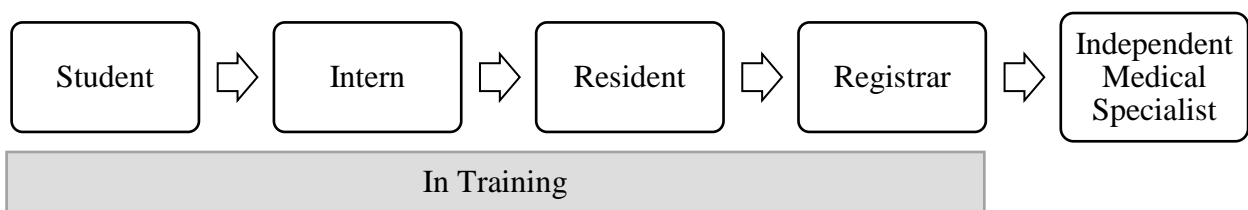


Figure 3. The progression of medical training, adapted from Fazio (2015). Note. ‘Independent medical specialists’ include general practitioners.

Although medical students (i.e. those completing undergraduate or postgraduate medical degrees in a medical school; Fazio, 2015) also lie on the continuum of medical training, there is a distinct shift in responsibilities and workload as students leave medical schools and become

interns (Fazio, 2015). Additionally, patient contact frequency and intensity are lower in students compared to further training stages which, according to Cordes and Dougherty (1993; refer Figure 4), should also raise burnout prevalence. Research also indicates different burnout patterns between medical students and medical trainees (Dyrbye & Shanafelt, 2016; Wu, Ireland, Hafekost, & Lawrence, 2013). Indeed, evidence suggests that burnout may be related to the process of medical training: while medical students demonstrate a comparable mental health profile to age-matched peers at entry to medical school (Dyrbye, Thomas, & Shanafelt, 2006), medical school graduates show a higher burnout prevalence compared with age-matched university graduates (Brazeau, Schroeder, Rovi, & Boyd, 2010). Given these factors, the present study excludes medical students from the definition of ‘medical trainees’ to focus exclusively on medical interns, residents and registrars.

		Intensity of Interpersonal Contact	
		Low	High
Frequency of Interpersonal Contact	High	Moderate Burnout	High Burnout
	Low	Low Burnout	Moderate Burnout

Figure 4. Cordes and Dougherty’s matrix to predict burnout according to intensity and frequency of interpersonal contact of professions (adapted from Cordes & Dougherty, 1993, p. 634)

1.2.2 Prevalence and associated outcomes

Compared to point prevalence estimates of burnout in the general population, which range from 7 to 13% (Norlund et al., 2010; Zijlstra & De Vries, 2001, as cited in Walter, Plaumann, & Krugmann, 2013), estimates in medical disciplines are consistently higher: ranging from 25 to 70% (Goehring, Gallacchi, Kunzi, & Bovier, 2005; Puffer et al., 2017; Roth et al., 2011; Shanafelt, Boone, Tan, & et al., 2012; Shanafelt, Gorringer, et al., 2015). Despite this

higher risk, medical professionals seem to give a low priority to their own self-care (AMA, 2008; Miller & McGowen, 2000). High prevalence of burnout and poor self-care practices can be traced back to early in the medical training process (AMA, 2008; IsHak et al., 2013). For example, the AMA (2008) found that 69% of surveyed interns were at risk of developing burnout. Wu et al. (2013) found that the prevalence of meeting the criteria for 'high' burnout on all three MBI subscales was lower in independent medical specialists (hereafter 'specialists') compared with medical residents and registrars. Similarly, Aldrees, Aleissa, Zamakhshary, Badri, and Sadat-Ali (2013) found registrars were 4.9 times more likely to be experiencing burnout than specialists. This evidence suggests that medical training is a critical point for interventions to prevent progression of burnout in future medical professionals.

Such a high prevalence is concerning given the deleterious consequences associated with burnout. For the trainee, burnout has been associated with difficulty concentrating at work (Fahrenkopf et al., 2008); increased likelihood of involvement in a motor vehicle accident (West, Tan, & Shanafelt, 2012); and increased suicidal ideation (van der Heijden, Dillingh, Bakker, & Prins, 2008). Indeed, research examining medical students has causally implicated burnout in suicidal thoughts (Dyrbye et al., 2008). This is particularly concerning, since suicidal ideation in medical trainees is already high compared with the general population (refer Table 1; Wu et al., 2013). Research with specialists and general populations has also found associations between burnout and alcohol abuse or dependence (Oreskovich et al., 2012); depression (Asai et al., 2007; Wurm et al., 2016); cardiovascular disease (Melamed, Shirom, Toker, Berliner, & Shapira, 2006); and poorer nonverbal memory and attention (Sandström, Rhodin, Lundberg, Olsson, & Nyberg, 2005).

Table 1

Rates of suicidal ideation and suicide attempts in medical trainees and the general population (Wu et al., 2013)

Outcome	Medical Interns	Medical Residents & Registrars	General Population
Suicidal ideation prior to last 12 months	25.8%	27.3%	13.3%
Suicidal ideation within last 12 months	12.3%	12.4%	2.3%

Those interacting with the trainee with burnout can also suffer. Trainees experiencing burnout are more likely to self-report suboptimal patient care practices (Shanafelt, Bradley, Wipf, & Back, 2002) and medical errors (West et al., 2006; West, Tan, Habermann, Sloan, & Shanafelt, 2009); factors which can substantially compromise patient care. Notably, self-perceived medical errors have been associated with worse burnout symptoms and general mental health (West et al., 2006; West et al., 2009), indicative of a vicious cycle. Additionally, hospital patients of medical professionals with burnout are more likely to report dissatisfaction with their practitioner and experience increased post-discharge recovery time (Halbesleben & Rathert, 2008). Colleagues of individuals with burnout also experience negative effects, including impaired team functioning (Welp, Meier, & Manser, 2016) and a greater propensity to develop burnout themselves (Bakker, Le Blanc, & Schaufeli, 2005).

For workplaces, burnout is associated with decreased productivity (Dewa, Loong, Bonato, Thanh, & Jacobs, 2014; Shanafelt, Mungo, et al., 2016) and increased intent to leave (Shanafelt, Sloan, Satele, & Balch, 2011; Sinsky et al., 2017), leading to considerable financial and productivity turnover costs (Shanafelt, Goh, & Sinsky, 2017). These costs extend to broader society. Dewa, Jacobs, Thanh, and Loong (2014) estimated that burnout in Canadian medical specialists cost \$213.1 million (Canadian) per year from early retirement and reduced

productivity; approximately 1% of total national specialists' services. Similarly, early retirement from burnout reduces return on educational investment, incurring considerable costs for governments (Dower, 2012). West, Dyrbye, and Shanafelt (2018) comment that burnout contributes to greater healthcare expenditure by increasing medical errors, malpractice claims and absenteeism, and reducing productivity. Indeed, Shanafelt, Dyrbye, West, and Sinsky (2016) estimated the loss in specialists' productivity across the United States of America (USA) from burnout is equivalent to losing the graduating classes of seven medical schools. These costs must also be considered in the context that lower productivity reduces patients' access to medical care (West et al., 2018). Given these considerable negative effects and costs, it is paramount that efforts be made to reduce and prevent medical trainee burnout.

1.2.3 Proposed causes of burnout in medical trainees

Various arguments have been posed to explain the high prevalence of burnout in medical specialists and trainees. Ariely and Lanier (2015) argue that three attributes of the current medical environment in the USA promote high burnout levels in the medical profession. First, there is an asymmetrical reward structure whereby positive outcomes are largely ignored, whilst negative outcomes can have detrimental consequences, particularly litigation. Second, the implementation of stringent medical policies and a greater reliance on technology reduces job autonomy. Consistent with this, research suggests that medical specialists spend up to twice as long working with electronic health record systems compared with direct clinical time (Sinsky et al., 2016); a task which can compound burnout symptoms (Shanafelt, Hasan, et al., 2015). Finally, medical practitioners must constantly make diagnoses and treatment decisions in limited

time. These decisions are cognitively taxing and can impair one's decision-making capacity. Medical trainees must face these work-related issues in addition to others.

Several of the chronic work stressors outlined by Maslach and Leiter (1997) apply specifically to medical trainees. First, financial *rewards* of their work or training may not be apparent to trainees facing considerable educational debts (Jennings, 2009). In some programmes, the highly competitive atmosphere of trainees' *communities* undermines their capacity to develop strong, supportive relationships with peers. This can be compounded by regular placement changes which may prevent trainees from establishing supportive relationships in their workplace (Jennings, 2009). Finally, trainees face *value conflicts* between the ideals they have been taught and the reality of working within time and resource constraints (Jennings, 2009). Whilst medical systems and training pathways vary internationally, many of these factors apply to all medical trainees.

Recent research has also examined trainees' perspectives of the causes of burnout. Hoffman and Bonney (2018) report that trainees found knowledge and ability limitations as major stressors, primarily because they raise concerns over their practising competency. Trainees also identified workplace and training stressors, including lack of supervisor empathy; examination study; and a lack of support from the workplace or training organisation. Finally, trainees identified self-care practices, particularly diet and exercise, as important preventative strategies. Interestingly, those who indicated they had experienced burnout reported experiencing deficits in at least two of the aforementioned domains (Hoffman & Bonney, 2018). Similarly, the AMA (2008, p. 5) argues that registrars face "... pressures as they establish their careers, cope with the demands of each new clinical placement and endeavour to succeed in their ongoing medical studies and career progression". In combination, these findings suggest that

burnout in medical trainees is multifactorial, with both the organisational climate and personal resources (or lack thereof) being critical to its development and maintenance.

1.2.4 Limitations of the literature

Despite much research examining correlates of burnout in medical trainees, the available data are plagued by inconsistent findings. For example, Spataro, Tilstra, Rubio, and McNeil (2016) found females were significantly more likely to experience burnout than males. However, there is also evidence to suggest no significant relationship between burnout and gender (Ripp et al., 2011; Selič, Stegne-Ignjatović, & Klemenc-Ketiš, 2012) and even higher prevalence in males (Malik et al., 2016). Conversely, a meta-analysis of the general population has identified that females tend to exhibit greater *emotional exhaustion* than males, whereas males exhibit greater *depersonalisation* than females (Purvanova & Muros, 2010). Whether these findings apply to medical trainees is not established.

The contribution of work hours burnout is also unclear. A meta-analysis of the general population found workload positively correlated with all burnout dimensions (Alarcon, 2011). Research examining general practice and oncology registrars has supported this (Cubero et al., 2016; Galam, Komly, Le Tourneur, & Jund, 2013). Conversely, Malik et al. (2016) found no significant relationship between burnout and working hours in general surgery registrars. Such inconsistencies, which hinder the development of interventions, can be attributed to two main reasons.

First, there are several inconsistencies and methodological flaws relating to the measurement of burnout. A key difficulty is the use of multiple burnout instruments, each based on different theoretical frameworks. For example, the MBI is based on Leiter and Maslach's

(1982) three-dimensional burnout model, whereas the Shirom-Melamed Burnout Measure (Shirom, 1989) assumes a unidimensional model focussing solely on exhaustion. Such differences in the definition of burnout inhibit comparisons between studies using different measures.

Even amongst those studies utilising the MBI there are discrepancies. Leiter and Maslach (1982) argue that burnout is a continuous construct and so the MBI should not be used for defining burnout 'cases'. Nevertheless, many authors have used cut-offs for 'low', 'average' and 'high' burnout levels listed in the manual to identify cases in their respective samples (e.g. Galam et al., 2013; Selič et al., 2012). Although this approach may seem intuitive, it is flawed for three reasons. First, the cut-offs in the manual are based on dividing the normative data into thirds (Maslach et al., 1996). Hence, these are statistically, but not clinically, meaningful cut-offs. Second, the MBI provides normalised data for the broad population of 'physicians' rather than medical trainees specifically (Maslach et al., 1996). Given that trainees' burnout scores tend to be higher than specialists' (Wu et al., 2013), defining cases of burnout in trainees using normative data for specialists is extremely tenuous. Finally, there is inconsistency in how cases of burnout are defined. Definitions range from requiring 'high' scores on *either* the emotional exhaustion or depersonalisation subscales (e.g. Blanchard et al., 2009); to requiring 'high' scores on *both* the emotional exhaustion and depersonalisation subscales (e.g. Fahrenkopf et al., 2008); to requiring 'high' scores on the emotional exhaustion and depersonalisation subscales, *and* 'low' scores on the personal accomplishment subscale (e.g. Gouveia et al., 2017). Thus, comparison of results from different studies which dichotomise MBI subscale scores to identify clinically significant 'cases' of burnout is problematic.

The second major limitation with the literature is that few studies have compared burnout characteristics and correlates in trainees across specialties (Dyrbye & Shanafelt, 2016), despite strong evidence identifying prevalence differences between specialties in specialists (Mariko et al., 2007; Shanafelt, Hasan, et al., 2015). For example, even after controlling for demographic and work-related variables, Shanafelt et al. (2012) found specialty could act as a significant risk or protective factor for developing burnout in specialists. Furthermore, a recent meta-analysis examining specialists found medical specialty moderated the strength of the relationship between burnout and other variables, such as work/life conflict and job autonomy (R. T. Lee, Seo, Hladkyj, Lovell, & Schwartzmann, 2013). Such relationships may explain some of the aforementioned inconsistencies in findings. For example, regarding the role of gender, Spataro et al. (2016) examined internal medicine registrars while Malik et al. (2016) examined general surgery registrars. That medical specialty may moderate the development and/or progression of burnout in trainees therefore warrants further investigation.

1.3 The Present Review

Given the confusion in how burnout is operationalised and the subsequent mixed findings, it is perhaps unsurprising that there is little evidence concerning preventative or curative interventions for burnout in the medical profession generally (West, Dyrbye, Erwin, & Shanafelt, 2016), let alone trainees (Dyrbye & West, 2018). Such interventions require some consensus from the literature, however reviews in this field have been lacking. To date, systematic reviews have considered medical interns (cf. Pougnet & Pougnet, 2017) and registrars (cf. Prins, Gazendam-Donofrio, et al., 2007) in isolation. Given that the intensity and frequency of patient contact is comparable for interns, resident and registrars, it is plausible that the

characteristics of burnout may be similar across these groups. Furthermore, understanding areas of difference will help establish the transferability of interventions between these subgroups. The one review to this author's knowledge that *has* examined burnout across medical training (including students) was not systematic (Dyrbye & Shanafelt, 2016). Thus, the information presented may have been biased towards the authors' viewpoints and unrepresentative of the contemporary literature.

