Prevalence of resident burnout remains unchanged worldwide despite efforts in the last 20 years: are we missing the point? A systematic review and meta-regression

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ABSTRACT

Background: Burnout is increasingly recognized as a crisis in the medical profession. Resident physicians are a particularly susceptible group.

Objectives: We aimed to establish the global prevalence of burnout among medical residents. Secondarily, we used this data to: 1) identify risk and protective factors for burnout, and 2) use meta-regression to establish whether prevalence of burnout varies by country of training, year of study, and specialty of practice.

Methodology: We searched Medline, EMBASE, PsycINFO, Cochrane, Web of Science and ERIC from their inception to August 21, 2018. Reviewers screened 8,505 studies in duplicates, rendering 197 studies that quantify burnout among resident physicians. Study data were extracted in duplicate by five investigators. Pooled prevalence was estimated using a random effects model with restricted maximum-likelihood estimator. A random effects meta-regression was employed for our secondary analysis.

Results: Our study encompasses data over 30 years among 44,000 residents across 47 countries. We report a pooled prevalence of 47.3% (95% CI 43.1%; 51.5%). A majority of studies found depression, stress, and lower job satisfaction to be associated with higher rates of burnout. Our meta-regression uncovered three novel findings: despite changes in duty hours and a focus on wellness, the prevalence of burnout has remained unchanged over the past 2 decades. Burnout varies by region, with residents of European countries experiencing the lowest level. Lastly, burnout was unaffected by specialty of practice.

Interpretation: Approximately 1 in 2 residents reported experiencing burnout. This prevalence has not changed over decades and may be modulated by systemic factors.

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INTRODUCTION

We are in a critical period within the medical profession as the alarming rates of suicide brings burnout to the forefront.[1–3] The effects of burnout are widespread, impacting both physician wellness and productivity as well as patient health outcomes.[2,4] Burnout is characterized by physical, emotional, and mental exhaustion, resulting from long term involvement in emotionally taxing situations.[5]

In the United States, approximately half of practicing physicians suffer from an episode of burnout during their career.[1,6,7] Canadian data reports a slightly lower prevalence; approximately 30% of the surveyed physicians endorsed burnout.[8] Residency is a particularly stressful time; the junior physician is tasked with a tremendous responsibility of consistently providing high quality care while learning and integrating new skills. Adapting to these job demands have a direct consequence on one's emotional and intellectual reserve, and ability to establish a healthy home-work interface.[9] Prevalence of burnout among resident physicians vary extensively from 3 to 88 percent, but there is no existing systematic investigation of burnout in this group.[7,10]

The objective of our study was two-fold; our main aim was to establish the prevalence of burnout among medical residents based on a meta-analysis of global literature. Secondarily, we used the extracted data to: 1) explore which commonly studied factors, such as age, sex, and marital status, increase risk for burnout, and 2) use meta-regression to understand whether country of training, year of study, and specialty of training were associated with burnout as these factors may explain heterogeneity in the prevalence of burnout.

METHODS

Data Sources and Searches

The search strategy was developed and conducted by a health research librarian (L.B.) at McMaster University. We searched Medline, EMBASE, PsycINFO, Cochrane, Web of Science and ERIC (Education Resources Information Center) from their inception to August 21, 2018. The search encompassed terms used to refer to residents worldwide (e.g., intern, junior physician, house officer, et cetera), burnout and its components (emotional exhaustion, physical exhaustion, depersonalization, cynicism), and the setting (medical, hospital, clinical). The reference lists of reviews identified were searched for relevant articles. No restrictions on geography or date were applied. However, we limited our search to studies published in English. The full search strategy is provided in Supplementary Table 1.

Study Selection

All studies measuring burnout among residents were included regardless of country of training, specialty, year of training, or setting. We accepted the definition of burnout as used in the study, recognizing that it is measured and defined variably across the literature. We included studies that either reported or provided data necessary to quantify burnout such as through the prevalence of burnout, residents' scores on a burnout scale or their classifications into percentiles based on score. Studies investigating doctors of osteopath were excluded, as were case studies, dissertations, and opinion papers. All titles, abstracts, and full-text articles were evaluated for

eligibility in duplicate by five reviewers using the Covidence software.[11] Any discrepancies were discussed and resolved by an independent reviewer when necessary. In addition, we reviewed the reference list of each identified study. Supplementary Figure 1 outlines the selection of articles.

Data Extraction and Quality Assessment

From each study, we extracted study characteristics, participant demographics, definition and measurement of burnout, burnout rates, and factors associated with burnout. Definitions for the following extracted associated factors were accepted as they were reported by study authors: depression, job satisfaction, and income satisfaction. As before, data was independently extracted in duplicate and discrepancies were resolved by an independent reviewer. There is a lack of a validated tool to assess risk of bias in cross sectional studies prohibiting us from doing so systematically. However, using the general framework of well-established tools the same reviewers also independently rated the quality of included studies in duplicate based on representativeness of the sample, sample size, ascertainment of outcome and reporting of findings.

Statistical Analyses

Primary Analysis

A pooled prevalence was calculated using a random effects model with a restricted maximum-likelihood estimator. We used raw proportions without transforming the data based on recommendations by Lipsey and Wilson since a vast majority of our proportions were between 0.2 and 0.8.[12] The meta-analysis was conducted in R using the metafor package.[13]

As we anticipated systematic differences between the results of studies (heterogeneity), we report both the tau^2 values of heterogeneity and calculated I^2. We sought to understand whether prevalence of burnout changed depending on the tool used to ascertain the prevalence. Therefore, we conducted a meta-regression analysis with the use of MBI, a validated tool, as a categorical moderator variable (yes *vs* no). We hypothesized that since use of MBI decreases heterogeneity in how burnout is defined, it will be a significant predictor in our meta-regression.[14,15] If found to be a significant variable, we intended to adjust all additional analyses for the use of MBI.

We conducted a subgroup analysis of only North American studies to establish a pooled estimate of burnout among North American residents. As before, we employed a random effects model to pool data.

Secondary Analysis

We conducted two secondary analyses. First, we extracted data on reported risk and protective factors, including age, sex, marital status, depression, level of stress, work hours, frequency of call shifts, job satisfaction, wage/income satisfaction, family/network support, sleep, and level of training. We present a descriptive summary of associations found for these factors in the literature. Second, we employed meta-regression to explore factors that may explain variation in burnout; specifically, we studied the year burnout data was collected (continuous variable), the region (categorical variable), and program of residency (medicine *vs* surgery). We first categorized regions as continents, but as only a handful of studies were

conducted in Africa, Asia, Australia, Middle East, and South America, we collapsed these regions into one and compared them against Europe and North America, which were appropriately powered. We used the Comprehensive Meta-Analysis software (version 3) to conduct our analysis. A random effects model was used to conduct the meta-regression. Due to the post-hoc nature of this analysis, we did not take a significant finding to be definitive, but rather to promote a direction for future research.

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) reporting guidelines.[20]

RESULTS

Study characteristics

Upon completion of screening, 197 of the 8,505 studies published between 1987 and 2018 met our eligibility criteria. These studies represent data from over 44,000 residents across 47 countries; a large proportion of studies (82/197), notably, were conducted in the United States. Residents included were from a variety of programs and at different levels of training. An overall proportion of burnout was reported in 114 studies. Four of these 114 studies report burnout in two separate populations of residents rendering 118 datasets eligible for our meta-analysis (Table 1).

Measurement of burnout

Among the studies included in our review, burnout was measured using a variety of tools, detailed in Supplementary Table 2. The most commonly utilized tool is the MBI (138 of 197 studies), in which burnout is assessed in the context of EE, DP, and PA. This is a 22-item self-administered questionnaire whereby respondents are asked to rank their responses on a 7-point Likert scale (ranging from 0 to 6, or less commonly, 1-7). While the MBI was initially created to assess burnout on a continuum, it has commonly been adapted to dichotomize burnout.[18] However, there is a lack of standardization regarding which of the three dimensions are necessary to constitute burnout or specific cut-off values for each of these dimensions.[2] For instance, amongst the 138 studies that used MBI, 83 studies reported an overall proportion of residents experiencing burnout. These studies defined burnout using 9 different definitions, with the most common one being a high score in either EE or DP (N=42/83). Five of 83 studies did not report how overall burnout was determined. The cutoff values for the individual dimensions also varied, as described in Supplementary Table 2. For instance, six different cut offs were used to define high EE, meanwhile 24 of 83 studies did not report a cutoff.

Twenty-nine of 197 studies utilized a modified single-item version of the MBI to measure burnout.[19] Thirty-one of 197 studies used a different tool altogether as described in Supplementary Table 2. This lack of an established quantitative definition for burnout likely contributes to heterogeneity in prevalence estimates; as such, the pooled results are crude estimates and should be interpreted with caution.

Pooled prevalence of burnout

Global: Overall, 31,210 residents from 114 studies, consisting of 118 datasets, were included in our meta-analysis. The pooled random effects estimate of burnout was 47.3% (95% CI: 43.1%-51.5%) between 2001 and 2017. An analysis of heterogeneity suggests significant differences among the pooled studies; tau^2 was 0.052 (P het < 10^{-16}) and I^2 was 98.56%. A forest plot of all studies is presented in Figure 1. We then sought to understand whether capturing burnout in a standardized manner using the MBI would explain heterogeneity in prevalence. We thus conducted a meta-regression analysis with MBI use as a categorical variable. As expected, use of MBI to capture burnout significantly explained heterogeneity in the prevalence (meta regression β 0.117, 95% CI: 0.027;0.207, P = 0.01). We therefore adjusted our future analyses for use of MBI.

North America: We aimed to estimate prevalence of burnout among Canadian residents, however only four studies captured burnout among Canadians (n=752), therefore, we assessed all North American studies together. Sixty studies captured North American data; the pooled random effects estimate of burnout among North American residents was 51.2% (95% CI: 45.9, 56.6). We further explored regional variation in burnout globally, results of this analysis are presented below.

Risk and protective factors

We aimed to study the following factors and their role on burnout: age, sex, marital status, depression, level of stress, work hours, frequency of call shifts, job satisfaction, wage/income satisfaction, family/network support, sleep, and level of training. However, due to heterogeneity in how these factors are studied and reported in literature, we were unable to pool results but rather present a descriptive analysis of our findings (Figure 2). In brief, we found that a majority of studies did not find a significant association between age, sex, relationship status, and level of training, with burnout. On the other hand, depression, stress, and lower job satisfaction were commonly associated with higher rates of burnout in the literature. Additionally, while 28/58 studies investigating the association between work hours and burnout found a positive association, 30/58 studies concluded otherwise. Similarly, only 7/23 studies found that burnout was positively and significantly associated with more call shifts.