A meta-analysis of this literature, using a validated definition of burnout, is warranted. Such a definition should be based on measures adhering to the same theoretical framework to ensure consistent operationalisation of burnout. Using statistical techniques, a meta-analysis consolidates the literature to provide an overview of conflicting findings (Borenstein, Hedges, Higgins, & Rothstein, 2009), something the medical trainee burnout literature lacks (West et al., 2018). A meta-analysis also improves sample size, statistical power and accuracy of estimates compared with a single study by combining effect sizes (Borenstein et al., 2009). In the context of burnout in medical trainees, a meta-analysis may: 1) help to identify areas warranting further research and thus direct future research efforts in appropriate avenues, and 2) inform the development and tailoring of effective interventions to prevent and reduce burnout in this vulnerable cohort.

1.3.1 Aims

The present systematic review seeks to consolidate and critically appraise the literature on the correlates of burnout in medical trainees. The specific aims are to:

1. Examine individual and work-related variables associated with burnout in medical trainees and to quantitatively pool the available data using meta-analytic techniques

2. Explore sources of study heterogeneity and conduct exploratory sub-group analyses, where data are available, including subgroup differences in burnout correlates between
 - a. Surgical and non-surgical registrars
 - b. Medical interns and residents, and medical registrars

Chapter 2

Methods

2.1 Literature Search

Five electronic databases were searched: Ovid Medline; Ovid PsycInfo; Embase; ERIC; and the Cochrane Library. Ovid Medline was chosen in favour of PubMed, as it offers adjacency searching (i.e. permits searching for records containing the search terms in any order and with words between them; Ovid Technologies, 2018). This function was advantageous for the present review given the different designations (i.e. titles, grades, specialties) used to refer to medical trainees in the international literature. A comprehensive list of the constructs to be searched (i.e. ‘medical trainees’ and ‘burnout’) was compiled with input from a senior research librarian and two general practice academic researchers (T.E, J.B). Search terms were broad to ensure all relevant data pertaining to medical trainees could be captured. Terms were split into two lists (refer Table 2) and a function in Workflow for iOS (an automation tool) used to generate all permutations of relevant phrases for ‘medical trainee’. This list was reviewed for irrelevant and duplicate phrases.

Search terms were tailored to each database by adding relevant thesaurus terms, specifying search fields, and adapting terms to account for truncation, wildcard and adjacency operators (see [Appendix A](#) for complete logic grids). Given the limited search functionality of the Cochrane Library, MeSH headings were added to the natural language logic grid to maximise relevant results. Additional studies were identified by using Scopus to search the reference lists and citations of all included studies, as well as relevant reviews (refer [Appendix B](#)). The study protocol is registered on the PROSPERO database for systematic reviews (registration CRD42018106901).

Table 2

The lists of terms relating to medical trainees

List One	List Two
Medical	Student
GP	Doctor
General Practitioner	Health Professional
General Practice	GP
Student	General Practitioner
Junior	General Practice
Undergraduate	Family Doctor
Trainee	Medicine
Registrar	Registrar
Resident	Trainee
Intern	Resident
Physician	Intern
	In Training
	Clerk

2.2 Study Eligibility

To be eligible for inclusion in the present study, articles needed to fulfil *all* the following criteria:

1. The sample had to be drawn from a population of medical trainees (i.e. all people being trained to practise medicine who have completed a medical degree: medical interns, residents and registrars)
2. The study utilised any version or subscale of the Maslach Burnout Inventory – Human Services Survey (MBI-HSS; Maslach et al., 1996) to assess burnout. The MBI-HSS was chosen as it was specifically designed for human services occupations; has been validated in

medical doctors (Maslach et al., 1996); and is arguably the most commonly used measure in the burnout literature (Schaufeli & Buunk, 2005).

3. The study's publication date needed to be between January 1981, the year the MBI was first released (Maslach & Jackson, 1981), and June 2018
4. Studies had to report the bivariate relationship between burnout and at least one individual or work variable. This included observational (i.e. cross-sectional, cohort, longitudinal) studies and intervention studies which provided a true baseline period (i.e. provided data prior to the intervention). To ensure the validity and generalisability of the results, only those variables that had been examined by two or more included studies were considered (Valentine, Pigott, & Rothstein, 2010)
5. The data presented needed to be amenable to conversion to Pearson's r (e.g. means, standard deviations, one-way ANOVAs, exact p -values)
6. The study needed to have an English-language full-text version available. Current evidence suggests that this criteria has little effect on meta-analytic results (Morrison et al., 2012).

Articles were excluded if they met *any* of the following criteria:

1. Examined a heterogeneous group of health professionals and did not differentiate between medical trainees and other professions (e.g. nurses, specialists)
2. Reported partial or semi-partial correlations between burnout and other variables
3. Study designs that were not amenable to a meta-analysis (e.g. qualitative research; case studies; editorial comments/replies)
4. Conference abstracts, which often lack sufficient details concerning methods and results for a meta-analysis (Balshem et al., 2013)

The screening process is depicted in Figure 5. The initial search yielded 3,190 results after language and date filters were applied. The removal of duplicates resulted in 2,392 citations. Eligibility criteria were then applied to the titles and abstracts of these citations, with 412 results retained. Citation screening was liberal regarding the populations, as many abstracts indicated the sample comprised of specialists (e.g. ‘physicians’), despite trainees being included in the study. The full-text articles for these 412 results were retrieved and screened against the eligibility criteria, reducing the number of included articles to 46. Scopus searching of reference lists and citations for included articles and 24 previously identified reviews (see [Appendix B](#) for a list), and screening of database alerts added a further 7 articles, bringing the total number of studies to 53.

Each article was then checked to ensure independence of samples. Seven studies with three overlapping samples were identified: two studies co-authored by Anagnostopoulos (Anagnostopoulos, Demerouti, Sykioti, Niakas, & Zis, 2015; Zis, Anagnostopoulos, & Sykioti, 2014) examined a sample of Greek registrars from Evangelismos General Hospital, Athens; two studies led by Prins (Prins, Hoekstra-Weebers, Gazendam-Donofrio, et al., 2007; Prins, Hoekstra-Weebers, van de Wiel, et al., 2007) examined a sample of Dutch registrars from the University Medical Centre, Groningen; and a further three studies co-authored by Prins (Prins et al., 2010; Prins et al., 2009; Schaufeli, Bakker, van der Heijden, & Prins, 2009) examined a sample of Dutch registrars from the Royal Dutch Medical Association. Only those studies which provided the most data (i.e. examined the most number of correlates) were retained (i.e. Anagnostopoulos et al. (2015); Schaufeli et al. (2009); and Prins, Hoekstra-Weebers, van de Wiel, et al. (2007)). This reduced the total number of articles to 49.

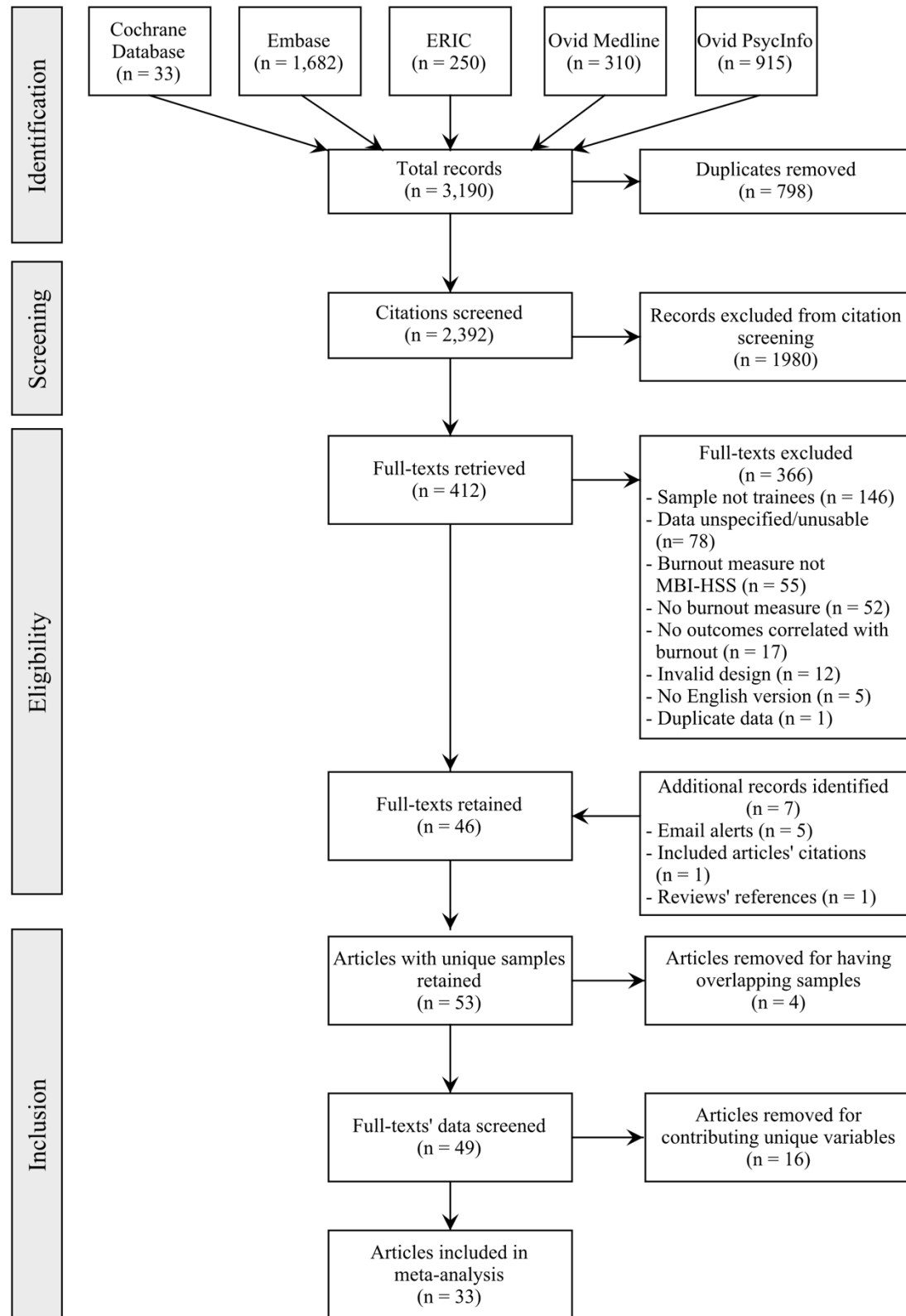


Figure 5. The study screening protocol

Variables examined by each article were then listed and articles contributing unique variables excluded, removing a further 16 articles. Thus, 33 articles were finally included in the meta-analysis. To minimise bias in study selection, a random sample of 21 articles (5% of all full-texts screened) was screened by an independent rater (postgraduate psychology student, T.M.) with good inter-rater reliability demonstrated (95%, kappa = .83).

2.3 Data Extraction, Organisation and Preparation

As per the PRISMA statement (Moher, Liberati, Tetzlaff, & Altman, 2009), a coding sheet to extract information from all studies was generated (refer [Appendix C](#)). The information collected concerned study characteristics (i.e. sample size, country, MBI measure utilised, mode of MBI administration); sample training characteristics (i.e. sample categorisation ['interns', 'residents', 'registrars', or combinations thereof]; sample training/specialty grouping ['Interns and Residents'; 'Mixed Registrars'; 'Non-Surgical Registrars'; and 'Surgical Registrars']; sample specialty, [e.g. 'Internal Medicine']); and effect size data (e.g. Pearson's or point-biserial correlation r ; sample size; means; standard deviations; independent samples t -tests). Fourteen studies provided data in the form of means and standard deviations for two groups (e.g. male vs females; married vs unmarried etc.) and two further studies provided the results of t -tests. These data were converted to r (Borenstein et al., 2009).

To assist in interpretation, effect sizes were grouped according to the three burnout domains under the MBI (i.e. emotional exhaustion, depersonalisation and personal accomplishment; Maslach et al., 1996). Variables were further divided within these domains into individual and work-related variables. Individual variables were categorised as *demographic* (i.e. age, gender, marital status and parenthood); *physical health* (i.e. alcohol consumption; hours

of sleep per day; self-rated health; and smoking status); *mental health* (i.e. depression, perceived stress and psychological wellbeing); *traits* (i.e. emotional intelligence and empathy); and *supports* (i.e. partner support). Work variables were categorised using Maslach and Leiter's (1997) six chronic work stressors: *community* (i.e. collegial relationships; collegial support; satisfaction with collegial support; and supervisor support); *control* (i.e. availability of professional development opportunities; job autonomy; and performance feedback regularity); *reward* (i.e. income satisfaction; job satisfaction; and specialty satisfaction); *values* (i.e. work/life conflict); and *workload* (i.e. career regret; demands on time; emotional demands of work; number of on-calls per month; professional self-efficacy; and working hours). None of the included studies examined variables that could be categorised under *fairness*.

2.4 Quality Assessment

An important part of conducting a meta-analysis is assessing the risk of bias of included studies (Moher et al., 2009). Accordingly, all included articles were evaluated against the *QualSyst* tool (Kmet, Lee, & Cook, 2004). Given only observational data were collected, criteria 5-7 (relating to interventional designs) were not applicable. Each study was therefore assessed on eleven criteria, with a maximum score of 22. Studies can be rated as either completely meeting criteria (score of two); partially meeting criteria (score of one); or not meeting criteria (score of zero). In addition to a total score, the percentage of criteria that each study met was calculated. A random sample of 10 articles was chosen and their quality appraised by an independent rater (T.E.), demonstrating good inter-rater reliability (80.00%, $r = .879$).

2.5 Effect Size Calculations

All data were entered into Comprehensive Meta-Analysis software (CMA, Version 3.0, Englewood, NJ: Biostat Inc). Analyses used a random effects model, allowing for the true effect size to vary between studies (Borenstein et al., 2009). This was deemed to be especially important, as sample specialties varied considerably across studies. All data were converted to Fisher's Z to provide a standardised metric, averaged and back-transformed into a Pearson's r (Borenstein et al., 2009). Pearson's r was chosen to reflect the continuous nature of burnout as operationalised by the MBI (Maslach et al., 1996). Cohen's (1988) guidelines for the interpretation of r were used, with values of .1, .3 and .5 representing small, medium and large associations, respectively. Finally, 95% confidence intervals (CIs) were calculated for each r to provide an estimate of statistical significance. Confidence intervals not containing zero indicate a significant relationship (Cumming, 2012).