Meta-regression

Year of study*:* We undertook a meta-regression of burnout with the year in which a study was conducted to evaluate whether heterogeneity in the prevalence of burnout was explained by time, i.e. whether burnout changed over time. Data for this analysis were available for 100 studies; 14 did not report the year of survey. Our analysis, adjusted for MBI use, found that year of study was not a significant moderator of burnout (estimate of meta regression β 0.002, 95% CI: -0.009;0.013, P = 0.717). Burnout prevalence over the years is presented in Figure 3.

Medical versus Surgical training*:* We additionally investigated whether prevalence of burnout was impacted by specialty; specifically, we were interested in understanding whether medical residents experienced lower burnout rates compared to surgical residents. Data were available for 82 studies. Our meta-regression analysis, adjusted for MBI use, showed no evidence that specialty of training was associated with burnout prevalence (estimate of meta regression β -0.005, 95% CI: -0.110;0.099, P = 0.924).

Geographic region*:* We anticipated that geographic region of study would be an important predictor of burnout prevalence. We first categorized regions by continents (Europe, Africa, Asia, Middle East/North Africa, North America, South America, and Australia/New Zealand), however, a vast majority of these regions included only a few studies, therefore we collapsed Africa, Asia, Australia, Middle East, and South America in to one category, and conducted an analysis with region as a three category variable (North America, Europe, and Rest of the World). Data from all 118 datasets were available for this analysis. Figure 4 illustrates burnout prevalence by region. Our analysis, adjusted for MBI use, found that region was a significant predictor of variation in burnout prevalence (estimate of meta regression $P = 0.0002$). The prevalence of burnout among European residents was 30.8%. By contrast, 51.2% of North American residents experienced burnout. Table 2 present the results of our meta-analysis of burnout prevalence by region.

Risk of Bias Assessment

Many of the included studies had methodological flaws limiting the reliability of their findings. Specifically, only 30% (60/197) of studies included a consecutive or obviously representative sample of residents, and 10% (19/197) of studies justified their sample size using a sample size calculation. Additionally, only 25% (50/197) of studies compared respondents' characteristics to those of non-respondents or had a satisfactory response rate of greater than 80%. While 98% (193/197) of studies used a well-described validated tool to measure burnout, this is of doubtful significance given the heterogeneity in interpreting the tool and establishing cutoff values highlighted above. Forty-five percent of studies (88/197) appropriately reported on descriptive statistics to describe the population with proper measures of dispersion. Lastly, 49% (97/197) of studies provided adequate statistics to describe burnout with proper measures of dispersion.

INTEPRETATION

Our study encompasses data collected over 30 years among 44,000 resident physicians across 47 countries. We report a global pooled estimate of burnout of 47.3%. Our assessment of the literature reveals that contrary to common belief, the majority of literature does not support an association between relationship status, work hours, or level of training with burnout. We report three novel findings: we found that there is significant variation in burnout around the world, with North American residents experiencing more burnout than Europeans. Second, the prevalence of burnout has not changed over time. And lastly, we found that medical and surgical residents experience similar levels of burnout. We outline below how these key findings will assist policy makers in targeting future interventions for mitigating burnout.

Residency programs, over the past decades, have introduced policies to circumvent burnout by limiting work hours, on-call responsibilities, and instituting wellness programs. However, our data shows that the prevalence has not significantly changed over the last two decades.[20] This is consistent with the equivocal findings of a recent systematic review.[21] These results call to light the probability that additional, yet not understood, causes exist for burnout. Further results of our analysis, instead, sheds light on these unknown causes. Our meta-regression showed that prevalence of burnout varied significantly by region of the world.

Amongst North American and European residents, the two most studied populations, there exists a stark difference in the rates of burnout. While there is a paucity of research comparing health care systems between these regions, a study of general workplace trends finds that factors such as more involved unions and longer paid vacations, among other such social policies, contribute to overall improved work-life balance and less burnout.[22] It is possible that our findings may be biased by methodological considerations such as the fact that MBI may be filled out in a different manner across cultures contributing to the variation between regions; our findings are nonetheless novel and warrant future research to identify differences in the training culture and environment between regions that may explain our results. In fact, several studies support this hypothesis; a systematic review by Panagioti *et al.,* evaluating strategies to mitigate burnout suggested the need for organizational level change.[4]

The need for systemic change is further emphasized by our finding that specialty of training does not affect burnout rates. This finding should support alliance of efforts, both policy and research, by medical and surgical training programs for a crisis that affects all residents equally. Ultimately, our study highlights that we do not yet have a grasp on what factors cause burnout among physicians; it is critical that we amend research efforts to better understand burnout so that appropriate interventions can be developed to alleviate this crisis.

Strengths and Limitations

Our large systematic review evaluates burnout among resident physicians on a global scale; we employed broad search terms to capture data from a sample of 44,000 residents across 47 countries. The comprehensiveness of our data make our results generalizable and provides a solid platform on which additional data can be added to make more robust conclusions. Our results also propose a clear novel direction of research; our study suggests that the key to mitigating burnout may lie in systemic changes that can be uncovered by studying regional variation in the medical culture.

There are multiple limitations to our study. First, there is significant heterogeneity in the measurement of burnout, subsequently leading to pooled estimates that are less reliable. It is worth noting that use of MBI to define burnout explained some heterogeneity and we subsequently adjusted our meta-regression accordingly to ensure robustness of our findings. We nonetheless encourage readers to assess the results critically. The bias resulting from substantial heterogeneity is a limitation that exists in literature and highlights the need for standardized measurement of burnout.

Conclusions

We present data on the epidemic of resident physician burnout affecting 1 in 2 residents worldwide. Despite its significant impact, there remains a lack of consensus surrounding the definition and measurement of burnout and interventions have thus far been largely inconsequential since burnout prevalence appears unchanged over the last few decades. We provide a novel and more comprehensive characterization of burnout within our profession and a new direction for future research.

Author contributions: LN, ZS, BS and JP conceived the research question. LN, BS, BD, ZS, and LT designed the review protocol. LN and LB designed the search strategy, which was completed by LB. LN, BS, AS, FN and OK completed the systematic screening of studies for inclusion independently and in duplicate. LN, BS, AS, FN and OK performed data extraction and quality assessment of included studies independently and in duplicate. LN, AA, and ZS performed data analyses. All authors contributed to the writing and revision of the manuscript. All authors approved the final version of the manuscript. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted. LN and ZS accept full responsibility for the finished article, had access to any data, and controlled the decision to publish.

Table 1 Characteristics of the 114 studies include in the meta-analysis

Author	Country	N Residents	Males (%)	Specialty	Year of Survey	Experiencing Burnout (%)	Tool used to Measure Burnout
Abdulrahman et al, 2018[23]	United Arab Emirates	302	63 (21.0)	Multiple	2016	70.20%	MBI
Agha et al, 2015[10]	Saudi Arabia	96	64 (67)	Multiple	NS	88.54%	MBI
Aksoy et al, 2014[24]	Turkey	28	10 (47)	Pediatrics	NS	27.27%	MBI
Aksoy et al, 2014[24]	Turkey	38	16 (47)	Internal Medicine	NS	33.33%	MBI
Al-Ma'mari et al, 2016[25]	Canada	143	19 (13.0)	Obstetrics and Gynecology	NS	73.70%	MBI
Aldrees et al, 2013[26]	Saudi Arabia	159	NR	Multiple	2010	86.00%	MBI
Aldrees et al, 2015[27]	Saudi Arabia	85	57 (67)	Otolaryngology	2013	45.00%	MBI
Aldrees et al, 2017[28]	Saudi Arabia	38	28 (74)	Plastic Surgery	2015	47.00%	MBI
Arora et al, 2014[29]	Australia	51	NR	Orthopedic Surgery	2012	53.00%	MBI
Ashkar et al, 2010[30]	Lebanon	155	86 (55.5)	Multiple	2008	80.00%	MBI
Attenello et al, 2018[31]	USA	346	270 (78.0)	Neurosurgery	2015	67.00%	MBI
Becker et al, 2006[32]	USA	118	25 (20.8)	Obstetrics and Gynecology	2004	21.00%	MBI
Billings et al, 2011[33]	USA	284	131 (46.0)	Internal Medicine	2008 to 2010	45.00%	MBI
Blanchard et al, 2010[15]	France	204	82 (40.0)	Oncology	2009	44.00%	MBI
Bogg et al, 2001[34]	England	56	NR	Multiple	NS	25.00%	MBI
Braun et al, 2017[35]	USA	32	25 (79)	Internal Medicine	2014	50.00%	MBI
Campbell et al, 2010[36]	USA	86	44 (51)	Internal Medicine	2003 to 2008	67.00%	MBI
Castelo-Branco et al, 2007[37]	Spain	109	15 (14.0)	Obstetrics and Gynecology	2004	58.00%	MBI
Chaput et al, 2015[38]	France	52	26 (50)	Plastic surgery	2013	28.80%	MBI
Chati et al, 2017[39]	France	251	144 (57.5)	General Surgery	2013	52.00%	MBI
Chaukos et al, 2017[40]	USA	54	21 (40)	Internal Medicine	NS	31.00%	MBI
Chaukos et al, 2017[40]	USA	14	6 (40)	Psychiatry	NS	14.00%	MBI
Cofer et al, 2018[41]	USA	40	27 (68)	General Surgery	2016	25.00%	MBI
Cubero et al, 2016[42]	Brazil	54	29 (54)	Oncology	2010	76.00%	MBI

De Andrade et al, 2016[43]	Brazil	32	7 (22)	Pediatrics	2009	18.80%	MBI
Dominguez et al, 2018[44]	Colombia	202	129 (69.3)	NR	2015	33.20%	MBI
Dyrbye et al, 2014[45]	USA	1701	827 (48.6)	Multiple	2012	60.30%	MBI
Elmore et al, 2016[46]	USA	665	375 (56.4)	General Surgery	2014	69.00%	MBI
Embriaco et al, 2007[47]	France	372	NR	NR	2004	42.70%	MBI
Fahrenkopf et al, 2008[48]	USA	123	37 (30.0)	NR	2003	75.00%	MBI
Galam et al, 2013[49]	France	4050	1268 (31.3)	General Practice	2011	24.10%	MBI
Garza et al, 2004[50]	USA	136	39 (29.9)	Obstetrics and Gynecology	NR	18.00%	MBI
Goitein et al, 2005[51]	USA	118	56 (47.5)	Internal Medicine	2004	68.00%	MBI
Golub et al, 2007[52]	USA	514	406 (79.0)	Otolaryngology	2005	10.00%	MBI
Gopal et al, 2005[53]	USA	121	58 (48.0)	Internal Medicine	2003	61.00%	MBI
Gopal et al, 2007[54]	USA	106	45 (42.5)	Internal medicine	2004	55.00%	MBI
Gouveia et al, 2017[55]	Brazil	129	62 (48.0)	Multiple	2015	27.90%	MBI
Govardhan et al, 2012[56]	USA	49	4 (9)	Obstetrics and Gynecology	2009	13.00%	MBI
Goveia et al, 2018[7]	Brazil	37	NR	Anesthesia	2014 to 2015	2.70%	MBI
Hameed et al, 2018[57]	Saudi Arabia	181	75 (41.4)	Multiple	2013 to 2014	80.70%	MBI
Hill et al, 2009[58]	USA	22	NR	Otolaryngology	2006	31.82%	MBI
Holmes et al, 2017[59]	USA	276	97 (35.0)	Multiple	2014	69.00%	MBI
Jamjoom et al, 2018[60]	Saudi Arabia	32	2 (6)	Pediatrics	2016	70.00%	MBI
Joaquim et al, 2018[61]	Portugal	115	30 (26.3)	Oncology	2011	45.20%	MBI
Krug et al, 2017[62]	USA	112	47 (42.0)	Internal Medicine	2012	61.00%	MBI
Kwah et al, 2016[63]	USA	32	NR	Internal Medicine	2012	75.00%	MBI
Landrigan et al, 2008[64]	USA	213	62 (29.3)	Pediatrics	2003 & 2004	75.40%	MBI
Landrigan et al, 2008[64]	USA	213	78 (31.7)	Pediatrics	2003 & 2004	57.00%	MBI
Lee et al, 2018[65]	Singapore	446	208 (46.6)	Multiple	2015	80.70%	MBI
Leung et al, 2017[66]	Australia, New Zealand	107	53 (50.0)	Oncology	2015	49.50%	MBI

Levin et al, 2017[67]	USA	354	182 (51.4)	Neurology	2016	67.20%	MBI
Lin et al, 2016[68]	USA	73	42 (58)	General Surgery	2013 to 2014	82.00%	MBI
Lindeman et al, 2013[69]	USA	30	21 (70)	General Surgery	2011	93.00%	MBI
Lindeman et al, 2013[69]	USA	36	24 (67)	General Surgery	2012	75.00%	MBI
Lindeman et al, 2017[70]	USA	88	46 (52)	General Surgery	2016	51.00%	MBI
Llera et al, 2014[71]	Argentina	92	28 (30)	Multiple	2011	19.60%	MBI
Malik et al, 2016[72]	Pakistan	133	98 (73.7)	Multiple	NS	57.90%	MBI
Martini et al, 2004[73]	USA	110	NR	Multiple	2003	49.00%	MBI
Martini et al, 2006[74]	USA	118	NR	Multiple	2004	41.00%	MBI
Mohammed et al, 2014[75]	Egypt	84	46 (55)	Multiple	2012	76.00%	MBI
Msaouel et al, 2010[76]	Greece	311	172 (55.3)	Multiple	NR	49.50%	MBI
Nolan et al, 2017[77]	Canada	166	43 (26.0)	Pediatrics	2014	42.00%	MBI
O'Connor et al, 2017[78]	Ireland	172	75 (43.6)	Multiple	2015	69.50%	MBI
Olson et al, 2014[79]	USA	76	40 (53)	Internal Medicine	2012	53.90%	MBI
Olson et al, 2015[80]	USA	45	16 (36)	Pediatrics	2014	40.00%	MBI
Pantaleoni et al, 2014[81]	USA	61	NR	Pediatrics	2011	46.00%	MBI
Ramey et al, 2017[82]	USA	205	141 (68.8)	Oncology	2016	33.20%	MBI
Ripp et al, 2010[83]	USA	145	73 (50.3)	Internal Medicine	2007	34.00%	MBI
Ripp et al, 2011[84]	USA	191	126 (66.0)	Internal Medicine	2009	81.00%	MBI
Ripp et al, 2015[85]	USA	133	77 (58.0)	Internal Medicine	2012	75.00%	MBI
Rosen et al, 2006[86]	USA	47	23 (49)	Internal Medicine	2003	55.30%	MBI
Sajjadi et al, 2017[87]	Canada	43	19 (45)	IM	2014	21.00%	MBI
Sargent et al, 2009[88]	USA	384	338 (88.0)	Orthopedic Surgery	NR	56.00%	MBI
Shanafelt et al, 2002[89]	USA	115	54 (47.0)	Internal Medicine	2001	76.00%	MBI
Siu et al, 2012[90]	Hong Kong	77	NR	NR	2009	48.00%	MBI
Spataro et al, 2016[91]	USA	198	102 (51.0)	Internal Medicine	2014	22.00%	MBI
Sulaiman et al, 2017[92]	Ireland	265	140 (52.8)	Multiple	NS	26.40%	MBI
Toral-Villanueva et al, 2009[93]	Mexico	312	177 (57.0)	Multiple	2003	40.00%	MBI
Waldman et al, 2009[94]	Argentina	106	70 (66.0)	Cardiology	2007	80.20%	MBI

Willcock et al, 2004[95]	Australia	110	70 (56.0)	Psychiatry	2001	54.00%	MBI
Williford et al, 2018[96]	USA	76	NR	General Surgery	2017	75.00%	MBI
Zis et al, 2014[9]	Greece	263	141 (53.6)	Multiple	2012	14.40%	MBI
Zis et al, 2015[97]	Greece	116	52 (44.8)	Neurology	2014	18.10%	MBI
Talih et al, 2016[98]	Lebanon	118	62 (53.0)	Multiple	2013	27.00%	Burnout Measure (modified)
Pereira-Lima et al, 2015[99]	Brazil	305	159 (52.1)	Multiple	NR	58.36%	Burnout Syndrome Inventory
See et al, 2016[100]	Singapore	64	NR	Internal Medicine	2013	71.80%	Copenhagen Burnout Inventory
Jovanovic et al, 2016[101]	Europe	1980	804 (40.6)	Psychiatry	2008 to 2012	36.70%	MBI-GS
Miyoshi et al, 2016[102]	Japan	85	47 (55)	NR	2013	30.59%	MBI-GS
Torppa et al, 2015[103]	Finland	97	NR	General Practice	2011	16.50%	Modified MBI (1 item)
De Oliveira Jr et al, 2013[104]	USA	1417	808 (57.0)	Anesthesia	NR	41.00%	Modified MBI (12 questions)
Ruitenburng et al, 2012[105]	Netherlands	181	76 (42.0)	Multiple	2009	7.00%	Modified MBI (13 items)
Ringrose et al, 2009[106]	Netherlands	47	23 (49)	Multiple	2007	31.00%	Modified MBI (15 items)
McNeeley et al, 2013[107]	USA	249	182 (73.0)	Radiology	2012	62.00%	Modified MBI (2 Single Item Measures, & PA (5 items))
Porrino et al, 2017[108]	USA	58	48 (83)	Radiology	2016	87.90%	Modified MBI (2 Single Item Measures, & PA (5 items))
Baer et al, 2017[109]	USA	258	54 (21.1)	Pediatrics	2013	39.10%	Modified MBI (2-Single Item Measures of EE and DP)
Mordant et al, 2014[110]	Italy (n=34), Netherlands (n=22), France (n=22), Belgium (n=17), UK	155	103 (66.5)	Multiple	2010	24.80%	Modified MBI (2-Single Item Measures of EE and DP)

	(n=14), Austria (n=7), Portugal (n=5), Poland (n=4), Spain (n=4), Slovenia (n=4), Germany (n=3), Lithuania (n=3), Greece (n=2), Ukraine (n=2), Ireland (n=2), Bulgaria (n=2), Other (n=22)						
Shanafelt et al, 2014[111]	USA	1345	710 (52.8)	Oncology	2014	34.10%	Modified MBI (2-Single Item Measures of EE and DP)
Simpkin et al, 2018[112]	US and Canada	49	15 (30)	Pediatrics	2015	31.00%	Modified MBI (2-Single Item Measures of EE and DP)
Trockel et al, 2018[113]	USA	185	NR	Multiple	NS	50.00%	Modified MBI (2-Single Item Measures of EE and DP)
van Vendelo et al, 2014[114]	Netherlands	105	83 (79.0)	Orthopedic Surgery	2011	27.60%	Modified MBI (2-Single Item Measures of EE and DP)
Prins et al, 2007[115]	The Netherlands	158	76 (48.0)	Multiple	2003	13.00%	Modified MBI (20 items)
Prins et al, 2010[116]	The Netherlands	2115	820 (38.8)	Multiple	2005	21.00%	Modified MBI (20 items)
van der Wal et al, 2016[117]	Netherlands	141	53 (37.6)	Anesthesia	2012	11.30%	Modified MBI (20 items)
van Vendeloo et al, 2018[118]	Netherlands	1231	325 (26.4)	Multiple	2015	15.00%	Modified MBI (20 items)
van Vendeloo et al, 2018[119]	Belgium	236	96 (40.7)	Multiple	2016	41.50%	Modified MBI (20 items)