Heterogeneity between studies was assessed using three statistics. First, the Q statistic is a measure which considers the ratio of variation to within-study error. If there is no heterogeneity, it is expected that Q will assume the value of the degrees of freedom (df), where $df = N_{studies} - 1$. A significant p -value for Q indicates sufficient evidence to reject the null hypothesis that all studies share a common effect size (Borenstein et al., 2009). Second, tau (τ) – estimated by T , refers to the standard deviation of the true effect sizes assuming a normal distribution of effects. Finally, I^2 represents the ratio of true heterogeneity to total variation in observed effects (Borenstein et al., 2009). Higgins, Thompson, Deeks, and Altman (2003) suggest that I^2 values of 25%, 50% and 75% reflect small, moderate and high amounts of observed variance, respectively. It is important to interpret T and I^2 together, as the former

reflects the range of true heterogeneity, while the latter reflects the proportion of observed dispersion due to heterogeneity (Borenstein et al., 2009).

Finally, due to the pervasive ‘file-drawer’ problem (Borenstein et al., 2009), Orwin’s Fail-safe N statistic (N_{fs}) was calculated for each analysis. This statistic reflects the number of non-significant studies required to reduce the meta-analytic results to a small ($r_w < .1$), non-significant finding (Orwin, 1983; Zakzanis, 2001). A conservative approach was taken when calculating N_{fs} such that the number of included studies was set as the number of studies contributing data for each variable, rather than the total number of studies in the meta-analysis. For the purpose of this meta-analysis, a result was considered to be robust to publication bias if the N_{fs} value exceeded the number of studies contributing data for the effect being examined (i.e. $N_{fs} > N_{studies}$).

2.6 Subgroup and Sensitivity Analyses

Sources of heterogeneity were examined with subgroup analyses. This included grouping studies by training level (i.e. intern, resident or registrars) and specialty (i.e. non-surgical or surgical). To ensure sufficient statistical power, subgroup analyses were only performed where there were at least two studies per subgroup and the pooled sample size (per subgroup) was greater than 80 (Higgins & Green, 2011; Huedo-Medina, Sánchez-Meca, Marín-Martínez, & Botella, 2006). Where variables were examined in more than one subgroup, the difference in effects was assessed with a Cochrane’s Q -test using a random effects model to allow for further variation within the subgroups (Borenstein et al., 2009). In addition, all meta-analyses with $N_{studies} \geq 3$ were subjected to sensitivity analyses. These analyses involve re-running of the meta-analysis, but removing one study at a time (Borenstein et al., 2009). Results of sensitivity

analyses were considered meaningful if there was a change in the effect size magnitude, based on Cohen's (1988) aforementioned guidelines *or* if the statistical significance estimate change (Borenstein et al., 2009).

Chapter 3

Results

3.1 Study Characteristics

Thirty-three independent studies, comprising a total sample of 7,229 medical trainees, were included in the present meta-analysis (refer [Appendix D](#) for full details). The median sample size was 157 trainees (range = 21 – 2,115), with Schaufeli, Bakker, Van der Heijden, and Prins' (2009) cohort of 2,115 mixed registrars from the Royal Dutch Medical Association comprising 29.26% of the pooled sample. Most studies originated from North America ($N_{studies} = 14$, $n = 2,364$), followed by Asia ($N_{studies} = 11$, $n = 1,523$) and Europe ($N_{studies} = 8$, $n = 3,342$). Twenty-seven studies (81.82%) involved cross-sectional designs, while six were longitudinal. The full version of the MBI-HSS was routinely used ($N_{studies} = 29$, 87.88%) and administered via mail or face-to-face ($N_{studies} = 13$), online ($N_{studies} = 7$) or a combination of these methods ($N_{studies} = 1$), although this was not routinely reported. Four studies administered individual MBI-HSS subscales, namely just the emotional exhaustion (Al-Dubai, Ganasegeran, Perianayagam, & Rampal, 2013; Anagnostopoulos et al., 2015); personal accomplishment (Guenette & Smith, 2018); or emotional exhaustion and depersonalisation subscales (Lindeman et al., 2017).

3.2 Sample Demographics

The sample comprised marginally more males ($n = 3,631$) than females ($n = 3,596$) and had an average age of 29.94 (SD = 3.51, $n = 5,186$; see Table 3). Most participants were registrars ($N_{studies} = 28$, $n = 6,511$). This included non-surgical registrars ($N_{studies} = 10$, $n = 1,475$); surgical registrars ($N_{studies} = 8$, $n = 1,169$); and a mixed group (i.e. non-surgical and surgical, or unspecified, specialties; $N_{studies} = 10$, $n = 3,867$). Only two studies examined residents (Al-Dubai

et al., 2013; Bakker, 2009), whilst Nason, Liddy, Murphy, and Doherty (2013) focused exclusively on interns. Agha et al. (2015) and Sochos, Bowers, and Kinman (2012) both surveyed mixed samples of interns, residents and registrars.

3.3 Reporting Quality of Included Studies

Reporting quality across the included studies was high, with an average raw score of 20.94 (SD = 1.27, range = 18 – 22) and percentage score of 95.18% (range: 81.82% - 100%; refer Figure 6 and [Appendix E](#)). All studies therefore met the conservative threshold for inclusion (i.e. met more than 75% of items), as proposed by Kmet et al. (2004). More specifically, studies clearly articulated their objective(s) (Criterion 1: 100% fulfilled), with most identifying and explaining their study design (Criterion 2: 96.97% fulfilled). Sample recruitment methods and baseline characteristics (i.e. gender, mean age, training level) were generally well reported (Criteria 3 and 4: 90.91% and 87.88% fulfilled, respectively). The key outcome variable (burnout, as measured by the MBI-HSS) and its correlates were consistently reported by most studies (Criterion 5: 87.88% fulfilled), as per the strict eligibility criteria adopted for this review. Most studies met the minimum sample size required to produce a sufficiently powered r (i.e. $N > 28$ for a large effect, with $\alpha = .05$ and power = .80; Cohen, 1992; Criterion 6: 93.94% fulfilled). Description of analytic methods (Criterion 7: 87.88% fulfilled) and reporting of variance estimates (e.g. SDs, confidence intervals; Criterion 8: 90.91% fulfilled) were generally satisfactory. However, fewer studies indicated attempts to control for confounding variables (e.g. gender imbalance; Criterion 9: 72.73% fulfilled). In all but one study, statistical results were reported in sufficient detail to allow replication of the analyses (Criterion 10: 96.97% fulfilled) and conclusions were supported by the study data (Criterion 11: 96.97% fulfilled).

Table 3.

Sample demographic and training characteristics (N_{studies} = 33, N_{participants} = 7,229)

	<i>N_{studies}</i>	<i>N_{participants}</i>	%	<i>M</i>	<i>SD</i>
<i>Participant Demographics</i>					
Age (years)	20	5,186		29.94	3.51
Gender	33				
Male		3,631	50.24%		
Female		3,596	49.76%		
		7,227 ^a	100%		
Marital/Partner Status	23				
Married/Have Partner		3,374	64.78%		
Single		1,834	35.22%		
		5,208	100%		
Parenthood	10				
Have Children		1,225	32.77%		
No Children		2,513	67.23%		
		3,738	100%		
<i>Training Factors</i>					
Training Level	33				
Registrar	28	6,511	90.07%		
Resident	2	412	5.70%		
Intern	1	26	0.36%		
Combination	2	280	3.87%		
		7,229	100%		
Specialty Grouping (Registrars)	29				
Non-Surgical	10	1,475	22.32%		
Surgical	7	976	14.77%		
Mixed	12	4,156	62.90%		
		6,607	100%		
Specialty (Registrars) ^b					
Anaesthesiology	2	170	5.50%		
Family Medicine	4	673	21.79%		
General Surgery	5	245	7.93%		
Internal Medicine	4	345	11.17%		
Otolaryngology	4	626	20.27%		
Paediatrics	5	156	5.05%		
Radiology	3	349	11.30%		
Other ^c	7	525	17.00%		
		3,089	100%		

^a In Prins, Hoekstra-Weebers, van de Wiel, et al. (2007), 2 participants' responses for gender was missing. ^b Some studies examining mixed registrars listed the specialties of samples. ^c Denotes specialties each contributing less than 5% to the overall sample; includes Cardiology, Dermatology, Emergency Medicine, Genetics, Haematology, Medical Microbiology, Nephrology, Neurology, Neurosurgery, Obstetrics/Gynaecology, Oncology, Ophthalmology, Oral Surgery, Orthopaedic Surgery, Pathology, Plastic Surgery, Psychiatry, Rehabilitation Medicine and Urology.

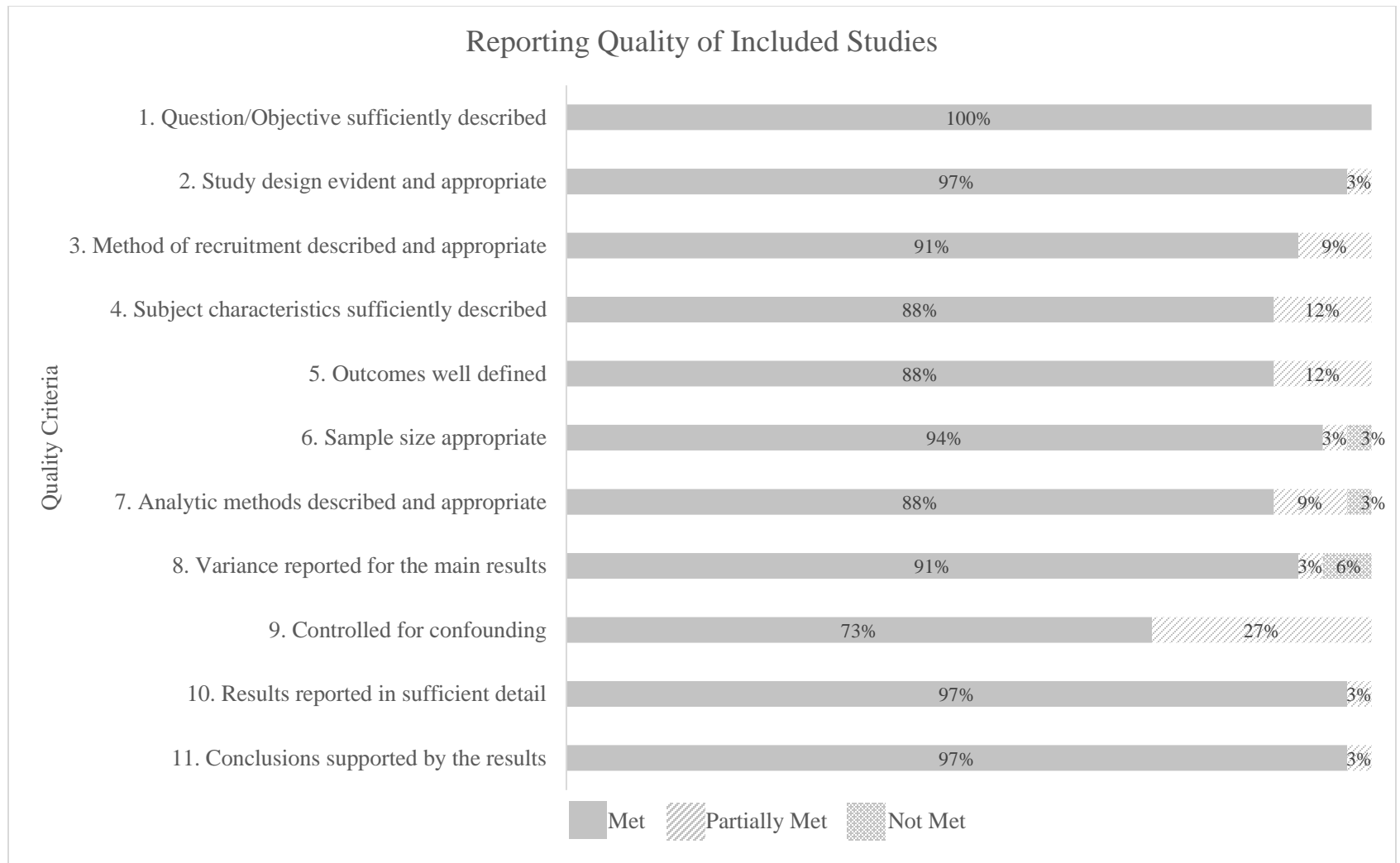


Figure 6. Proportion of included studies meeting each criterion on the QualSyst tool (Kmet et al., 2004)

3.4 Meta-Analyses

3.4.1 Emotional exhaustion

Data was pooled from thirty studies examining correlates of *emotional exhaustion* (refer Table 4). Notably, none of the four *demographic* variables examined by included studies (age, gender, marital status and parenthood) were significantly associated with this burnout dimension. In comparison, self-reported general health had a moderate association with emotional exhaustion: trainees who self-reported more health-related complaints also experienced higher levels of emotional exhaustion. Similarly, all three *mental health* constructs demonstrated significant relationships (all $p < .001$), indicating depressive symptomatology, higher perceived stress and poorer general psychological wellbeing were associated with higher emotional exhaustion in trainees. However, a high level of inconsistency across effect estimates for perceived stress were identified by moderate-to-large I^2 values. Nonetheless, these pooled findings were robust to publication bias ($N_{fs} > N_{studies}$).

Twelve of the 17 work variables investigated were weakly-to-strongly related to *emotional exhaustion*. In particular, a sense of *community* (i.e. collegial relationships; collegial support; and supervisor support); *control* (i.e. availability of professional development opportunities; job autonomy; and performance feedback regularity); and *rewards* (i.e. job and specialty satisfaction) helped to buffer against emotional exhaustion. Conversely, *value conflicts* (i.e. work/life conflict); and *workload* (i.e. demands on time; number of on-calls per month; and working hours) were associated with higher emotional exhaustion. However, many of these constructs had wide confidence intervals, suggesting some imprecision in the pooled r_w from the few contributing studies.

Table 4.