Block et al, 2013[120]	USA	55	29 (53)	Internal Medicine	2011	76.00%	Modified MBI (6 items)
Lebares et al, 2018[121]	USA	566	277 (49.0)	General Surgery	2016	68.95%	Modified MBI (9 items)
Shakir et al, 2017[122]	USA	255	205 (80.4)	Neurosurgery	2016	36.50%	Modified MBI (9 items)
Huggard et al, 2011[123]	New Zealand	253	104 (41.1)	Multiple	NR	19.50%	Professional Quality of Life Index Version 3
Low et al, 2018[124]	Singapore	43	18 (43)	Multiple	2015	34.88%	Professional Quality of Life Scale
Markwell et al, 2009[125]	Australia, New Zealand	914	402 (44.0)	Multiple	2008	69.00%	Professional Quality of Life Scale
Cooke et al, 2013[126]	Australia	128	NR	General Practice	2010	14.00%	Single item measure
Kealy et al, 2016[127]	Canada	400	123 (30.8)	Psychiatry	2014	21.00%	Single item measure
Lambden et al, 2018[128]	USA	72	NR	Multiple	2017	53.50%	Single item measure
Leach et al, 2018[129]	USA	43	27 (63)	General Surgery	2017	30.20%	Single item measure
Raviola et al, 2002[130]	Kenya	50	NR	Multiple	NS	82.00%	Single item measure
Robertson et al, 2017[131]	USA	340	143 (42.0)	Multiple	2015	34.00%	Single item measure
Schweitzer, 1994[132]	South Africa	36	NR	NR	NR	55.50%	Single item measure

Table 2 Meta regression of burnout prevalence with region

Region	n residents	N studies	Estimate of β coefficient (95% CI)**
Europe	12,782	24	Reference
Africa	86	2	0.20 (0.10-0.30)
Asia	914	8	
Australia & New Zealand	1,563	6	
Middle East & North Africa	1,250	10	
South America	957	8	
North America	14,004	60	0.18 (0.09-0.28)

* Meta-analysed estimates for each region

** β coefficients are calculated using meta-regression with Europe as the reference group

Figure 1 Forest plot of studies included in the meta-analysis
(attached separately)

Figure 2 The association between commonly studied factors and burnout in residents

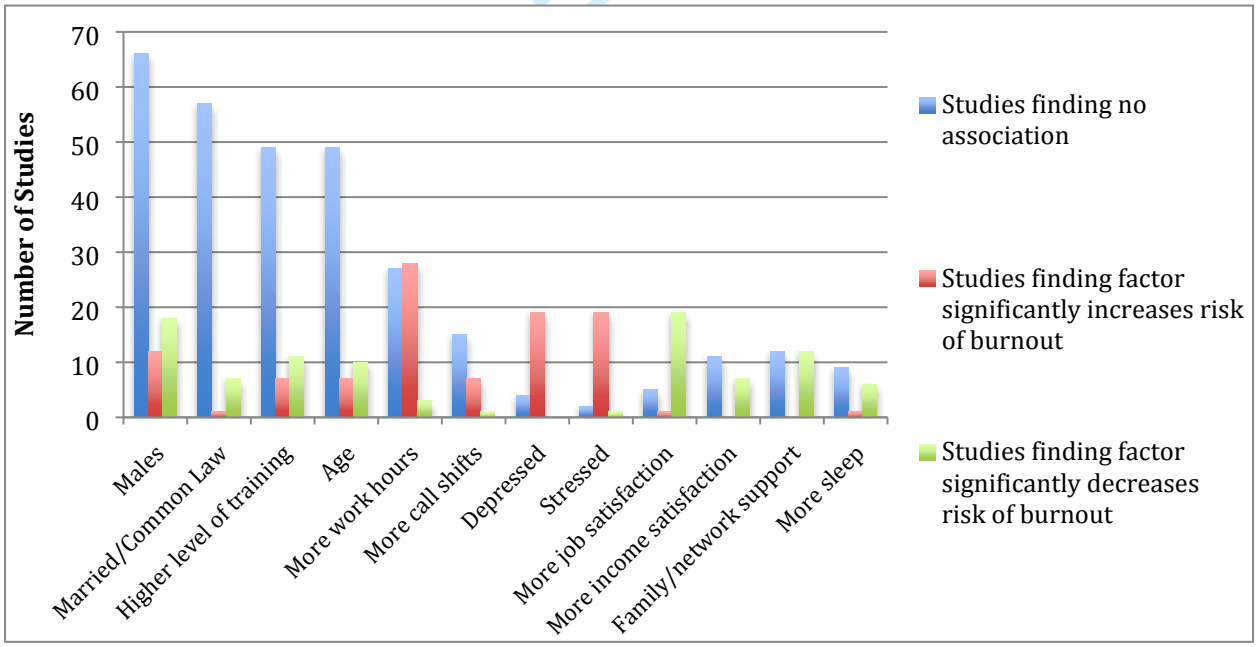

Figure 3 Prevalence of burnout by year

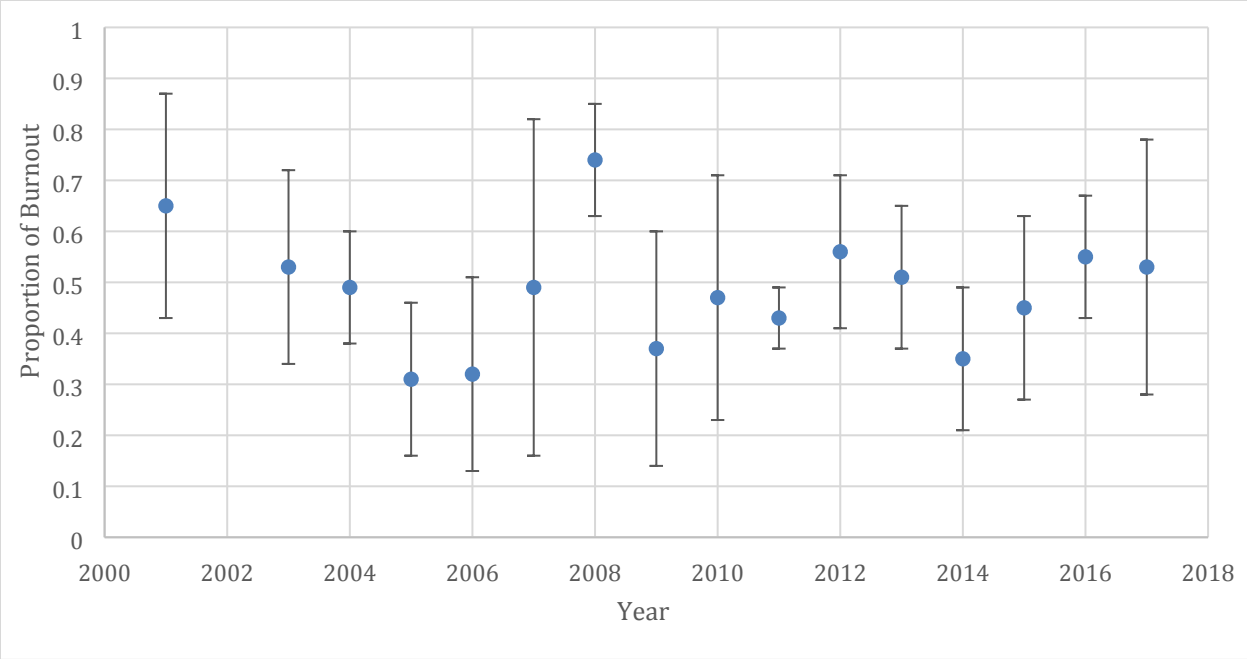

Figure 4 Geographic distribution of burnout rates among resident physicians

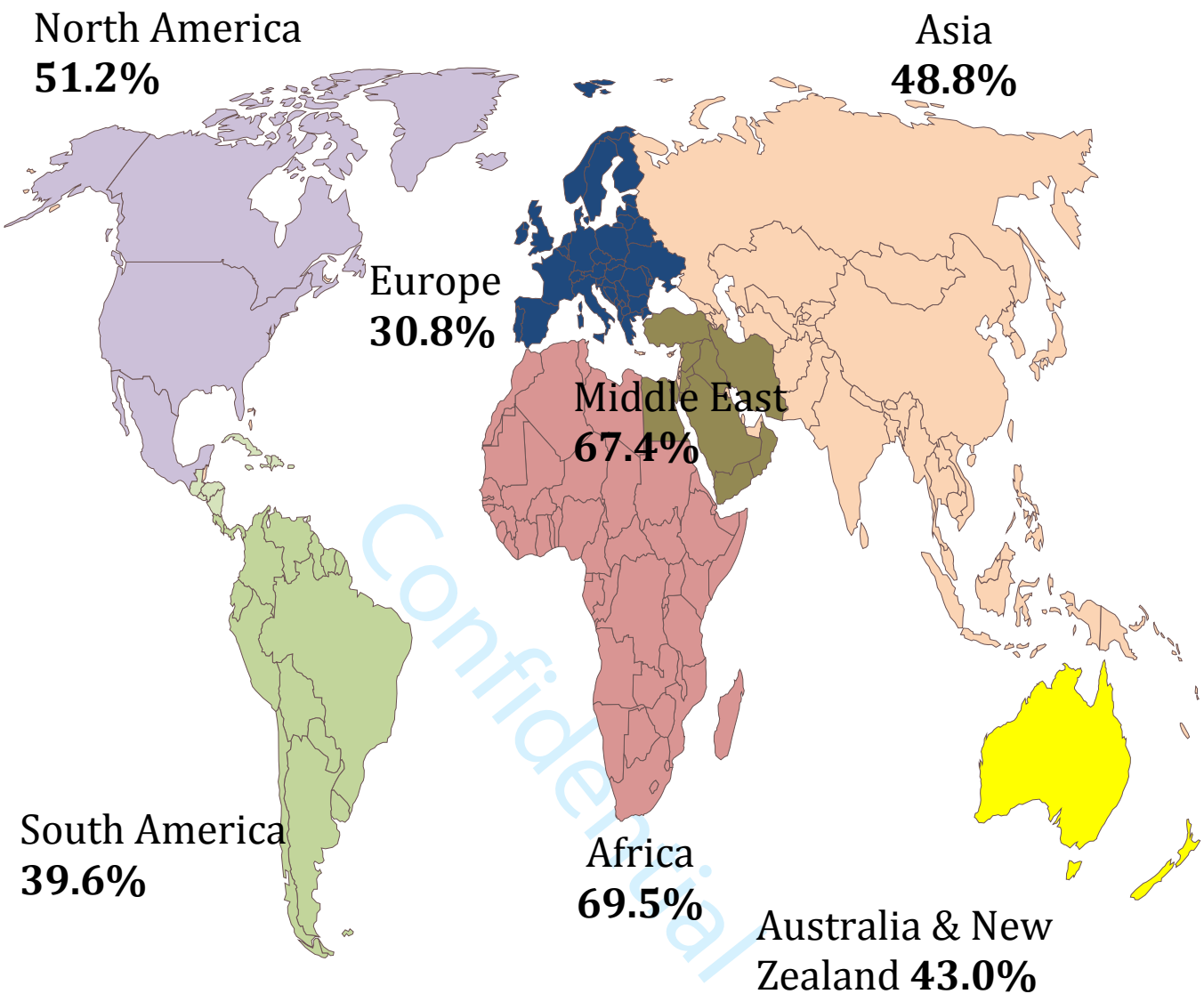

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Figure 1: Forest plot of studies included in the meta-analysis