Correlations for emotional exhaustion with individual and work variables

Correlates	$N_{studies}$	N	r_w	p	95% CI		N_{fs}	Heterogeneity			
					Lower	Upper		Q	p	T	I^2
Individual											
Demographic											
Age	6	565	.032	.742	-.157	.219	4	23.654	<.001	.207	78.9%
Gender ^a	16	2,415	-.011	.692	-.064	.043	18	24.051	.064	.064	37.6%
Marital status ^b	10	1,374	-.063	.113	-.140	.015	16	17.559	.041	.085	48.7%
Parenthood ^c	3	547	-.080	.385	-.256	.101	5	7.821	.020	.138	74.4%
Physical Health											
Alcohol consumption ^d	2	413	.062	.203	-.034	.158	1	0.124	.724	0	0.0%
Hours sleep per day	3	637	.252	.482	-.430	.751	5	79.463	<.001	.623	97.5%
Self-rated health	2	259	-.441	<.001	-.534	-.336	11	0.216	.642	0	0%
Smoking status ^e	2	413	.110	.117	-.028	.245	0	1.124	.289	.073	11.1%
Mental Health											
Depression	3	253	.409	<.001	.188	.591	9	6.084	.048	.176	67.1%
Perceived stress	2	208	.544	<.001	.301	.721	9	8.981	.003	.204	88.9%
Psychological wellbeing	2	455	-.665	<.001	-.737	-.577	15	2.336	.126	.078	57.2%
Traits											
Emotional intelligence	3	206	-.377	.168	-.744	.166	14	31.309	<.001	.481	93.6%
Empathy	2	362	-.124	.501	-.452	.234	4	5.200	.023	.238	80.8%
Supports											
Partner support	3	637	-.128	.556	-.507	.292	7	28.102	<.001	.362	92.9%

Table 4 (cont'd).

Correlations for emotional exhaustion with individual and work variables

Correlates	$N_{studies}$	N	r_w	p	95% CI		N_{fs}	Heterogeneity				
					Lower	Upper		Q	p	T	I^2	
Work												
Community												
Collegial relationships	2	629	-.295	.001	-.447	-.126	8	3.129	.077	.108	68.0%	
Collegial support	2	2,377	-.246	<.001	-.283	-.208	7	0.392	.532	0	0%	
Collegial support satisfaction	2	272	-.257	.084	-.509	.036	7	5.396	.020	.195	81.5%	
Supervisor support	2	465	-.359	<.001	-.436	-.277	9	0.205	.651	0	0%	
Control												
Professional development opportunities	3	2,465	-.382	<.001	-.415	-.348	14	0.146	.930	0	0%	
Job autonomy	3	2,465	-.259	<.001	-.339	-.174	11	3.909	.142	.056	48.8%	
Performance feedback regularity^f	2	2,203	-.299	<.001	-.337	-.261	8	0.047	.828	0	0%	
Reward												
Income satisfaction	4	752	-.073	.400	-.237	.096	7	10.013	.018	.140	70.0%	
Job satisfaction	3	657	-.441	<.001	-.579	-.279	16	6.581	.037	.136	69.6%	
Specialty satisfaction^g	3	190	-.380	<.001	-.539	-.195	14	3.675	.159	.121	45.6%	
Values												
Work/life conflict	6	3,035	.482	<.001	.318	.618	23	75.561	<.001	.218	93.1%	
Workload												
Career regret ^h	2	116	.075	.745	-.360	.483	1	6.044	.014	.298	83.5%	
Demands on time	2	375	.396	<.001	.215	.551	6	3.998	.046	.126	75.0%	
Emotional demands	2	2,377	.290	.053	-.004	.538	4	22.001	<.001	.213	95.5%	

Table 4 (cont'd).

Correlations for emotional exhaustion with individual and work variables

Correlates	$N_{studies}$	N	r_w	p	95% CI		N_{fs}	Heterogeneity			
					Lower	Upper		Q	p	T	I^2
Workload (cont'd)											
Number of on-calls per month	3	164	.249	.002	.097	.390	4	1.986	.370	0	0%
Professional self-efficacy	2	698	-.045	.922	-.733	.689	3	110.466	<.001	.640	99.1%
Working hours	4	968	.254	.010	.063	.427	6	22.325	<.001	.180	86.6%

Note. **Bold** figures denote significant findings at $p < .05$ and $N_{fs} > N_{studies}$. ^a -1 = females, 1 = males. ^b -1 = unmarried, 1 = married. ^c -1 = non-parents, 1 = parents. ^d -1 = alcohol abstainers, 1 = alcohol consumers. ^e -1 = non-smoker, 1 = smoker. ^f Rated five-point scales from 'never' to 'always'. ^g -1 = specialty dissatisfaction, 1 = specialty satisfaction. ^h -1 = no regret, 1 = regret.

3.4.2 Depersonalisation

Table 5 summarises the pooled data from 21 studies examining depersonalisation. Again, *demographic* variables were not identified as significant correlates, although moderate-to-large heterogeneity was noted for age, gender, marital status and parenthood. Both *mental health* variables examined (depression and perceived stress) yielded robust, moderate and positive weighted correlations. These findings were, however, based on a small number of studies ($N_{studies} < 4$), resulting in wide confidence intervals. Work-related variables that significantly correlated with depersonalisation related to *reward* (i.e. job satisfaction) and *workload* (i.e. a sense of career regret and hours worked). Notably, none of the examined work variables displayed significant heterogeneity.

3.4.3 Personal accomplishment

The pooled data from 13 studies contributed to the burnout domain of personal accomplishment (refer Table 6). Of the nine variables examined, only two (perceived stress and job satisfaction) demonstrated significant, albeit small relationships: trainees who experienced high levels of stress and low job satisfaction also reported a low sense of personal accomplishment. Furthermore, a weak, negative correlation for career regret was close to significance ($p = .065$). Given that these findings were based on a very small number of studies they should be cautiously interpreted.

Table 5.

Correlations for depersonalisation with individual and work variables

Correlates	<i>N</i> _{studies}	<i>N</i>	<i>r_w</i>	<i>p</i>	95% CI		<i>N_{fs}</i>	Heterogeneity			
					Lower	Upper		<i>Q</i>	<i>p</i>	<i>T</i>	<i>I²</i>
Individual											
Demographic											
Age	5	597	-.107	.282	-.293	.088	10	21.621	<.001	.198	81.5%
Gender ^a	16	2,379	.073	.189	-.036	.179	4	98.540	<.001	.197	84.8%
Marital status ^b	9	1,183	-.051	.309	-.149	.048	14	21.196	.007	.115	62.3%
Parenthood ^c	3	547	-.105	.408	-.340	.143	6	14.920	.001	.204	86.6%
Mental Health											
Depression	3	253	.346	.028	.040	.592	7	10.372	.006	.253	80.7%
Perceived stress	2	416	.343	<.001	.255	.426	5	0.040	.842	0	0%
Traits											
Emotional intelligence	2	118	-.258	.529	-.795	.507	7	18.480	<.001	.577	94.6%
Empathy	2	362	-.327	.094	-.628	.057	9	6.186	.013	.265	83.8%
Work											
Community											
Collegial relationships	2	136	-.251	.107	-.515	.056	7	1.858	.173	.166	46.2%
Reward											
Job satisfaction	2	143	-.330	<.001	-.468	-.178	9	0.043	.836	0	0%
Values											
Work/life conflict	2	2,136	.313	.117	-.081	.623	4	3.338	.068	.256	70.0%
Workload											
Career regret^d	2	116	.238	.009	.059	.402	3	0.023	.879	0	0%
Working hours	3	284	.294	.004	.098	.468	6	3.353	.187	.120	40.3%

Note. **Bold** figures denote significant findings at $p < .05$ and $N_{fs} > N_{studies}$. ^a -1 = females, 1 = males. ^b -1 = unmarried, 1 = married. ^c -1 = non-parents, 1 = parents. ^d -1 = no regret, 1 = regret.

Table 6.

Correlations for personal accomplishment with individual and work variables

Correlates	$N_{studies}$	N	r_w	p	95% CI		N_{fs}	Heterogeneity			
					Lower	Upper		Q	p	T	I^2
Individual											
Demographic											
Age	4	485	.112	.108	-.025	.244	0	6.365	.095	.100	52.9%
Gender ^a	13	2,065	.025	.440	-.038	.772	10	22.721	.030	.076	47.2%
Marital status ^b	9	1,382	.019	.659	-.064	.101	7	16.986	.030	.088	52.9%
Parenthood ^c	2	338	.235	.228	-.148	.556	3	2.948	.086	.239	66.1%
Mental Health											
Perceived stress	2	416	-.186	.027	-.341	-.022	6	2.803	.094	.097	64.3%
Traits											
Empathy	2	362	-.300	.232	-.673	.195	8	9.990	.002	.348	90.0%
Work											
Reward											
Job satisfaction	2	143	.225	.026	.027	.406	3	1.442	.230	.083	30.7%
Workload											
Career regret ^d	2	116	-.171	.065	-.342	.011	5	0.394	.530	0	0%
Working hours	2	263	-.074	.237	-.194	.048	3	0.409	.523	0	0%

Note. **Bold** figures denote significant findings at $p < .05$ and $N_{fs} > N_{studies}$. ^a -1 = females, 1 = males. ^b -1 = unmarried, 1 = married. ^c -1 = non-parents, 1 = parents. ^d -1 = no regret, 1 = regret.

3.5 Subgroup Analyses

Subgroup analyses were conducted to investigate potential sources of sample heterogeneity, namely specialty groupings and training level (aims 2a and 2b). Sufficiently powered data (i.e. $N_{studies} \geq 2$ and subgroup $N_{participants} > 80$; Higgins & Green, 2011; Huedo-Medina et al., 2006) was available for nine variables: age; emotional intelligence; gender; income satisfaction; marital status; number of on-calls per month; parenthood; specialty satisfaction; and work/life conflict. The only significant findings related to surgical registrars (refer Tables 7-9). For this group of trainees, high emotional intelligence; satisfaction with one's income and chosen specialty; and a satisfactory work/life balance all helped to buffer against *emotional exhaustion*. These analyses were also robust to publication bias ($N_{fs} > N_{studies}$). Although a significant association was identified between gender and *personal accomplishment* for surgical registrars (i.e. males were more likely than females to have lower personal accomplishment), between-group analyses found no significant difference between surgical and non-surgical registrars ($Q_B(1) = 2.929, p = .087$). Similarly, no significant differences were found between surgical and non-surgical registrars in relation to the association between age and *emotional exhaustion* ($Q_B(1) = 0.193, p = .660$), nor gender and *depersonalisation* ($Q_B(1) = 0.000, p = .987$). Finally, there were no significant differences group between surgical registrars; non-surgical registrars; and interns and residents in relation to gender and *emotional exhaustion* ($Q_B(2) = 0.025, p = .988$).

Table 7.

Subgroup analyses for emotional exhaustion

Group	Correlates	$N_{studies}$	N	r_w	p	95% CI		N_{fs}
						Lower	Upper	
Non-Surgical Registrars								
	Age	2	156	.066	.726	-.296	.412	1
	Gender ^a	5	582	-.043	.559	-.184	.100	7
	Marital status ^b	3	188	-.172	.195	-.410	.089	8
	Parenthood ^c	2	230	-.064	.729	-.402	.290	3
Surgical Registrars								
	Age	3	280	-.041	.791	-.327	.253	4
	Emotional intelligence	2	161	-.601	<.001	-.756	-.383	14
	Gender ^a	2	350	-.042	.667	-.227	.147	3
	Income satisfaction	3	637	-.145	.038	-.277	-.008	7
	Number of on-calls per month	2	123	.242	.065	-.015	.469	3
	Specialty satisfaction^d	2	123	-.454	<.001	-.586	-.300	11
	Work/life conflict	4	658	.521	<.001	.309	.684	17
Interns and Residents								
	Gender ^a	2	217	-.022	.849	-.244	.202	2

Note. **Bold** figures denote significant findings at $p < .05$ and $N_{fs} > N_{studies}$. ^a -1 = females, 1 = males. ^b -1 = unmarried, 1 = married. ^c -1 = non-parents, 1 = parents. ^d -1 = specialty dissatisfaction, 1 = specialty satisfaction.

Table 8.

Subgroup analyses for depersonalisation

Group	Correlates	$N_{studies}$	N	r_w	p	95% CI		N_{fs}
						Lower	Upper	
Non-Surgical Registrars								
	Age	3	311	-.057	.584	-.255	.146	5
	Gender ^a	6	737	.115	.424	-.167	.380	1
	Marital status ^b	3	188	-.141	.302	-.391	.127	7
	Parenthood ^c	2	230	-.123	.627	-.552	.358	7
Surgical Registrars								
	Gender ^a	2	350	.111	.645	-.347	.526	4

Note. **Bold** figures denote significant findings at $p < .05$ and $N_{fs} > N_{studies}$. ^a -1 = females, 1 = males. ^b -1 = unmarried, 1 = married. ^c -1 = non-parents, 1 = parents.

Table 9.

Subgroup analyses for personal accomplishment

Group	Correlates	$N_{studies}$	N	r_w	p	95% CI		N_{fs}
						Lower	Upper	
Non-Surgical Registrars								
	Gender ^a	3	423	.016	.736	-.079	.111	3
Surgical Registrars								
	Gender^a	2	350	-.107	.044	-.208	-.003	4

Note. **Bold** figures denote significant findings at $p < .05$ and $N_{fs} > N_{studies}$. ^a -1 = females, 1 = males.

3.6 Sensitivity Analyses

Sensitivity analyses were conducted to examine the potential influence of outlier or influential effect estimates for each MBI subscale (refer Table 10). For *emotional exhaustion*, age became a significant, albeit weak correlate after removing Abut et al's (2012) study examining 157 Turkish registrars, although this finding was susceptible to publication bias ($N_{fs} < N_{studies}$). A similar finding was made for age and personal accomplishment with the removal of Chan, Cuevas, and Jenkins' (2016) sample of 129 mixed-specialty American registrars. Although emotional intelligence; income satisfaction; and specialty satisfaction also showed statistical significance and/or increased magnitude, these results mirrored those of the previous subgroup analyses performed. Notably, following the exclusion of Joaquim et al's (2018) study of 115 Portuguese mixed-specialty registrars, parenthood was the only *demographic* variable to correlate significantly with *emotional exhaustion*. Although this association was small, this finding was robust to publication bias. The removal of Aldrees et al's (2017) study of 38 Saudi Arabian plastic surgery registrars produced a significant, moderate and negative relationship between partner support and *emotional exhaustion*. Finally, the removal of Lafreniere et al's (2016) study of 44 French internal medicine registrars increased the magnitude of the relationship between depression and *depersonalisation* to a strong correlation.

Table 10.

Changed results from sensitivity analyses

Dimension	Correlate	Removed Study	$N_{studies}$	N	r_w	p	95% CI		N_{fs}	Area of Change
							Lower	Upper		
Emotional Exhaustion										
	Age	Abut 2012	5	408	.111	.027	.013	.207	1	Significance
	Emotional intelligence	Olson 2015	2	161	-.601	<.001	-.756	-.383	14	Significance + Magnitude
	Income satisfaction	Joaquim 2018	3	637	-.145	.038	-.277	-.008	7	Significance
	Parenthood	Joaquim 2018	2	432	-.156	.020	-.282	-.024	5	Significance
	Partner support	Aldrees 2017	2	599	-.369	<.001	-.533	-.178	9	Significance + Magnitude
	Specialty satisfaction	Lemkau 1988	2	123	-.454	<.001	-.586	-.300	11	Magnitude
Depersonalisation										
	Depression	Lafreniere 2016	2	209	.495	<.001	.387	.591	8	Magnitude
Personal Accomplishment										
	Age	Chan 2016	3	356	.184	.001	.081	.283	3	Significance

Note. **Bold** figures denote significant findings at $p < .05$ and $N_{fs} > N_{studies}$.

Chapter 4

Discussion

4.1 Key Findings

The present meta-analysis identified a combination of individual and work-related variables associated with burnout in a sample of 7,229 medical trainees. Notably, *demographic* variables did not play a key role, with generally non-significant correlations reported. In comparison, poor self-rated health was related to *emotional exhaustion*. *Mental health* also yielded significant relationships across all three burnout dimensions. However, the strongest correlations were associated with work-related variables, notably *values*, *rewards* and *workload*. Subgroup analyses indicated the significance and magnitude of the relationships for some variables (e.g. emotional intelligence) differed between specialty groupings. These findings, and their implications for research and practice, will be critically evaluated in this chapter.

4.1.1 Individual variables

Demographic

The burnout literature has generally found a weak and negative, albeit significant, correlation between burnout and age (Brewer & Shapard, 2004; Gomez-Urquiza, Vargas, De la Fuente, Fernandez-Castillo, & Canadas-De la Fuente, 2017). This relationship is, however, confounded by years of experience in a discipline, which itself is associated with burnout (Brewer & Shapard, 2004). Hence, the relationship between burnout and age may be confounded by older workers having developed effective coping strategies from their professional experience, or that younger workers who do not develop effective coping strategies leave the field (Aydemir & Icelli, 2013; Brewer & Shapard, 2004). Consistent with this, trainees

were specifically examined in the present review and so, by definition, will have limited experience in their field. Additionally, there was a narrow distribution of participants' ages in the present review ($M_{age} = 29.94$, $SD = 3.51$), potentially limiting the capacity to detect any relationship. The limited age range may also explain why being married and/or having children were not significant correlates in the present review, contrary to other literature (Maslach & Jackson, 1985; Ramirez et al., 1995). Similarly, the main analyses did not yield significant relationships between any burnout dimension and gender. Although subgroup analyses indicated that, for surgical registrars, *personal accomplishment* levels were higher in females than males, between-group analyses demonstrated that this was not significant.

Physical health

Of the *physical health*-related variables examined, the only significant finding was a moderate, negative relationship between self-rated general health and *emotional exhaustion*. This aligns with previous research (Cheng, Chen, Chen, Burr, & Hasselhorn, 2013) and with associations between burnout and deleterious health outcomes, including type two diabetes (Melamed, Shirom, Toker, & Shapira, 2006) and cardiovascular disease (de Vente, van Amsterdam, Olf, Kamphuis, & Emmelkamp, 2015). Whilst alcohol consumption was not a key variable for the present sample of trainees, alcohol consumption was dichotomised into 'consumers' and 'non-consumers', rather than considering alcohol abuse or dependence, as has been identified in the specialist literature (Oreskovich et al., 2012).

Mental health

Trainees' *mental health* yielded relationships with all burnout dimensions. In particular, depressive symptom severity moderately correlated with *emotional exhaustion* and *depersonalisation*, consistent with previous research (cf. Asai et al., 2007; Wurm et al., 2016). Interestingly, the relationship between depression and *depersonalisation* increased to a strong correlation (from $r_w = .346$ to $.495$) when internal medicine trainees were removed from the analysis, leaving family medicine and paediatrics trainees. This suggests that, even within the surgical/non-surgical division of specialties, the strength of the relationship between some variables and burnout may vary. Psychological wellbeing and perceived stress also demonstrated strong correlations with burnout dimensions. These findings align with other research (Schwarzer & Hallum, 2008) and with Leiter and Maslach's (1982, 1991) model of burnout, which has work-based stressors as its basis. That perceived stress held a weaker correlation with *depersonalisation* than with *emotional exhaustion* corresponds with the model's explanation of burnout development. Interestingly, since low *personal accomplishment* is thought to stem directly from stressors like emotional exhaustion, the model would suggest a stronger relationship should have been found. This inconsistency may have arisen because few studies examined *personal accomplishment*.

Traits

In the main analyses, emotional intelligence did not yield significant relationships with any burnout dimension. However, subgroup analyses found a strong, negative correlation between emotional intelligence and *emotional exhaustion* for surgical registrars. This may be an artefact of the use of different instruments utilised for measuring emotional intelligence. Olson,

Kemper, and Mahan (2015) used the Emotional Social Competency Inventory (ESCI; Boyatzis & Sala, 2004), which is based on a competency theory of emotional intelligence and uses multisource feedback (Boyatzis & Sala, 2004). Conversely, Lin, Liebert, Tran, Lau, and Salles (2016) and Lindeman et al. (2017) used the Trait Emotional Intelligence Questionnaire Short Form (TEI-Que-SF; Petrides, 2009) which assumes a trait theory of emotional intelligence and is based on self-report (Petrides, 2009). Hence, the source of the identified heterogeneity may not entirely be due to specialty differences. Interestingly, empathy, a facet of emotional intelligence (Gardner, 2011; Goleman, 1996), showed large and significant heterogeneity for all three MBI subscales despite being measured by the same instrument (Jefferson Scale of Physician Empathy; Hojat et al., 2001). Although there was insufficient data to further investigate this, the possibility remains that specialty may moderate the relationship between emotional intelligence and *emotional exhaustion*.

Supports

Evaluation of partner support (i.e. whether relationships provided intimacy, care etc.) demonstrated no significant relationship with any MBI subscale in the main or subgroup analyses. However, the exclusion of Aldrees et al's (2017) study of plastic surgery registrars yielded a moderate, negative relationship with *emotional exhaustion*. The remaining two studies in this sensitivity analysis comprised samples of otolaryngology registrars. Hence, this provides further evidence that, even within a surgical/non-surgical divide of registrars, specialty may moderate the association between some variables and burnout.

4.1.2 Work variables

Community

The importance of supportive collegial and supervisor relationships, which had moderate, negative correlations with *emotional exhaustion*, is unsurprising. Recent qualitative research with registrars identified colleagues and supervisors as having a key role in burnout management (Hoffman & Bonney, 2018). This also aligns with Cordes and Dougherty's (1993) argument that work supports can mitigate development of burnout by promoting individuals' self-efficacy and belief that others will help in addressing challenges.

Control

Variables concerning job *control* (i.e. job autonomy; availability of professional development opportunities; and performance feedback regularity) demonstrated moderate, negative correlations with *emotional exhaustion*. That is, trainees who perceived a low level of control over their working conditions, including resources to help them perform better, exhibited higher *emotional exhaustion*. This is consistent with meta-analytic data based on the general population (Alarcon, 2011) and other health professionals (e.g. psychotherapists; J. Lee, Lim, Yang, & Lee, 2011).

Rewards

Regarding *rewards* from work, job satisfaction held moderate, negative correlations with *emotional exhaustion* and *depersonalisation*, and a weak, positive association with *personal accomplishment*. The related construct of specialty satisfaction also demonstrated a moderate, negative relationship with *emotional exhaustion*. These findings are consistent with meta-

analyses examining burnout in specialists (R. T. Lee et al., 2013). Interestingly, subgroup analyses identified specialty satisfaction as a strong, negative correlate of *emotional exhaustion* in surgical registrars. Notably, this subgroup analysis involved two recent studies (Aldrees, Badri, Islam, & Alqahtani, 2015; Aldrees et al., 2017). An older meta-analysis did not, however, report such an association (R. T. Lee & Ashforth, 1996), suggesting that this change in magnitude may be an artefact of changing attitudes over time. Similarly, a weak, negative relationship with *emotional exhaustion* and income satisfaction was identified for surgical registrars.

Values

Although work/life conflict was the only variable examined concerning trainees' *values*, it yielded the strongest relationship of any work variable with *emotional exhaustion* ($r_w = .482$), consistent with other reviews of medical professionals (cf. Amofo, Hanbali, Patel, & Singh, 2014; Thomas, 2004). This indicates that high work/life conflict is an area requiring urgent attention for minimising burnout. Subgroup analyses identified that this relationship was strong in surgical registrars ($r_w = .521$), although there was insufficient data to undertake a statistical comparison with non-surgical registrars.

Workload

In most analyses, *workload* (i.e. demands on time; number of on-calls per month; and working hours) held a moderate positive relationship with *emotional exhaustion* and *depersonalisation*. This corroborates research identifying workload as a major risk factor of

burnout (Aydemir & Icelli, 2013) and of trainees' reports of excessive workload contributing to burnout (Dyrbye & Shanafelt, 2016; Thomas, 2004).

4.2 Implications

Several important findings from this research have direct implications for interventions to reduce medical trainee burnout. In particular, a number of *modifiable* variables held strong correlations with burnout. This included *mental health*, namely general psychological wellbeing, depression and perceived stress. This suggests that interventions targeting trainees' mental wellbeing may also reduce burnout levels. Similarly, variables related to the workplace may be suitable intervention targets – with *values* (i.e. work/life conflict); *rewards* (i.e. job and specialty satisfaction); and *workload* (especially working hours) all demonstrating strong associations. Interestingly, however, research examining the importance of either individual or work-based interventions in the management of medical trainee burnout has had mixed findings (West et al., 2016). For example, Kim and Wiedermann (2011) found the national restriction of duty hours to an 80 hour work-week for registrars in the USA was associated with a significant reduction in burnout, whereas Goitein, Shanafelt, Wipf, Slatore, and Back (2005) found no significant reductions. This reinforces previous calls for burnout interventions to take an integrated approach by targeting individual *and* work variables (DeCaporale-Ryan et al., 2017; Lemaire & Wallace, 2017; West et al., 2016), an area lacking research (West et al., 2016).

Subgroup analyses comparing surgical and non-surgical registrars identified further differences in the significance and magnitude of some correlates. In particular, specialty satisfaction was a key variable related to *emotional exhaustion* amongst surgical registrars. Sensitivity analyses also identified changes within non-surgical and surgical specialty groupings

(e.g. partner support). These specialty differences are consistent with literature examining specialists (Mariko et al., 2007; Shanafelt, Hasan, et al., 2015) and suggest differences in burnout patterns and correlates between specialties. Such differences may make interventions more effective in some specialties than others, limiting the generalisability of interventions across specialties.

4.3 Limitations and Future Research

Multiple methodological limitations were encountered in the present review. In particular, many subgroup analyses exploring specialty differences were based on few studies, reducing the capacity to control for other factors (e.g. sample country). This is most notable in the subgroup analysis of emotional intelligence, where the changed results may be explained by specialty, instrument, or survey administration differences. Although heterogeneity in empathy suggested specialty may be relevant here, this could not be further explored due to insufficient studies examining empathy. Given the lack of research examining this, future research should examine what role specialty (i.e. surgical vs non-surgical specialties, and within these specialty groupings) plays for burnout in trainees. Indeed, considering these findings, future research should explicitly divide samples by specialty to permit further investigation of the role that specialty plays.

Similarly, subgroup analyses examining the role of country could not be performed. For example, a large, significant degree of heterogeneity was detected in the relationship between *emotional exhaustion* and perceived stress. The two studies contributing data to this analysis examined Turkish (Abut et al., 2012) and French (Myszkowski, Villoing, Zenasni, Jaury, & Boujut, 2017) registrars. Given research suggests that culture may moderate the relationship

between perceived job stress and burnout (Schwarzer & Hallum, 2008), this would have been useful to explore.

Additionally, few included studies examined interns and residents ($N_{studies} = 5$). Although this may be due to the stringent inclusion criteria applied in the present study, these criteria were established to ensure studies were comparable in their definition of burnout. Thus, further research can specifically examine intern and resident samples to compare burnout patterns and correlates in these populations compared with registrars.

Another limitation concerns the present review's operationalisation of burnout. Fifty-five studies examining burnout were excluded for not using the MBI-HSS, while a further 47 studies were excluded because the construct of burnout was dichotomised. Although this was done to ensure the construct of burnout was consistently assessed, this leaves much literature overlooked in the present review. Future reviews are warranted to explore this literature and compare these findings with those from the present review.

Moreover, a variety of individual variables examined in the general literature could not be examined in this review, notably personality and coping styles. One meta-analysis found that the personality dimension hardiness (i.e. one's ability to face stressful situations without experiencing deleterious effects of stressors; Aydemir & Icelli, 2013; Kobasa, 1979) held strong correlations with all three burnout dimensions (Alarcon, Eschleman, & Bowling, 2009). Research has also consistently shown that emotion-oriented coping (whereby individuals emphasise emotions arising from stressful situations) and avoidance-oriented coping (entailing attempts to avoid problems) are strongly associated with high burnout levels in healthcare professionals (Hätinen, Mäkikangas, Kinnunen, & Pekkonen, 2013; Howlett et al., 2015; Narumoto et al., 2008; Teague, 1992). Conversely, a task-oriented coping style (where the

individual focuses on problem-solving) may afford a protective effect against burnout development (Howlett et al., 2015; Tartas et al., 2016). In searching for relevant studies in the present review, no literature examining either construct in medical trainees was identified. Considering both hardiness and coping styles have been implicated in burnout development and that both are amenable to training (Maddi, Harvey, Khoshaba, Fazel, & Resurreccion, 2009; Quan, Wang, Chu, & Zhou, 2018), further research should investigate these psychological constructs among medical trainees specifically.

Although the present review adopted the Leiter and Maslach (1982, 1991) model of burnout as a framework, individual variables were added to gain a more holistic view of burnout in this population. Since individual variables were significant correlates in the present review and much other research (cf. Alarcon et al., 2009; Dyrbye & Shanafelt, 2016; Purvanova & Muros, 2010; West et al., 2018), this suggests the model needs revision to account for other factors. Competing models acknowledge the role of individual and situational variables beyond the workplace that interact with work variables to produce burnout (e.g. Dunn, Iglewicz, & Moutier, 2008; Manzano-García & Ayala-Calvo, 2013). However, these models lend themselves to a dichotomised conceptualisation of burnout, inconsistent with the MBI. Future research to elaborate on models of burnout to acknowledge the role of individual *and* work variables in the development of burnout, whilst maintaining a continuous conceptualisation of burnout, is warranted.