Part 1 of 2

Study	Sample size	Proportion	95% CI
Abdulrahman, Farooq, Al Kharmiri, et al. 2018	302	0.70	(0.65–0.75)
Agha, Mordya, Anwar, et al. 2015	96	0.88	(0.82–0.95)
Aksoy, Durusu Tanriover, Dizdar, et al. 2014 (1)	28	0.27	(0.11–0.44)
Aksoy, Durusu Tanriover, Dizdar, et al. 2014 (2)	38	0.33	(0.18–0.48)
Al–Ma'mari, Naimi, Tulandi, et al. 2016	143	0.74	(0.66–0.81)
Aldrees, Aleissa, Zamakhshary, et al. 2013	159	0.86	(0.81–0.91)
Aldrees, Badri, Islam, et al. 2015	85	0.45	(0.34–0.56)
Aldrees, Hassouneh, Alabdulkarim, et al. 2017	38	0.47	(0.31–0.63)
Arora, Diwan, Harris, et al. 2014	51	0.53	(0.39–0.67)
Ashkar, Romani, & Musharrafieh. 2010	155	0.80	(0.74–0.86)
Attenello, Buchanan, Wen, et al. 2018 (1)	346	0.67	(0.62–0.72)
Baer, Feraco, & Tuysuzoglu Sagalowsky. 2017	258	0.39	(0.33–0.45)
Becker, Milad, & Klock. 2006	118	0.21	(0.14–0.28)
Billings, Lazarus, Wenrich, et al. 2011	284	0.45	(0.39–0.51)
Blanchard, Truchot, Albiges–Sauvin, et al. 2010	204	0.44	(0.37–0.51)
Block, Wu, & Feldman. 2013	55	0.76	(0.65–0.87)
Bogg, Gibbs, & Bundred. 2001	56	0.25	(0.14–0.36)
Braun, Auerbach, Rybarczyk, et al. 2017	32	0.50	(0.33–0.67)
Campbell, Prochazka, Yamashita, et al. 2010	86	0.67	(0.57–0.77)
Castelo–Branco, Figueras, Eixarch, et al. 2007	109	0.58	(0.49–0.67)
Chaput, Bertheuil, Jacques, et al. 2015	52	0.29	(0.16–0.41)
Chati, Huet, Grimberg, et al. 2017	251	0.52	(0.46–0.58)
Chaukos, Chad–Friedman, Mehta, et al. 2017 (1)	54	0.31	(0.19–0.43)
Chaukos, Chad–Friedman, Mehta, et al. 2017 (2)	14	0.14	(–0.04–0.32)
Cofer, Hollis, Goss, et al. 2018	40	0.25	(0.12–0.38)
Cooke, Doust, & Steele. 2013	128	0.14	(0.08–0.20)
Cubero, Fumis, de Sa, et al. 2016	54	0.76	(0.65–0.87)
De Andrade, Amaro, Farhat, et al. 2016	32	0.19	(0.05–0.32)
De Oliveira Jr, Chang, & Fitzgerald. 2013	1417	0.41	(0.38–0.44)
Dominguez, Stassen, de Grave, et al. 2018	202	0.33	(0.27–0.40)
Dyrbye, West, Satele et al. 2014	1701	0.60	(0.58–0.63)
Elmore, Jeffe, Jin, et al. 2016	665	0.69	(0.65–0.73)
Embriaco, Azoulay, Barrau, et al. 2007	372	0.43	(0.38–0.48)
Fahrenkopf, Sectish, & Barger. 2008	123	0.75	(0.67–0.83)
Galam, Komly, Le Tourneur, et al. 2013	4050	0.24	(0.23–0.25)
Garza, Schneider, Promecene, et al. 2004	136	0.18	(0.12–0.24)
Goitein, Shanafelt, Wipf ,et al. 2005	118	0.68	(0.60–0.76)
Golub, Weiss, Ramesh, et al. 2007	514	0.10	(0.07–0.13)
Gopal, Glasheen, Miyoshi, et al. 2005	121	0.61	(0.52–0.70)
Gopal. 2007	106	0.55	(0.46–0.64)
Gouveia, Ribeiro, & Aschoff. 2017	129	0.28	(0.20–0.36)
Govardhan, Pinelli, Schnatz, et al. 2012	49	0.13	(0.04–0.22)
Goveia, Cruz, de Miranda, et al. 2018	37	0.03	(–0.03–0.08)
Hameed, Masuadi, Al Asmary, et al. 2018	181	0.81	(0.75–0.86)
Hill & Smith. 2009	22	0.32	(0.12–0.51)
Holmes, Connolly, Putnam, et al. 2017	276	0.69	(0.64–0.74)
Huggard & Dixon. 2011	253	0.20	(0.15–0.24)
Jamjoom & Park. 2018	32	0.70	(0.54–0.86)
Joaquim, Custodio, & Savva–Bordalo. 2018	115	0.45	(0.36–0.54)
Jovanovic, Podlesek, & Volpe. 2016	1980	0.37	(0.35–0.39)
Kealy, Halli, Ogrodniczuk, et al. 2016	400	0.21	(0.17–0.25)
Krug, Golob, Wander, et al. 2017	112	0.61	(0.52–0.70)
Kwah, Weintraub, Fallar, et al. 2016	32	0.75	(0.60–0.90)
Lambden, Chamberlin, & Kozlov. 2018	72	0.54	(0.42–0.65)
Landrigan. 2008 (1)	144	0.75	(0.68–0.82)
Landrigan. 2008 (2)	124	0.57	(0.48–0.66)
Leach, Nygaard, & Chipman. 2018	43	0.30	(0.16–0.44)
Lebares, Guvva, & Ascher. 2018	566	0.69	(0.65–0.73)
Lee, Loh, Sng, et al. 2018	446	0.81	(0.77–0.84)
Leung & Rioseco, 2017	107	0.50	(0.40–0.59)

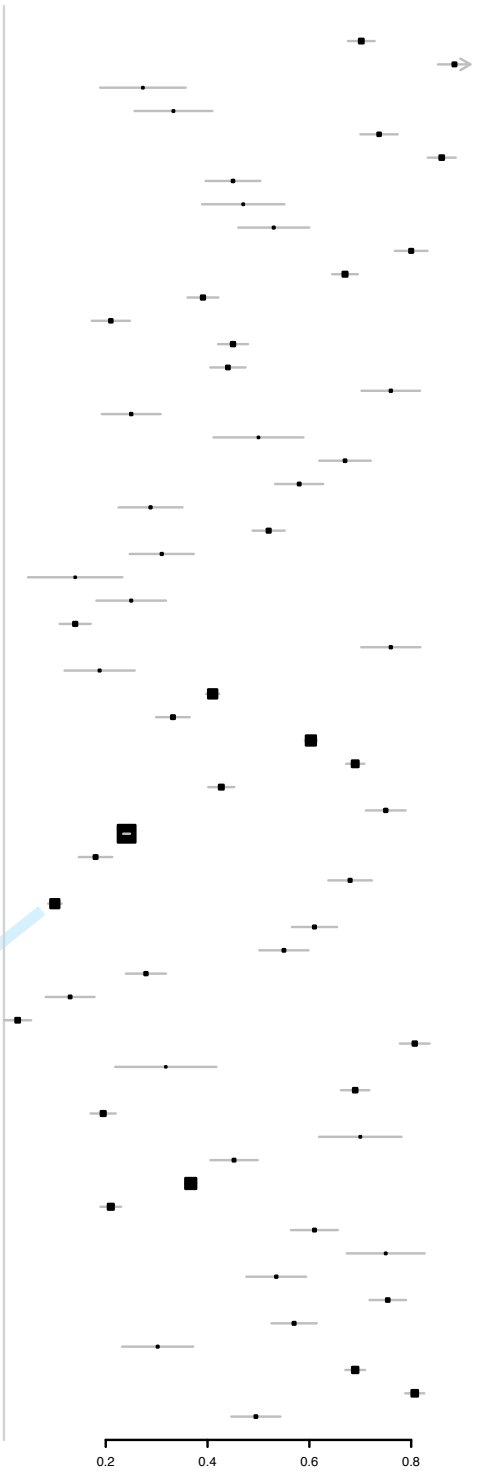
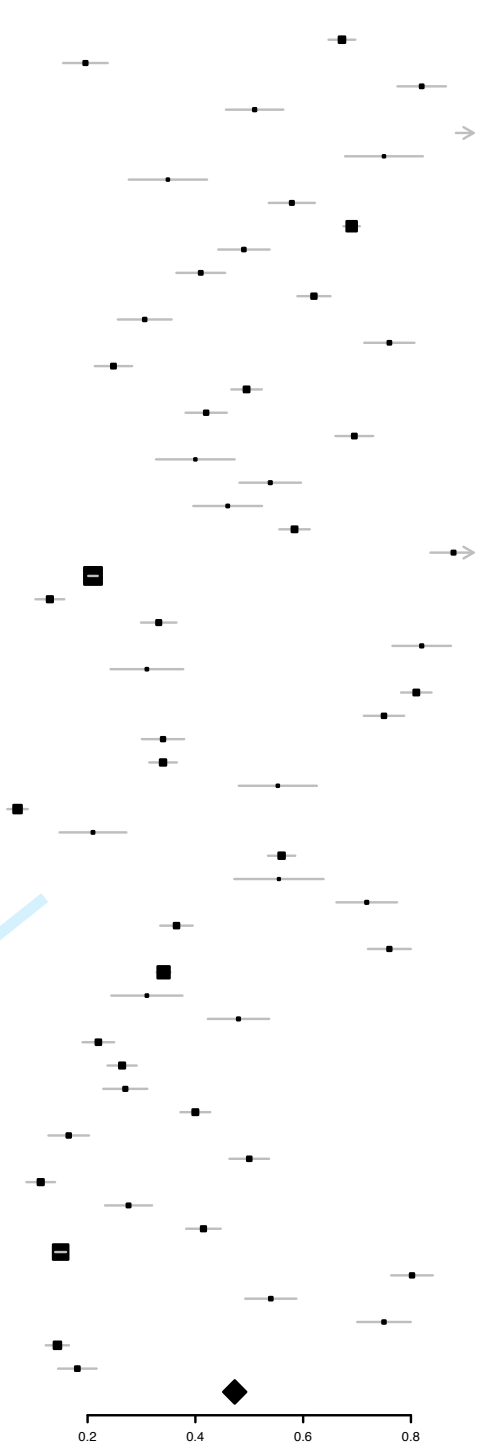