Finally, far fewer variables could be examined for *depersonalisation* (13 variables) and *personal accomplishment* (9 variables) than *emotional exhaustion* (31 variables). Although this may partly be attributable to survey length (West, Dyrbye, Satele, Sloan, & Shanafelt, 2012) and disagreements around the definition of burnout (Manzano-García & Ayala-Calvo, 2013), most

included studies reported using the full MBI-HSS ($N_{studies} = 29$). Despite this, relationships for all subscales were rarely reported by included studies. Yet, the individual and work variables examined in the present study displayed different relationships between each of the three dimensions. This reinforces the multidimensional nature of burnout, with further research needed to explore *depersonalisation* and *personal accomplishment* in medical trainees.

4.4 Conclusion

Considering the high prevalence of burnout in the medical trainee population and the deleterious effects it has for the trainee; their colleagues, patients and workplace; and broader society, research efforts must be directed to developing effective interventions. The present findings identify modifiable individual and work-related variables for future interventions to target. These findings also suggest that specialty may affect burnout in medical trainees, posing a new area for research. In combination, the present findings offer new avenues for research and, by consolidating the current burnout literature for medical trainees, provide an evidence-base for future interventional endeavours to prevent and reduce burnout in this population.

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Note: References marked with an asterisk denote studies included in the meta-analysis

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Appendices

Appendix A: Logic Grids with Boolean Operators

Ovid Medline

	Medical Trainees	AND→	Burnout
OR→	(Students, Medical).sh (exp Education, Medical) (Medic* ADJ4 Student*).mp (Medic* ADJ4 Registrar*).mp (Medic* ADJ4 Train*).mp (Medic* ADJ4 Resident*).mp (Medic* ADJ4 Intern?).mp (Medic* ADJ4 Interns*).mp (Medic* ADJ4 Clerk*).mp (GP? ADJ4 Student*).mp (GP? ADJ4 Registrar*).mp (GP? ADJ4 Train*).mp (GP? ADJ4 Resident*).mp (GP? ADJ4 Intern?).mp (GP? ADJ4 Interns*).mp (GP? ADJ4 Clerk*).mp (General* Practi* ADJ4 Student*).mp (General* Practi* ADJ4 Registrar*).mp (General* Practi* ADJ4 Train*).mp (General* Practi* ADJ4 Resident*).mp (General* Practi* ADJ4 Intern?).mp	OR→	(Burnout, Professional).sh (Compassion Fatigue).sh Depersonalization.sh (Resilience, Psychological).sh Burnout*.mp (Emotion* ADJ4 Exhaust*).mp Cynic*.mp Deperson*.mp Resilien*.mp

<p>(General* Practi* ADJ4 Interns*).mp</p> <p>(General* Practi* ADJ4 Clerk*).mp</p> <p>Student* Doctor*.mp</p> <p>Student* Health* Profession*.mp</p> <p>(Student* ADJ4 Famil* Doctor*).mp</p> <p>(Student* ADJ1 Physic*).mp</p> <p>Junior* Doctor*.mp</p> <p>Junior Heal* Profession*.mp</p> <p>Junior* GP?.mp</p> <p>(Junior ADJ4 Medic*).mp</p> <p>(Junior ADJ4 Resident*).mp</p> <p>Junior Clerk*.mp</p> <p>Undergrad* ADJ4 Doctor*.mp</p> <p>Undergrad* Heal* Profession*.mp</p> <p>Undergrad* GP?.mp</p> <p>Undergrad* General* Practi*.mp</p> <p>Undergrad* medic*.mp</p> <p>Postgrad* Doctor*.mp</p> <p>Postgrad* Heal* Profession*.mp</p> <p>Postgrad* GP?.mp</p> <p>Postgrad* General* Practi*.mp</p> <p>Postgrad* Medic*.mp</p> <p>(Train* ADJ4 Doctor*).mp</p> <p>(Train* ADJ4 Heal* Profession*).mp</p> <p>(Train* ADJ4 Famil* Doctor*).mp</p> <p>(Train* ADJ4 Physic*).mp</p>		
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<p>(Train* ADJ4 Hospital*).mp</p> <p>Registrar*.mp</p> <p>(Resident* ADJ4 Doctor*).mp</p> <p>(Resident* ADJ4 Heal* Profession*).mp</p> <p>(Resident* ADJ4 Famil* Doctor*).mp</p> <p>(Resident* ADJ4 Physic*).mp</p> <p>Resident medic* officer*.mp</p> <p>RMO.mp</p> <p>(Intern? ADJ4 Doctor*).mp</p> <p>(Interns* ADJ4 Doctor*).mp</p> <p>(Intern? ADJ4 Heal* Profession*).mp</p> <p>(Interns* ADJ4 Heal* Profession*).mp</p> <p>(Intern? ADJ4 Famil* Doctor*).mp</p> <p>(Interns* ADJ4 Famil* Doctor*).mp</p> <p>(Physic* ADJ4 Intern?).mp</p> <p>(Physic* ADJ4 Interns*).mp</p> <p>(Physic* ADJ4 Clerk*).mp</p> <p>Prevocation* Train*.mp</p> <p>PGPPP.mp</p> <p>General* Practi* Educat*.mp</p>		
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Ovid PsycInfo

	Medical Trainees	AND→	Burnout
OR→	Medical Students.sh Medical Education.sh Medical Internship.sh Medical Residency.sh (Medic* ADJ4 Student*).mp (Medic* ADJ4 Registrar*).mp (Medic* ADJ4 Train*).mp (Medic* ADJ4 Resident*).mp (Medic* ADJ4 Intern?).mp (Medic* ADJ4 Interns*).mp Medic* Clerk*.mp (GP? ADJ4 Student*).mp (GP? ADJ4 Registrar*).mp (GP? ADJ4 Train*).mp (GP? ADJ4 Resident*).mp (GP? ADJ4 Intern?).mp (GP? ADJ4 Interns*).mp (GP? ADJ4 Clerk*).mp (General* Practi* ADJ4 Student*).mp (General* Practi* ADJ4 Registrar*).mp (General* Practi* ADJ4 Train*).mp	OR→	exp Occupational Stress Fatigue.sh Cynicism.sh Depersonalization.sh (Resilience, psychological).sh (Psychological endurance).sh Burnout*.mp (Emotion* ADJ4 Exhaust*).mp Cynic*.mp Deperson*.mp Resilien*.mp

<p>(General* Practi* ADJ4 Resident*).mp</p> <p>(General* Practi* ADJ4 Intern?).mp</p> <p>(General* Practi* ADJ4 Interns*).mp</p> <p>(General* Practi* ADJ4 Clerk*).mp</p> <p>Student* Doctor*.mp</p> <p>Student* Health* Profession*.mp</p> <p>(Student* ADJ4 Famil* Doctor*).mp</p> <p>(Student* ADJ1 Physic*).mp</p> <p>Junior* Doctor*.mp</p> <p>Junior Heal* Profession*.mp</p> <p>Junior* GP?.mp</p> <p>(Junior* ADJ4 General* Practi*).mp</p> <p>Junior Medic*.mp</p> <p>Junior Resident*.mp</p> <p>Junior Clerk*.mp</p> <p>Undergrad* Doctor*.mp</p> <p>Undergrad* Heal* Profession*.mp</p> <p>Undergrad* GP?.mp</p> <p>Undergrad* General* Practi*.mp</p> <p>Undergrad* medic*.mp</p> <p>Postgrad* Doctor*.mp</p> <p>Postgrad* Heal* Profession*.mp</p> <p>Postgrad* GP?.mp</p> <p>Postgrad* General* Practi*.mp</p> <p>Postgrad* Medic*.mp</p>		
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<p>(Train* ADJ4 Doctor*).mp</p> <p>(Train* ADJ4 Heal* Profession*).mp</p> <p>(Train* ADJ4 Famil* Doctor*).mp</p> <p>(Train* ADJ4 Physic*).mp</p> <p>(Train* ADJ4 Hospital*).mp</p> <p>Registrar*.mp</p> <p>(Resident* Doctor*).mp</p> <p>(Resident* ADJ4 Heal* Profession*).mp</p> <p>(Resident* ADJ4 Famil* Doctor*).mp</p> <p>(Resident* ADJ4 Physic*).mp</p> <p>Resident medic* officer?.mp</p> <p>RMO.mp</p> <p>(Intern\$ ADJ4 Doctor*).mp</p> <p>(Interns* ADJ4 Doctor*).mp</p> <p>(Intern? ADJ4 Heal* Profession*).mp</p> <p>(Interns* ADJ4 Heal* Profession*).mp</p> <p>(Intern? ADJ4 Famil* Doctor*).mp</p> <p>(Interns* ADJ4 Famil* Doctor*).mp</p> <p>(Physic* ADJ4 Intern?).mp</p> <p>(Physic* ADJ4 Interns*).mp</p> <p>(Physic* ADJ4 Clerk*).mp</p> <p>Prevocation* Train*.mp</p> <p>General* Practi* Educat*.mp</p>		
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Embase

	Medical Trainees	AND→	Burnout
OR→	“Medical student”/de “resident”/de “Medic* Student*”:ab,kw,ti “Medic* Registrar*”:ab,kw,ti (Medic* near/4 Train*):ab,kw,ti (Medic* near/4 Resident*):ab,kw,ti (Medic* near/4 Intern\$):ab,kw,ti (Medic* near/4 Interns*):ab,kw,ti (“Medic* Clerk*”):ab,kw,ti (GP\$ near/4 Student*):ab,kw,ti (GP\$ near/4 Registrar*):ab,kw,ti (GP\$ near/4 Train*):ab,kw,ti (GP\$ near/4 Resident*):ab,kw,ti (GP\$ near/4 Intern\$):ab,kw,ti (GP\$ near/4 Interns*):ab,kw,ti (GP\$ near/4 Clerk*):ab,kw,ti (“General* Practi*” near/4 Student*):ab,kw,ti (“General* Practi*” near/4 Registrar*):ab,kw,ti (“General* Practi*” near/4 Train*):ab,kw,ti (“General* Practi*” near/4 Resident*):ab,kw,ti	OR→	“burnout”/de “depersonalization”/de Burnout:ab,kw,ti (Emotion* near/4 exhaust*):ab,kw,ti Cynic*:ab,kw,ti Deperson*:ab,kw,ti Resilien*:ab,kw,ti

<p>(“General* Practi*” near/4 Intern\$):ab,kw,ti</p> <p>(“General* Practi*” near/4 Interns*):ab,kw,ti</p> <p>(“General* Practi*” near/4 Clerk*):ab,kw,ti</p> <p>“Student* Doctor*”:ab,kw,ti</p> <p>“Student* Health* Profession*”:ab,kw,ti</p> <p>(Student* near/4 “Famil* Doctor*”):ab,kw,ti</p> <p>(Student* near/4 Physic*):ab,kw,ti</p> <p>“Junior* Doctor*”:ab,kw,ti</p> <p>“Junior Heal* Profession*”:ab,kw,ti</p> <p>“Junior* GP\$”:ab,kw,ti</p> <p>(Junior* near/4 “General* Practi*”):ab,kw,ti</p> <p>(Junior* near/4 “Famil* Doctor*”):ab,kw,ti</p> <p>“Junior Medic*”:ab,kw,ti</p> <p>“Junior Resident*”:ab,kw,ti</p> <p>“Junior Clerk*”:ab,kw,ti</p> <p>“Undergrad* Doctor*”:ab,kw,ti</p> <p>“Undergrad* Heal* Profession*”:ab,kw,ti</p> <p>“Undergrad* GP\$”:ab,kw,ti</p> <p>“Undergrad* General* Practi*”:ab,kw,ti</p> <p>“Undergrad* medic*”:ab,kw,ti</p> <p>“Postgrad* Doctor*”:ab,kw,ti</p>		
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<p>“Postgrad* Heal* Profession*”:ab,kw,ti</p> <p>“Postgrad* GP\$”:ab,kw,ti</p> <p>“Postgrad* General* Practi*”:ab,kw,ti</p> <p>“Postgrad* Medic*”:ab,kw,ti</p> <p>(Train* near/4 Doctor*):ab,kw,ti</p> <p>(Train* near/4 “Heal* Profession*”):ab,kw,ti</p> <p>(Train* near/4 “Famil* Doctor*”):ab,kw,ti</p> <p>(Train* near/4 Physic*):ab,kw,ti</p> <p>(Train* near/4 Hospital*):ab,kw,ti</p> <p>Registrar*:ab,kw,ti</p> <p>(Resident* near/4 Doctor*):ab,kw,ti</p> <p>(Resident* near/4 “Heal* Profession*”):ab,kw,ti</p> <p>(Resident* near/4 “Famil* Doctor*”):ab,kw,ti</p> <p>(Resident* near/4 Physic*):ab,kw,ti</p> <p>“Resident medic* officer\$”:ab,kw,ti</p> <p>RMO:ab,kw,ti</p> <p>(Intern near/4 Doctor*):ab,kw,ti</p> <p>(Interns* near/4 Doctor*):ab,kw,ti</p> <p>(Intern near/4 “Heal* Profession*”):ab,kw,ti</p> <p>(Interns* near/4 “Heal* Profession*”):ab,kw,ti</p> <p>(Intern near/4 “Famil* Doctor*”):ab,kw,ti</p>		
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<p>(Interns* near/4 "Famili* Doctor*"):ab,kw,ti</p> <p>(Physic* near/4 Intern):ab,kw,ti</p> <p>(Physic* near/4 Interns*):ab,kw,ti</p> <p>(Physic* near/4 Clerk*):ab,kw,ti</p> <p>"Prevocation* Train*":ab,kw,ti</p> <p>"General* Practi* Educat*":ab,kw,ti</p> <p>"Junior Fami* Doctor*":ab,kw,ti</p> <p>PGPPP:ab,kw,ti</p> <p>(Hospital* near/4 train*):ab,kw,ti</p>		
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ERIC

	Medical Trainees	AND→	Burnout
OR→	DE “Medical Students” DE “Premedical Students” DE “Medical Education” DE “Clinical Medical Education” DE “Clinical Clerkship” DE “Premedical Education” DE “Residents (Medical)” DE “Medical School Graduates” DE “Psychology of Medical Students” AB (Medic* N4 Student* Medic* N4 Registrar* Medic* N4 Train* Medic* N4 Resident* Medic* N4 Intern? Medic* N4 Interns* “Medic* Clerk*” GP? N4 Student* GP? N4 Registrar* GP? N4 Train* GP? N4 Resident* GP? N4 Interns*	OR→	DE “Burnout (Psychology)” DE "Resilience (Psychology)" AB (Burnout* Emotion* N4 Exhaust* Cynic* Deperson* Resilien*) KW (Burnout* Emotion* N4 Exhaust* Cynic* Deperson* Resilien*) TI (Burnout* Emotion* N4 Exhaust* Cynic* Deperson* Resilien*)

<p> “General* practi*” N4 Student* “General* practi*” N4 Registrar* “General* practi*” N4 Train* “General* practi*” N4 Resident* “General* practi*” N4 Intern? “General* practi*” N4 Interns* “General* practi*” N4 Clerk* “Student* Doctor*” Student* N4 “Heal* Profession*” Student* N4 “FAMIL* Doctor*” Student* N4 Physic* “Junior* Doctor*” “Junior* Heal* Profession*” Junior* GP? “Junior* General* Practi*” Junior* N4 Medic* Junior* N4 Resident* “Junior* Clerk*” Undergrad* N4 Doctor* Undergrad* N4 “Heal* Profession*” “Undergrad* GP?” “Undergrad* General* Practi*” Undergrad* N4 Medic* “Postgrad* Doctor*” Postgrad* N4 “Heal* Profession*” “Postgrad* General* Practi*” </p>		
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<p>Postgrad* N4 Medic*</p> <p>Train* N4 Doctor*</p> <p>Train* N4 “Heal* Profession*”</p> <p>Train* N4 GP?</p> <p>Train* N4 “General* Practi*”</p> <p>Train* N4 “Famil* Doctor*”</p> <p>Train* N4 Physic*</p> <p>Train* N4 Hospital*</p> <p>Registrar*</p> <p>Resident* N4 Doctor*</p> <p>Resident* N4 “Heal* Profession*”</p> <p>Resident* N4 “Famil* Doctor*”</p> <p>Resident* N4 Physic*</p> <p>RMO</p> <p>Intern? N4 Doctor*</p> <p>Interns* N4 Doctor*</p> <p>Intern? N4 “Heal* Profession*”</p> <p>Interns* N4 “Heal* Profession*”</p> <p>Physic* N4 Intern?</p> <p>Physic* N4 Interns*</p> <p>Physic* N4 Clerk*</p> <p>“Prevocation* train*”</p> <p>PGPPP</p> <p>“General* practi*” N4 educat*</p> <p>)</p> <p>KW (</p>		
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<p> Medic* N4 Student* Medic* N4 Train* Medic* N4 Resident* Medic* N4 Intern? Medic* N4 Interns* “Medic* Clerk*” GP? N4 Student* “General* practi*” N4 Registrar* “General* practi*” N4 Train* Student* N4 “Heal* Profession*” Student* N4 Physic* “Junior* Doctor*” “Undergrad* GP?” Undergrad* N4 Medic* “Postgrad* General* Practi*” Postgrad* N4 Medic* Train* N4 Doctor* Train* N4 “Heal* Profession*” Train* N4 “General* Practi*” Train* N4 Physic* Train* N4 Hospital* Registrar* Resident* N4 Physic* “Prevocation* train*” “General* practi*” N4 educat*) </p>		
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<p>TI (</p> <p>Medic* N4 Student*</p> <p>Medic* N4 Registrar*</p> <p>Medic* N4 Train*</p> <p>Medic* N4 Resident*</p> <p>Medic* N4 Intern?</p> <p>Medic* N4 Interns*</p> <p>“Medic* Clerk*”</p> <p>GP? N4 Student*</p> <p>GP? N4 Registrar*</p> <p>GP? N4 Train*</p> <p>GP? N4 Resident*</p> <p>“General* practi*” N4 Student*</p> <p>“General* practi*” N4 Registrar*</p> <p>“General* practi*” N4 Train*</p> <p>“General* practi*” N4 Resident*</p> <p>“General* practi*” N4 Clerk*</p> <p>“Student* Doctor*”</p> <p>Student* N4 “Heal* Profession*”</p> <p>Student* N4 “Famil* Doctor*”</p> <p>Student* N4 Physic*</p> <p>“Junior* Doctor*”</p> <p>“Junior* General* Practi*”</p> <p>Junior* N4 Medic*</p> <p>Junior* N4 Resident*</p> <p>“Junior* Clerk*”</p>		
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Undergrad* N4 Doctor*		
Undergrad* N4 "Heal* Profession*"		
"Undergrad* GP?"		
"Undergrad* General* Practi*"		
Undergrad* N4 Medic*		
"Postgrad* Doctor*"		
"Postgrad* GP?"		
"Postgrad* General* Practi*"		
Train* N4 Doctor*		
Train* N4 "Heal* Profession*"		
Train* N4 "General* Practi*"		
Train* N4 "Famil* Doctor*"		
Train* N4 Physic*		
Train* N4 Hospital*		
Registrar*		
Resident* N4 Doctor*		
Resident* N4 "Heal* Profession*"		
Resident* N4 Physic*		
RMO		
Intern? N4 Doctor*		
Interns* N4 Doctor*		
Intern? N4 "Heal* Profession*"		
Interns* N4 "Heal* Profession*"		
Physic* N4 Intern?		
Physic* N4 Interns*		
Physic* N4 Clerk*		

	“Prevocation* train*” “General* practi*” N4 educat*)		
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	Medical Trainees	AND→	Burnout
OR→	MeSH Descriptor: [Students, Medical] MeSH Descriptor: [Education, Medical] explode all terms “Medical Student” “Medical Registrar” “Medical Trainee” “Medical Resident” “Medical Intern” “Medical Clerk” “GP Student” “GP Registrar” “GP Trainee” “GP Resident” “GP Intern” “GP In Training” “GP Clerk” “General practitioner Student” “General practitioner Registrar” “General practitioner Trainee” “General practitioner Resident” “General practitioner Intern” “General practitioner In Training” “General practitioner Clerk”	OR→	MeSH Descriptor: [Burnout, Professional] MeSH Descriptor: [Compassion Fatigue] MeSH Descriptor: [Depersonalization] MeSH Descriptor: [Resilience, Psychological] “Burnout” “Emotional exhaustion” “Cynicism” “Depersonalisation” “Resilience”

<p>“General practice Student”</p> <p>“General practice Registrar”</p> <p>“General practice Trainee”</p> <p>“General practice Resident”</p> <p>“General practice Intern”</p> <p>“General practice In Training”</p> <p>“General practice Clerk”</p> <p>“Student Doctor”</p> <p>“Student Health Professional”</p> <p>“Student GP”</p> <p>“Student General Practitioner”</p> <p>“Student General practice”</p> <p>“Student Family Doctor”</p> <p>“Student Physician”</p> <p>“Junior Doctor”</p> <p>“Junior Health Professional”</p> <p>“Junior GP”</p> <p>“Junior General Practitioner”</p> <p>“Junior General practice”</p> <p>“Junior Family Doctor”</p> <p>“Junior Medicine”</p> <p>“Junior Registrar”</p> <p>“Junior Trainee”</p> <p>“Junior Resident”</p> <p>“Junior Intern”</p> <p>“Junior In Training”</p>		
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<p>“Junior Clerk”</p> <p>“Undergraduate Doctor”</p> <p>“Undergraduate Health Professional”</p> <p>“Undergraduate GP”</p> <p>“Undergraduate General Practitioner”</p> <p>“Undergraduate General practice”</p> <p>“Undergraduate Family Doctor”</p> <p>“Undergraduate Medicine”</p> <p>“Undergraduate Registrar”</p> <p>“Trainee Doctor”</p> <p>“Trainee Health Professional”</p> <p>“Trainee GP”</p> <p>“Trainee General Practitioner”</p> <p>“Trainee General practice”</p> <p>“Trainee Family Doctor”</p> <p>“Trainee Medicine”</p> <p>“Trainee Physician”</p> <p>“Registrar”</p> <p>“Registrar Doctor”</p> <p>“Registrar Health Professional”</p> <p>“Registrar GP”</p> <p>“Registrar General Practitioner”</p> <p>“Registrar General practice”</p> <p>“Registrar Family Doctor”</p> <p>“Registrar Physician”</p> <p>“Resident Doctor”</p>		
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<p>“Resident Health Professional”</p> <p>“Resident GP”</p> <p>“Resident General Practitioner”</p> <p>“Resident General practice”</p> <p>“Resident Family Doctor”</p> <p>“Resident Medicine”</p> <p>“Resident Physician”</p> <p>“Resident medical officer”</p> <p>“RMO”</p> <p>“Intern Doctor”</p> <p>“Intern Health Professional”</p> <p>“Intern GP”</p> <p>“Intern General Practitioner”</p> <p>“Intern General practice”</p> <p>“Intern Family Doctor”</p> <p>“Intern Medicine”</p> <p>“Physician Intern”</p> <p>“Physician In Training”</p> <p>“Physician Clerk”</p> <p>“Doctor in training”</p> <p>“Postgraduate medicine”</p> <p>“Prevocational training”</p> <p>“PGPPP”</p> <p>“Prevocational general practice training program”</p> <p>“Hospital trainee”</p> <p>“General practice educator”</p>		
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Appendix B: List of Reviews Scanned

- DeCaporale-Ryan, L., Sakran, J. V., Grant, S. B., Alseidi, A., Rosenberg, T., Goldberg, R. F., . . . Moalem, J. (2017). The undiagnosed pandemic: Burnout and depression within the surgical community. *Current Problems in Surgery*, *54*(9), 453-502. doi: 10.1067/j.cpsurg.2017.07.001
- Dewa, C. S., Loong, D., Bonato, S., Thanh, N. X., & Jacobs, P. (2014). How does burnout affect physician productivity? A systematic literature review. *BMC Health Services Research*, *14*, 325. doi: 10.1186/1472-6963-14-325
- Dewa, C. S., Loong, D., Bonato, S., & Trojanowski, L. (2017). The relationship between physician burnout and quality of healthcare in terms of safety and acceptability: A systematic review. *BMJ Open*, *7*(6). doi: 10.1136/bmjopen-2016-015141
- Dyrbye, L. N., & Shanafelt, T. (2016). A narrative review on burnout experienced by medical students and residents. *Medical education*, *50*(1), 132-149.
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- Hamidi, M. S., Boggild, M. K., & Cheung, A. M. (2016). Running on empty: a review of nutrition and physicians' well-being. *Postgraduate Medical Journal*, *92*(1090), 478-481.
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- McCray, L. W., Cronholm, P. F., Bogner, H. R., Gallo, J. J., & Neill, R. A. (2008). Resident physician burnout: is there hope? *Family Medicine*, *40*(9), 626-632.
- McKinley, T. F., Boland, K. A., & Mahan, J. D. (2017). Burnout and interventions in pediatric residency: A literature review. *Burnout Research*, *6*, 9-17.
- Oskrochi, Y., Maruthappu, M., Henriksson, M., Davies, A. H., & Shalhoub, J. (2016). Beyond the body: A systematic review of the nonphysical effects of a surgical career. *Surgery*, *159*(2), 650-664.
- Panagioti, M., Geraghty, K., & Johnson, J. (2018). How to prevent burnout in cardiologists? A review of the current evidence, gaps, and future directions. *Trends in Cardiovascular Medicine*, *28*(1), 1-7. doi: 10.1016/j.tcm.2017.06.018
- Pougnnet, R., & Pougnnet, L. (2017). Anxiety, depressive disorder and burnout of junior doctors: Review of the literature 2004-2014. *Journal Medical Libanais*, *65*(1), 35-43.
- Prins, J., Gazendam-Donofrio, S. M., Tubben, B. J., van der Heijden, F. M., van de Wiel, H. B., & Hoekstra-Weebers, J. E. (2007). Burnout in medical residents: A review. *Medical education*, *41*(8), 788-800.
- Pulcrano, M., Evans, S. R. T., & Sosin, M. (2016). Quality of life and burnout rates across surgical specialties: A systematic review. *JAMA Surgery*, *151*(10), 970-978. doi: 10.1001/jamasurg.2016.1647
- Raj, K. S. (2016). Well-Being in Residency: A Systematic Review. *Journal of Graduate Medical Education*, *8*(5), 674-684.

- Regehr, C., Glancy, D., Pitts, A., & LeBlanc, V. R. (2014). Interventions to reduce the consequences of stress in physicians: A review and meta-analysis. *Journal of Nervous and Mental Disease*, 202(5), 353-359.
- Rothenberger, D. A. (2017). Physician Burnout and Well-Being: A Systematic Review and Framework for Action. *Diseases of the Colon & Rectum*, 60(6), 567-576.
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Appendix C: Data Extraction Sheet

Citation (Lead author + year)	
Sample	<ul style="list-style-type: none"> • Interns • Residents • Registrars • All
Specialty Grouping	<ul style="list-style-type: none"> • Interns & Residents • Mixed Registrars • Non-Surgical Registrars • Surgical Registrars • All
Specialty (Registrars only)	
Clinical Setting (e.g. Hospital)	
Country	
Sample Source	
Burnout Measure	<ul style="list-style-type: none"> • Full MBI-HSS • Partial MBI-HSS (circle all included subscales): <ul style="list-style-type: none"> ○ Emotional Exhaustion ○ Depersonalisation ○ Personal Accomplishment
Translated MBI Version?	<ul style="list-style-type: none"> • Yes • No
Survey Administration Method	<ul style="list-style-type: none"> • Online • Paper • Mail • Unspecified
Methodological Design	<ul style="list-style-type: none"> • Cross-Sectional • Longitudinal
Sample Size	
Variables Examined	

Appendix D: Included Study Details

Table 1.