Figure 1: Forest plot of studies included in the meta-analysis

Part 2 of 2

Study	Sample size	Proportion	95% CI
Levin, Shanafelt, Keran, et al. 2017	354	0.67	(0.62–0.72)
Liera & Durante. 2014	92	0.20	(0.11–0.28)
Lin, Liebert, Tran ,et al. 2016	73	0.82	(0.73–0.91)
Lindeman, Petrusa, McKinley, et al. 2017	88	0.51	(0.41–0.61)
Lindeman, Sacks, Hirose, et al. 2013 (1)	30	0.93	(0.84–1.02)
Lindeman, Sacks, Hirose, et al. 2013 (2)	36	0.75	(0.61–0.89)
Low, Tan, & See. 2018	43	0.35	(0.21–0.49)
Malik, Bhatti, Shafiq, et al. 2016	133	0.58	(0.50–0.66)
Markwell & Wainer. 2009	914	0.69	(0.66–0.72)
Martini, Arfken, Churchill, et al. 2004	110	0.49	(0.40–0.58)
Martini. 2006	118	0.41	(0.32–0.50)
McNeeley, Perez, & Chew. 2013	249	0.62	(0.56–0.68)
Miyoshi, Matsuo, Takeda, et al. 2016	85	0.31	(0.21–0.40)
Mohammed, Ali, Youssef, et al. 2014	84	0.76	(0.67–0.85)
Mordant, Deneuve, Rivera, et al. 2014	155	0.25	(0.18–0.32)
Msaouel, Keramaris, Tasoulis, et al. 2010	311	0.50	(0.44–0.55)
Nolan, Writer, Ladhani, et al. 2017	166	0.42	(0.34–0.50)
O'Connor, Lydon, O'Dea, et al. 2017	172	0.70	(0.63–0.76)
Olson, Kemper, Mahan, et al. 2015	45	0.40	(0.26–0.54)
Olson, Odo, Duran, et al. 2014	76	0.54	(0.43–0.65)
Pantaleoni, Augustine, Sourkes, et al. 2014	61	0.46	(0.33–0.59)
Pereira–Lima & Loureiro. 2015	305	0.58	(0.53–0.64)
Porrino, Mulcahy, & Mulcahy. 2017	58	0.88	(0.80–0.96)
Prins, Hoekstra–Weebers, et al. 2010	2115	0.21	(0.19–0.23)
Prins, Hoekstra–Weebers, van de Wiel, et al. 2007	158	0.13	(0.08–0.18)
Ramey, Ahmed, Takita, et al. 2017	205	0.33	(0.27–0.40)
Raviola. 2002	50	0.82	(0.71–0.93)
Ringrose, Houterman, Koops, et al. 2009	47	0.31	(0.18–0.44)
Ripp, Babyatsky, Fallar, et al. 2011	191	0.81	(0.75–0.87)
Ripp, Bellini, Fallar, et al. 2015.	133	0.75	(0.68–0.82)
Ripp, Fallar, Babyatsky, et al. 2010	145	0.34	(0.26–0.42)
Robertson, Robinson, & Reid. 2017	340	0.34	(0.29–0.39)
Rosen, Gimotty, Shea, et al 2006	47	0.55	(0.41–0.70)
Ruitenburg 2012	181	0.07	(0.03–0.11)
Sajjadi, Norena, Wong, et al. 2017	43	0.21	(0.09–0.33)
Sargent, Sotile, Sotile, et al. 2009	384	0.56	(0.51–0.61)
Schweitzer. 1994	36	0.56	(0.39–0.72)
See, Lim, & Kua. 2016	64	0.72	(0.61–0.83)
Shakir, McPheeters, & Shallwani. 2017	255	0.36	(0.31–0.42)
Shanafelt, Bradley, Wipf, et al. 2002	115	0.76	(0.68–0.84)
Shanafelt, Raymond, & Horn. 2014	1345	0.34	(0.32–0.37)
Simpkin, Khan, West, et al. 2018	49	0.31	(0.18–0.44)
Siu, Yuen, Cheung, et al. 2012	77	0.48	(0.37–0.59)
Spataro, Tilstra, Rubio, et al. 2016.	198	0.22	(0.16–0.28)
Sulaiman, Henn, Smith, et al. 2017	265	0.26	(0.21–0.32)
Talih, Warakian, Ajaltouni, et al. 2016	118	0.27	(0.19–0.35)
Toral–Villanueva, Aguilar–Madrid, et al. 2009	312	0.40	(0.35–0.45)
Torppa, Kuikka, Nevalainen, et al. 2015	97	0.16	(0.09–0.24)
Trockel, Bohman, & Lesure. 2018	185	0.50	(0.43–0.57)
van der Wal, Bucx, Hendriks, et al. 2016	141	0.11	(0.06–0.17)
van Vendeloo, Brand, Verheyen, et al. 2014	105	0.28	(0.19–0.36)
van Vendeloo, Godderis, Brand ,et al. 2018	236	0.42	(0.35–0.48)
van Vendeloo, Prins, Verheyen, et al. 2018	1231	0.15	(0.13–0.17)
Waldman, Lopez Diez, Arazi, et al. 2009	106	0.80	(0.73–0.88)
Willcock, Daly, Tennant, et al. 2004	110	0.54	(0.45–0.63)
Williford, Scarlet, Meyers, et al. 2018	76	0.75	(0.65–0.85)
Zis, Anagnostopoulos, Sykioti, et al. 2014	263	0.14	(0.10–0.19)
Zis, Artemiadis, Lykouri, et al. 2015	116	0.18	(0.11–0.25)
Cumulative Prevalence		**0.47**	**(0.43–0.52)**



Supplementary Material

Supplementary Table 1: Sample Search Strategy

Supplementary Table 2: Characteristics of the 197 studies included in systematic review

Supplementary Figure 1: The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Flow Diagram

Appendix Table 1: Sample Search Strategy

Database	Search Terms	Yield
EMBASE	1 exp job stress/ 2 burnout/ 3 stress/ or acute stress/ or emotional stress/ or mental stress/ or role stress/ 4 emotional disorder/ 5 depersonalization/ 6 deperson*.ti,ab,kw. 7 ((emotional* or mental* or physical*) adj2 (fatigue* or exhaust* or drain* or distress*)).ti,ab,kw. 8 burnout.ti,ab,kw. 9 (stress* adj2 (psychological or emotional or mental or professional or job or work or occupational)).ti,ab,kw. 10 compassion fatigue.ti,ab,kw. 11 (cynicism or cynical).ti,ab,kw. 12 exhaustion/ or fatigue/ 13 or/1-12 14 residency education/ 15 (intern or interns or internship).ti,ab,kw. 16 (resident or residents or residency).ti,ab,kw. 17 housemanship*.ti,ab,kw. 18 house staff.ti,ab,kw. 19 housestaff.ti,ab,kw. 20 ((physician or doctor) adj2 training).ti,ab,kw. 21 (junio?r doctor* or foundation doctor* or house officer*).ti,ab,kw. 22 or/14-21 23 13 and 22 24 23 not (animals/ not (humans/ and animals/)) 25 remove duplicates from 24	5178

Appendix Table 2: Characteristics of the 197 studies included in systematic review

Author	Country	Region	No. of Residents	Age	Males No. (%)	Specialty	Year of Survey	Tool to Measure Burnout	Experiencing Burnout (%)	Definition of Burnout
Abdulrahman et al, 2018[1]	United Arab Emirates	ME & NA	302	NR	63 (21.0)	Multiple	2016	MBI	70.20%	High EE or DP
Afzal et al, 2010[2]	USA	North America	115	NR	67 (58.0)	Multiple	2008	MBI	NR	NR
Agha et al, 2015[3]	Saudi Arabia	ME & NA	96	NR	64 (67)	Multiple	NS	MBI	88.54%	High EE or DP or low PA
Akdeniz et al, 2011[4]	Turkey	Asia	174	Mean: 32.2, SD: 4.5	74 (42.4)	General Practice	2008	MBI	NR	NR
Aksoy et al, 2014[5]	Turkey	Asia	28	Mean: 25.9, SD: 2.0	10 (47)	Pediatrics	NS	MBI	27.27%	High EE or DP
Aksoy et al, 2014[5]	Turkey	Asia	38	Mean: 26.6, SD: 1.5	16 (47)	Internal Medicine	NS	MBI	33.33%	High EE or DP
Al Atassi et al, 2018[6]	USA	North America	238	NR	190 (80.0)	Oral and Maxillofacial Surgery	2017	MBI	NR	NR
Al-Dubai et al, 2013[7]	Malaysia	Asia	191	Mean: 26.5, SD: 1.6	85 (44.5)	Multiple	NS	MBI	NR	NR
Al-Ma'mari et al, 2016[8]	Canada	North America	143	NR	19 (13.0)	Obstetrics and Gynecology	NS	MBI	73.70%	High EE or DP or low PA
Aldrees et al, 2013[9]	Saudi Arabia	ME & NA	159	NR	NR	Multiple	2010	MBI	86.00%	High EE or DP or low PA
Aldrees et al, 2015[10]	Saudi Arabia	ME & NA	85	Mean: 29, SD: 2.3	57 (67)	Otolaryngology	2013	MBI	45.00%	High EE and DP

Aldrees et al, 2017[11]	Saudi Arabia	ME & NA	38	Mean: 28, SD 1.9	28 (74)	Plastic Surgery	2015	MBI	47.00%	High EE and DP
Anil et al, 2017[12]	Turkey	Asia	71	Mean: 27.8, SD: 1.7	24 (33)	Pediatrics	2010	MBI	NR	NR
Antiel et al, 2013[13]	USA	North America	156	NR	106 (68.0)	General surgery	2012	Modified MBI (2-Single Item Measures of EE and DP)	NR	NR
Arora et al, 2014[14]	Australia	Australia & New Zealand	51	NR	NR	Orthopedic Surgery	2012	MBI	53.00%	High EE or DP
Ashkar et al, 2010[15]	Lebanon	ME & NA	155	NR	86 (55.5)	Multiple	2008	MBI	80.00%	High EE or DP or low PA
Attenello et al, 2018[16]	USA	North America	346	NR	270 (78.0)	Neurosurgery	2015	MBI	67.00%	High EE or DP
Baer et al, 2017[17]	USA	North America	258	Mean: 29.4, SD: 2.3	54 (21.1)	Pediatrics	2013	Modified MBI (2-Single Item Measures of EE and DP)	39.10%	High EE or DP
Barrack et al, 2006[18]	USA	North America	34	Mean: 30.5, SD: 2.6	29 (85)	Orthopedic Surgery	2005	MBI	NR	NR
Becker et al, 2006[19]	USA	North America	118	Mean: 29.3, SD: 3	25 (20.8)	Obstetrics and Gynecology	2004	MBI	21.00%	High EE + DP
Beckman et al, 2010[20]	USA	North America	131	NR	82 (62.7)	Internal Medicine	2007	MBI	NR	NR
Beckman et al, 2011[21]	USA	North America	202	NR	116 (57.4)	Internal Medicine	2009	MBI	NR	High EE or DP

Belayachi et al, 2016[22]	Morocco	Africa	198	Mean: 29.3, SD: 3.2	82 (41.4)	Multiple	2010	MBI	NR	NR
Bellolio et al, 2014[23]	USA	North America	188	NR	34 (18.0)	Multiple	NS	Professional Quality of Life Scale Version 5	NR	>=42
Biaggi et al, 2003[24]	Switzerland	Europe	60	33.7 (total); residents (n=39), 31; chief residents (n=21): 38.6.	36 (60)	Multiple	2000	Seven point scale	41.70%	NR
Billings et al, 2011[25]	USA	North America	284	NR	131 (46.0)	Internal Medicine	2008 to 2010	MBI	45.00%	High EE or DP
Blanchard et al, 2010[26]	France	Europe	204	NR	82 (40.0)	Oncology	2009	MBI	44.00%	High EE or DP
Block et al, 2013[27]	USA	North America	55	Mean: 29, SD: 3	29 (53)	Internal Medicine	2011	Modified MBI (6 items)	76.00%	NS
Bogg et al, 2001[28]	England	Europe	56	NR	NR	Multiple	NS	MBI	25.00%	High EE, high DP and low PA
Bragard et al, 2010[29]	Belgium	Europe	102	NR	NR	Multiple	NS	MBI	NR	NR
Bragard et al, 2012[30]	Belgium	Europe	113	Mean: 28, SD: 2.9	28 (25.0)	Multiple	2002 to 2006	MBI	NR	NR
Brant et al, 2010[31]	England	Europe	36	Mean: 25, Range: 23-30	15 (42)	NR	2005 to 2007	MBI	NR	NR
Braun et al, 2017[32]	USA	North America	32	Mean: 28.59	25 (79)	Internal Medicine	2014	MBI	50.00%	High EE or DP

				, SD: 2.69						
Campbell et al, 2010[33]	USA	North America	86	NR	44 (51)	Internal Medicine	2003 to 2008	MBI	67.00%	High EE or DP
Castelo-Branco et al, 2007[34]	Spain	Europe	109	Mean: 27, SD: 2.3	15 (14.0)	Obstetrics and Gynecology	2004	MBI	58.00%	High EE or DP
Chaput et al, 2015[35]	France	Europe	52	Mean: 28.9, Range 25-34	26 (50)	Plastic surgery	2013	MBI	28.80%	High EE or DP
Chati et al, 2017[36]	France	Europe	251	Mean: 29.5, SD: 2.7	144 (57.5)	General Surgery	2013	MBI	52.00%	High EE or DP
Chaukos et al, 2017[37]	USA	North America	54	NR	21 (40)	Internal Medicine	NS	MBI	31.00%	High EE or DP
Chaukos et al, 2017[37]	USA	North America	14	NR	6 (40)	Psychiatry	NS	MBI	14.00%	High EE or DP
Chen et al, 2013[38]	Taiwan	Asia	278	NR	NR	Multiple	2012	MBI	NR	High EE or DP
Choi et al, 2017[39]	USA	North America	2011 (507), 2013 (520)	NR		Multiple	2011 & 2013	Single item measure	NR	NR
Cofer et al, 2018[40]	USA	North America	40	NR	27 (68)	General Surgery	2016	MBI	25.00%	2/3 of high EE, high DP or low PA
Coluccia, et al, 2017[41]	Italy	Europe	41	NR	17 (42)	Psychiatry	2016	MBI	NR	NR
Cooke et al, 2013[42]	Australia	Australia & New Zealand	128	NR	NR	General Practice	2010	Single item measure	14.00%	Selecting statements 3-5
Creed et al, 2014[43]	Australia	Australia & New Zealand	355	Mean: 28.06, Range: 21-58	111 (31.2)	NR	NR	Copenhagen Burnout Inventory	NR	NR
Cubero et al, 2016[44]	Brazil	South America	54	NR	29 (54)	Oncology	2010	MBI	76.00%	High EE or DP

Dahlin et al, 2010[45]	Sweden	Europe	186	Mean: 27.4, SD: 4	75 (40.3)	NR	2003 & 2006	Oldenburg Burnout Inventory	**NR**	NR
De Andrade et al, 2016[46]	Brazil	South America	32	NR	7 (22)	Pediatrics	2009	MBI	18.80%	High EE and DP
De Oliveira Jr et al, 2013[47]	USA	North America	1417	NR	808 (57.0)	Anesthesia	NR	Modified MBI (12 questions)	41.00%	Moderate or high in 2/3 of EE, DP or PA
Demirci et al, 2010[48]	Turkey	Asia	11	NR	NR	NR	2006	MBI	NR	High EE or DP
Dikmetas et al, 2011[49]	Turkey	Asia	270	Mean: 30, SD/Range: NR	178 (65.9)	Multiple	2009	MBI	NR	High EE or DP or low PA
Dominguez et al, 2018[50]	Colombia	South America	202	Mean: 28.63, SD: 2.96	129 (63.9)	NR	2015	MBI	33.20%	High EE and 1 of high DP or low PA)
Doolittle et al, 2013[51]	USA	North America	108	Mean: 30, SD: 4.8	54 (50.0)	Multiple	2010	MBI	NR	NR
Durning et al, 2013[52]	USA	North America	17	Mean: 29.6, SD: 2	10 (59)	Internal Medicine	NR	Modified MBI (2-Single Item Measures of EE and DP)	NR	NR
Dyrbye et al, 2014[53]	USA	North America	1701	NR	827 (48.6)	Multiple	2012	MBI	60.30%	High EE or DP
Elmore et al, 2016[54]	USA	North America	665	Mean: 30.3, SD: 3.3	375 (56.4)	General Surgery	2014	MBI	69.00%	High EE or DP or low PA
Embriaco et al, 2007[55]	France	Europe	372	NR	NR	NR	2004	MBI	42.70%	Total score between -8 to +34
Fahrenkopf et al, 2008[56]	USA	North America	123	NR	37 (30.0)	NR	2003	MBI	75.00%	High EE and DP

Ferreira et al, 2012[57]	Brazil	South America	12	NR	NR	NR	2011	Burnout Syndrome Inventory	NR	NR
Fulop et al, 2011[58]	Hungary	Europe	67	Mean: 31.45. SD: 5.79	16 (24)	NR	2011	MBI	NR	NR
Galam et al, 2013[59]	France	Europe	4050	Mean: 26.4, SD: NR	1268 (31.3)	General Practice	2011	MBI	24.10%	2/3 of high EE, high DP or low PA
Garza et al, 2004[60]	USA	North America	136	NR	39 (29.0)	Obstetrics and Gynecology	NR	MBI	18.00%	High EE, DP and low PA
Geelan-Hansen et al, 2018[61]	USA	North America	14	NR	NR	NR	NR	MBI	NR	NR
Gelfand et al, 2004[62]	USA	North America	26	NR	NR	Gen surg (and some off service PGY1 surgical residents)	2003	MBI	NR	High EE, high DP and low PA
Goitein et al, 2005[63]	USA	North America	118	NR	55 (47.0)	Internal Medicine	2004	MBI	68.00%	High EE or DP
Golub et al, 2007[64]	USA	North America	514	Mean: 31, Range: 24-45	406 (79.0)	Otolaryngology	2005	MBI	10.00%	High EE, high DP and low PA
Gopal et al, 2005[65]	USA	North America	121	NR	58 (48.0)	Internal Medicine	2003	MBI	61.00%	High EE or DP
Gopal et al, 2007[66]	USA	North America	106	NR	45 (42.5)	Internal medicine	2004	MBI	55.00%	High EE or DP
Gouveia et al, 2017[67]	Brazil	South America	129	NR	62 (48.1)	Multiple	2015	MBI	27.90%	High EE, high DP and low PA
Govardhan et al, 2012[68]	USA	North America	49	Mean: 30.1, SD: 3	4 (9)	Obstetrics and Gynecology	2009	MBI	13.00%	High EE, high DP and low PA