Included study details

Author	N	Country	Study Design	Survey Administration	MBI Version		Demographics	
					All Subscales?	Translated Version?	Age (Years) (Mean ± SD)	Gender (% F)
Abut 2012	157	Turkey	Cross-Sectional	Paper	Y	Turkish	31.14 ± 3.82	50%
Agha 2015	96	Saudi Arabia	Cross-Sectional	Paper	Y	N		33%
Al-Dubai 2013	191	Malaysia	Cross-Sectional	Paper	Only EE ^a	N	26.5 ± 1.6	55%
Aldrees 2015	85	Saudi Arabia	Cross-Sectional	Paper	Y	N	29 ± 2.3	33%
Aldrees 2017	38	Saudi Arabia	Cross-Sectional	Paper	Y	N	28 ± 1.9	26%
Anagnostopoulos 2015	264	Greece	Cross-Sectional	Paper	Only EE ^a	Greek	33.5 ± 3.3	47%
Bakker 2009	221	Netherlands	Cross-Sectional	Mail	Y	N	31.52 ± 3.49	57%
Chan 2016	129	USA	Cross-Sectional	Paper	Y	N		29%
Dikmetas 2011	270	Turkey	Cross-Sectional	Unstated	Y	Turkish	30	34%
Golub 2007	514	USA	Cross-Sectional	Mail	Y	N	31	21%
Guenette 2018	314	USA	Cross-Sectional	Online	Only PA ^b	N	31.1 ± 2.8	31%
Jamjoom 2018	32	Saudi Arabia	Cross-Sectional	Online	Y	Unstated		94%

Author	N	Country	Study Design	Survey Administration	MBI Version		Demographics	
					All Subscales?	Translated Version?	Age (Years) (Mean \pm SD)	Gender (% F)
Joaquim 2018	115	Portugal	Cross-Sectional	Unstated	Y	Portuguese	28.4 \pm 2.2	76%
Karaoglu 2015	74	Turkey	Cross-Sectional	Unstated	Y	Turkish	27.6 \pm 2.25	59%
Lafreniere 2016	44	USA	Cross-Sectional	Unstated	Y	N		57%
Lebensohn 2013	168	USA	Cross-Sectional	Online	Y	N		60%
Lemkau 1988	67	USA	Cross-Sectional	Paper			29.09 \pm 3.78	21%
Lin 2016	73	USA	Longitudinal	Online	Y	N	30.8 \pm 3.22	42%
Lindeman 2017	88	USA	Longitudinal	Online	Only EE ^a and DP ^c	N		48%
Michels 2003	350	USA	Longitudinal	Paper	Y	N	30.4 \pm 5.2	32%
Myszkowski 2017	259	France	Cross-Sectional	Online	Y	French	25.6	77%
Nason 2013	26	Ireland	Cross-Sectional	Unstated	Y	N	25.1	69%
Nomura 2016	41	Japan	Cross-Sectional	Unstated	Y	Japanese	29 \pm 1.9	44%
Okpozo 2017	203	USA	Cross-Sectional	Unstated	Y	N		52%
Olson 2015	45	USA	Longitudinal	Unstated	Y	N	28.4 \pm 1.7	64%
Park 2016	317	South Korea	Cross-Sectional	Unstated	Y	Korean	30.44 \pm 2.98	32%
Pirinnci 2015	222	Turkey	Cross-Sectional	Unstated	Y	Turkish	29.95 \pm 3.79	64%
Prins 2007	158	Netherlands	Cross-Sectional	Mail	Y	Dutch	31.9 \pm 3.2	51%

Author	<i>N</i>	Country	Study Design	Survey Administration	MBI Version		Demographics	
					All Subscales?	Translated Version?	Age (<i>Years</i>) (<i>Mean</i> ± <i>SD</i>)	Gender (% <i>F</i>)
Salles 2018	193	USA	Longitudinal	Paper OR Online	Y	N		37%
Sargent 2004	21	USA	Cross- Sectional	Unstated	Y	N	30	14%
Schaufeli 2009	2115	Netherlands	Cross- Sectional	Mail	Y	Dutch	31.5 ± 3.5	61%
Sochos 2012	184	England	Cross- Sectional	Online	Y	N	30.6 ± 4.4	60%
Woodside 2018	155	USA	Longitudinal	Unstated	Y	N	35 ± 7.5	68%

Note. ^a EE refers to Emotional Exhaustion. ^b PA refers to Personal Accomplishment. ^c DP refers to Depersonalisation

Table 2.

Sample details for included studies.

Author	Training Factors		Burnout Levels		
	Training Level	Specialties	<i>EE</i> (Mean ± SD)	<i>DP</i> (Mean ± SD)	<i>PA</i> (Mean ± SD)
Abut 2012	Registrars	Anaesthesiology			
Agha 2015	Residents & Registrars	Emergency Medicine, General Surgery, Gynaecology, Internal Medicine, Nephrology, Paediatrics			
Al-Dubai 2013	Residents	NA	23.1 ± 10.4		
Aldrees 2015	Registrars	Otolaryngology	29.5 ± 9.6	10.7 ± 6	32.33 ± 6
Aldrees 2017	Registrars	Plastic Surgery			
Anagnostopoulos 2015	Registrars	Unspecified	25.05 ± 11.13		
Bakker 2009	Residents	NA			
Chan 2016	Registrars	Anaesthesiology, Emergency medicine, Family medicine, General surgery, Internal medicine, Neurosurgery, Obstetrics/gynaecology, Ophthalmology, Orthopaedic surgery, Otolaryngology, Paediatrics, Radiology			

Author	Training Factors		Burnout Levels		
	Training Level	Specialties	<i>EE</i> (Mean ± SD)	<i>DP</i> (Mean ± SD)	<i>PA</i> (Mean ± SD)
Dikmetas 2011 ^a	Registrars	Unspecified	2.99 ± 0.71	2.95 ± 0.77	2.94 ± 0.66
Golub 2007	Registrars	Otolaryngology	22.4 ± 10.0	10.7 ± 6.2	38.0 ± 6.4
Guenette 2018	Registrars	Radiology			35.6 ± 8.7
Jamjoom 2018	Registrars	Paediatrics			
Joaquim 2018	Registrars	Haematology, Oncology, Radiotherapy			
Karaoglu 2015 ^a	Registrars	Paediatrics and Unspecified 'Other'	26.06 ± 6.64	16.39 ± 3.50	28.02 ± 3.39
Lafreniere 2016	Registrars	Internal Medicine			
Lebensohn 2013	Registrars	Family Medicine	17.1 ± 9.5	6.38 ± 4.7	
Lemkau 1988	Registrars	Family Medicine	25 ± 7.3	12 ± 5.5	38 ± 5.9
Lin 2016	Registrars	General Surgery	36.7 ± 12.36	18 ± 7.44	43.92 ± 6.92
Lindeman 2017	Registrars	General Surgery	29.2 ± 11.5	12.9 ± 6.1	
Michels 2003	Registrars	Family Medicine	19.2 ± 9.86	8.37 ± 5.41	38.90 ± 7.40
Myszkowski 2017	Registrars	Internal Medicine	24.6 ± 11.7	12.5 ± 6.5	35.8 ± 7.1
Nason 2013	Interns	NA			
Nomura 2016 ^a	Registrars	Paediatrics	13.5 ± 4.0	10.8 ± 3.7	17.2 ± 4.2

Author	Training Factors		Burnout Levels		
	Training Level	Specialties	<i>EE</i> (Mean ± SD)	<i>DP</i> (Mean ± SD)	<i>PA</i> (Mean ± SD)
Okpozo 2017 ^b	Registrars	Anaesthesiology, Emergency medicine, Family medicine, General surgery, Internal medicine, Obstetrics and gynaecology, Psychiatry	3.38 ± 1.17	2.23 ± 1.08	4.65 ± 0.71
Olson 2015	Registrars	Paediatrics	21.1 ± 9.4	8.9 ± 4.8	39.0 ± 5.8
Park 2016	Registrars	Anaesthesiology, Dermatology, Emergency Medicine, Family Medicine, General Surgery, Internal Medicine, Laboratory Medicine, Neurology, Neurosurgery, Nuclear Medicine, Obstetrics and Gynaecology, Occupational and Environmental Medicine, Ophthalmology, Orthopaedics, Otolaryngology, Paediatrics, Pathology, Plastic Surgery, Preventive Medicine, Psychiatry, Radiation Oncology, Radiology, Rehabilitation Medicine, Thoracic Surgery, Tuberculosis Medicine, Urology			
Pirincci 2015 ^a	Registrars	Unspecified	22.33 ± 8.37	8.72 ± 4.74	18.76 ± 5.87

Author	Training Factors		Burnout Levels		
	Training Level	Specialties	<i>EE</i> (Mean ± SD)	<i>DP</i> (Mean ± SD)	<i>PA</i> (Mean ± SD)
Prins 2007 ^a	Registrars	Anaesthesiology, Cardiology, Dermatology, General Surgery, Genetics, Internal Medicine, Medical Microbiology, Neurology, Obstetrics and Gynaecology, Ophthalmology, Oral Surgery, Otolaryngology, Paediatrics, Pathology, Psychiatry, Radiology, Radiotherapy, Rehabilitation Medicine	13.6 ± 7.5	6.4 ± 3.6	26.6 ± 4.1
Salles 2018 ^b	Registrars	Cardiothoracic, General surgery, Neurosurgery, Otolaryngology head and neck surgery, Ophthalmology, Orthopaedics, Plastic Surgery, Urology, Vascular	3.44 ± 1.2	3.15 ± 1.28	5.65 ± 0.92
Sargent 2004	Registrars	Orthopaedic Surgery	27.7 ± 9.7	15.1 ± 6.3	36.3 ± 5.3
Schaufeli 2009 ^a	Registrars	Unspecified	1.98 ± 1.05	1.42 ± 0.88	4.43 ± 0.74
Sochos 2012	All	Unspecified			
Woodside 2018	Registrars	Family Medicine; Psychiatry			

Note. ‘Unspecified’ in ‘Specialties’ means all specialties of participants are not listed. ^a Denotes studies which used translated MBI versions with different scoring systems. ^b Denotes studies reporting average scores for individual items rather than average total score.

Appendix E: Quantitative Study Reporting Quality Review Data

Lead author (date)	1: Question/objective sufficiently described	2: Study design evident and appropriate	3: Subject/comparison group selection or source of information/input variables described/appropriate	4: Subject (and comparison group, if applicable) characteristics sufficiently described	8: Outcome(s) well defined and robust to measurement/misclassification bias. Means of assessment reported.	9: Sample size appropriate	10: Analytic methods described/justified/appropriate	11: Some estimate of variance reported	12: Controlled for confounding	13: Results reported in sufficient detail	14: Conclusions supported by results	Total (0-22)	Total (%)
Abut 2012	●	●	◐	●	●	●	●	◐	●	●	●	20	91%
Agha 2015	●	●	●	●	●	●	●	●	●	●	●	22	100%
Al-Dubai 2013	●	●	●	●	●	●	●	●	●	●	●	22	100%
Aldrees 2015	●	●	●	●	◐	●	●	●	●	●	●	21	95%
Aldrees 2017	●	◐	●	●	◐	◐	●	●	◐	●	●	18	82%
Anagnostopoulos 2015	●	●	●	●	●	●	●	●	●	●	●	22	100%

Lead author (date)	1: Question/objective sufficiently described	2: Study design evident and appropriate	3: Subject/comparison group selection or source of information/input variables described/appropriate	4: Subject (and comparison group, if applicable) characteristics sufficiently described	8: Outcome(s) well defined and robust to measurement/misclassification bias. Means of assessment reported.	9: Sample size appropriate	10: Analytic methods described/justified/appropriate	11: Some estimate of variance reported	12: Controlled for confounding	13: Results reported in sufficient detail	14: Conclusions supported by results	Total (0-22)	Total (%)
Bakker 2009	●	●	●	●	●	●	●	●	●	●	●	22	100%
Chan 2016	●	●	●	●	●	●	●	○	●	●	●	20	91%
Dikmetas 2011	●	●	●	●	●	●	●	●	●	●	●	22	100%
Golub 2007	●	●	●	●	●	●	●	●	◐	●	●	21	95%
Guenette 2018	●	●	●	●	●	●	●	●	●	◐	●	21	95%
Jamjoom 2018	●	●	●	●	●	◐	●	●	◐	●	●	20	91%
Joaquim 2018	●	●	◐	●	●	●	●	●	●	●	●	21	95%
Karaoglu 2015	●	●	●	●	●	●	●	●	●	●	◐	21	95%

Lead author (date)	1: Question/objective sufficiently described	2: Study design evident and appropriate	3: Subject/comparison group selection or source of information/input variables described/appropriate	4: Subject (and comparison group, if applicable) characteristics sufficiently described	8: Outcome(s) well defined and robust to measurement/misclassification bias. Means of assessment reported.	9: Sample size appropriate	10: Analytic methods described/justified/appropriate	11: Some estimate of variance reported	12: Controlled for confounding	13: Results reported in sufficient detail	14: Conclusions supported by results	Total (0-22)	Total (%)
Lafreniere 2016	●	●	●	●	●	●	●	●	●	●	●	21	95%
Lebensohn 2013	●	●	●	●	●	●	●	●	●	●	●	22	100%
Lemkau 1988	●	●	●	●	●	●	●	●	●	●	●	21	95%
Lin 2016	●	●	●	●	●	●	●	●	●	●	●	22	100%
Lindeman 2017	●	●	●	●	●	●	●	●	●	●	●	22	100%
Michels 2003	●	●	●	●	●	●	●	●	●	●	●	22	100%
Myszkowski 2017	●	●	●	●	●	●	●	●	●	●	●	20	91%
Nason 2013	●	●	●	●	●	●	●	●	●	●	●	19	86%

Lead author (date)	1: Question/objective sufficiently described	2: Study design evident and appropriate	3: Subject/comparison group selection or source of information/input variables described/appropriate	4: Subject (and comparison group, if applicable) characteristics sufficiently described	8: Outcome(s) well defined and robust to measurement/misclassification bias. Means of assessment reported.	9: Sample size appropriate	10: Analytic methods described/justified/appropriate	11: Some estimate of variance reported	12: Controlled for confounding	13: Results reported in sufficient detail	14: Conclusions supported by results	Total (0-22)	Total (%)
Nomura 2016	●	●	●	●	●	●	●	●	●	●	●	21	95%
Okpozo 2017	●	●	●	●	●	●	○	●	●	●	●	18	82%
Olson 2015	●	●	●	●	●	○	●	●	●	●	●	20	91%
Park 2016	●	●	●	●	●	●	●	●	●	●	●	22	100%
Pirincci 2015	●	●	●	●	●	●	●	●	●	●	●	21	95%
Prins 2007	●	●	●	●	●	●	●	●	●	●	●	22	100%
Salles 2018	●	●	●	●	●	●	●	●	●	●	●	21	95%
Sargent 2004	●	●	●	●	●	○	●	●	●	●	●	18	82%

Lead author (date)	1: Question/objective sufficiently described	2: Study design evident and appropriate	3: Subject/comparison group selection or source of information/input variables described/appropriate	4: Subject (and comparison group, if applicable) characteristics sufficiently described	8: Outcome(s) well defined and robust to measurement/misclassification bias. Means of assessment reported.	9: Sample size appropriate	10: Analytic methods described/justified/appropriate	11: Some estimate of variance reported	12: Controlled for confounding	13: Results reported in sufficient detail	14: Conclusions supported by results	Total (0-22)	Total (%)
Schaufeli 2009	●	●	●	●	●	●	●	●	●	●	●	21	95%
Sochos 2012	●	●	●	●	●	●	●	●	●	●	●	19	86%
Woodside 2008	●	●	●	●	●	●	●	○	●	●	●	19	86%