Goveia et al, 2018[69]	Brazil	South America	37	Mean: 30, SD: 2.9	NR	Anesthesia	2014 to 2015	MBI	2.70%	High EE, high DP and low PA
Guenette et al, 2017[70]	USA	North America	94	NR	59 (63)	Radiology	2016	MBI	NR	High EE, high DP and low PA
Guenette et al, 2018[71]	USA	North America	314	Mean: 31.1, SD: 2.8	217 (69.0)	Radiology	2017	MBI	NR	Low PA
Gulen et al, 2016[72]	Turkey	Asia	48	Mean: 30.5, SD: 3.2	26 (55)	Emergency Medicine	2015	MBI	NR	NR
Guthrie et al, 1999[73]	England	Europe	64	NR	31 (48)	Psychiatry	NR	MBI	NR	High EE, high DP and low PA
Halliday et al, 2017[74]	United Kingdom	Europe	292	HST 33, JST 28	128 (43.8)	NR	NR	Oldenburg Burnout Inventory	NR	NR
Hameed et al, 2018[75]	Saudi Arabia	ME & NA	181	Mean: 27.6, SD/Range: NR	75 (41.4)	Multiple	2013 to 2014	MBI	80.70%	High EE or DP
Hannan et al, 2018[76]	Ireland	Europe	101	Mean: 28, Range: 23-43	45 (44.4)	NR	2012 to 2014	MBI	NR	NR
Hausler et al, 2017[77]	Austria	Europe	136	Mean: 32, SD: 4.8	47 (34.6)	Multiple	2015 to 2016	Modified MBI (21 items)	NR	NR
Henning et al, 2014[78]	New Zealand	Australia & New Zealand	17	NR	6 (35)	NR	NR	Copenhagen Burnout Inventory	NR	NR
Hill et al, 2009[79]	USA	North America	22	NR	NR	Otolaryngology	2006	MBI	31.82%	High EE and DP
Hillhouse et al, 2000[80]	USA	North America	46	Mean: 30.6,	31 (67)	Multiple	nr	Staff Burnout Scale	NR	NR

				SD: 4.7				for Health Professionals		
Holmes et al, 2017[81]	USA	North America	276	NR	97 (35.0)	Multiple	2014	MBI	69.00%	High EE or DP
Huggard et al, 2011[82]	New Zealand	Australia & New Zealand	253	Mean: 31.1, SD: 5.9	104 (41.1)	Multiple	NR	Professional Quality of Life Index Version 3	19.50%	NR
Hutter et al, 2006[83]	USA	North America	58	NR	NR	Multiple	2013 & 2014	MBI	NR	NR
Hwang et al, 2018[84]	USA	North America	45	NR	39 (87)	Orthopedic Surgery	2,011	MBI	NR	High EE and DP and low PA
Hyman et al, 2011[85]	USA	North America	34	NR	20 (59)	Multiple	2007	Modified MBI NS	NR	High EE, high DP and low PA
Jamjoom et al, 2018[86]	Saudi Arabia	ME & NA	32	NR	2 (6)	Pediatrics	2016	MBI	70.00%	NR
Jin et al, 2015[87]	China	Asia	135	NR	66 (48.9)	NR	2008	MBI-GS	NR	NR
Joaquim et al, 2018[88]	Portugal	Europe	115	Mean: 28.4, SD: 2.2	30 (26.3)	Oncology	2011	MBI	45.20%	NR
Jovanovic et al, 2016[89]	Europe	Europe	1980	Mean: 31.9, SD: 5.3	804 (40.6)	Psychiatry	2008 to 2012	MBI-GS	36.70%	High MBI-EX and MBI-CY
Kang et al, 2013[90]	South Korea	Asia	86	NR	64 (74)	NR	2010	MBI	NR	NR
Karaoglu et al, 2015[91]	Turkey	Asia	74	Mean: 27.6, SD: 2.25	28 (41)	Multiple	2011	Modified MBI (21 items)	NR	NR
Kash et al, 2000[92]	USA	North America	76	NR	53 (70)	Oncology	NS	MBI	NR	NR
Kassam et al, 2015[93]	Canada	North America	301	Mean: 30.9, SD: 4.3	119 (39.4)	NR	2012	Copenhagen Burnout		NR

								Inventory		
Kealy et al, 2016[94]	Canada	North America	400	NR	123 (30.8)	Psychiatry	2014	Single item measure	21.00%	Self-report
Kolarik et al, 2018[95]	USA	North America	161	Mean: 29.6, SD: 2.9	83 (51.6)	Multiple	2017	Modified MBI (2-Single Item Measures of EE and DP)	NR	NR
Komur et al, 2017[96]	Turkey	Asia	54	NR	NR	Pathology	NS	MBI	NR	NR
Krug et al, 2017[97]	USA	North America	112	NR	47 (42)	Internal Medicine	2012	MBI	61.00%	High EE or DP
Kwah et al, 2016[98]	USA	North America	32	NR	NR	Internal Medicine	2012	MBI	75.00%	High EE or DP
Lambden et al, 2018[99]	USA	North America	72	NR	NR	Multiple	2017	Single item measure	53.50%	>=3 on single-item question
Landrigan et al, 2008[100]	USA	North America	213	30.2	62 (29.3)	Pediatrics	2003 & 2004	MBI	75.40%	High EE or DP
Landrigan et al, 2008[100]	USA	North America	213	29.1	68 (31.7)	Pediatrics	2003 & 2004	MBI	57.00%	High EE or DP
Leach et al, 2018[101]	USA	North America	43	NR	27 (63)	General Surgery	2017	Single item measure	30.20%	>=3
Lebares et al, 2018[102]	USA	North America	566	NR	277 (49.0)	General Surgery	2016	Modified MBI (9 items)	68.95%	High EE or DP or low PA
Lebensohn et al, 2013[103]	USA	North America	168	Median: 29.0, IQR: NR	67 (40.1)	Family Medicine	2012 to 2013	MBI	NR	NR
Lee et al, 2018[104]	Singapore	Asia	446	Mean: 29.4, SD: 2.6	208 (46.6)	Multiple	2015	MBI	80.70%	High EE, DP or low PA
Lemkau, 1987[105]	USA	North America	67	Mean: 29.1,	53 (79)	General Practice	1984	MBI	NR	NR

				SD: 3.8						
Leung et al, 2017[106]	Australia, New Zealand	Australia & New Zealand	107	Median: 31.4, IQR: NR	54 (50.0)	Oncology	2015	MBI	49.50%	High EE or DP
Levin et al, 2017[107]	USA	North America	354	Mean: 33, SD: 4	182 (51.4)	Neurology	2016	MBI	67.20%	High EE or DP
Lin et al, 2016[108]	USA	North America	73	Mean: 30.8, SD: 3.22	42 (58)	General Surgery	2013 to 2014	MBI	82.00%	High EE or DP
Lindeman et al, 2013[109]	USA	North America	30	Mean: 30, Range: 25-36	21 (70)	General Surgery	2011	MBI	93.00%	>=13
Lindeman et al, 2013[109]	USA	North America	36	Mean: 30, Range: 25-36	24 (67)	General Surgery	2012	MBI	75.00%	>=13
Lindeman et al, 2017[110]	USA	North America	88	NR	46 (52)	General Surgery	2016	MBI	51.00%	High EE
Llera et al, 2014[111]	Argentina	South America	92	NR	28 (30)	Multiple	2011	MBI	19.60%	High EE and DP and low PA
Low et al, 2018[112]	Singapore	Asia	43	Median: 25, Range: 25-27	18 (43)	Multiple	2015	Professional Quality of Life Scale	34.88%	>=57
Lue et al, 2010[113]	Taiwan	Asia	555	Mean: 29.35, SD: 2.58	376 (67.7)	Multiple	2007	Copenhagen Burnout Inventory		NR
Malik et al, 2016[114]	Pakistan	Asia	133	NR	98 (73.7)	Multiple	NS	MBI	57.90%	High in 2 of EE, DP or PA
Markwell et al, 2009[115]	Australia, New Zealand	Australia & New Zealand	914	NR	402 (44.0)	Multiple	2008	Professional Quality of Life Scale	69.00%	NR
Martini et al, 2004[116]	USA	North America	110	NR	NR	Multiple	2003	MBI	49.00%	NR

Martini et al, 2006[117]	USA	North America	118	NR	NR	Multiple	2004	MBI	41.00%	NR
McNeeley et al, 2013[118]	USA	North America	249	Mean: 31, Range: 25-46	182 (73.0)	Radiology	2012	Modified MBI (2 Single Item Measures, & PA (5 items))	62.00%	High EE or DP
Michels et al, 2003[119]	USA	North America	350	Mean: 30.4, SD: 5.2	238 (68.0)	General Practice	1993	MBI	NR	NR
Miyoshi et al, 2016[120]	Japan	Asia	85	Mean: 26.24, SD: 3.81	47 (55)	NR	2013	MBI-GS	30.59%	High EE and 1 of high DP or low PA
Mohammed et al, 2014[121]	Egypt	ME & NA	84	NR	46 (55)	Multiple	2012	MBI	76.00%	2/3 of high EE, high DP or low PA
Moloney et al, 2000[122]	New Zealand	Australia & New Zealand	99	NR	52 (52)	Psychiatry	1997	MBI	NR	NR
Mordant et al, 2014[123]	Europe	Europe	155	Mean: 34.6, SD: 8.2	103 (66.5)	Multiple	2010	Modified MBI (2-Single Item Measures of EE and DP)	24.80%	"Once a week or less" response to at least one question
Msaouel et al, 2010[124]	Greece	Europe	311	Median: 32, Range: 26-45	172 (55.3)	Multiple	NR	MBI	49.50%	High EE and 1 of high DP or low PA)
Myszkowski et al, 2017[125]	France	Europe	259	Mean: 25.6, SD/Range: NR	60 (23.2)	Internal Medicine	NR	MBI	NR	NR
Nolan et al, 2017[126]	Canada	North America	166	Median: 27.5,	43 (26.0)	Pediatrics	2014	MBI	42.00%	High EE or DP

				IQR: 4.0						
O'Connor et al, 2017[127]	Ireland	Europe	172	NR	75 (43.6)	Multiple	2015	MBI	69.50%	High EE or DP
Ogundipe et al, 2014[128]	Nigeria	Africa	204	Mean: 33.44, SD: 4.5	119 (58.3)	Multiple		MBI	NR	High EE and DP and low PA
Okpozo et al, 2017[129]	USA	North America	203	NR	105 (51.7)	Multiple	NR	MBI	NR	NR
Olson et al, 2014[130]	USA	North America	76	Mean: 29.2, SD: 2.9	40 (53)	Internal Medicine	2012	MBI	53.90%	High EE or DP
Olson et al, 2015[131]	USA	North America	45	Mean: 28.4, SD: 1.7	16 (36)	Pediatrics	2014	MBI	40.00%	High EE or DP or low PA
Panagopoulou et al, 2006[132]	Greece	Europe	141	Mean: 32, SD: 5	78 (55.0)	Internal medicine	2004	MBI	NR	High EE and DP
Pantaleoni et al, 2014[133]	USA	North America	61	NR	NR	Pediatrics	2011	MBI	46.00%	High EE or DP
Park et al, 2016[134]	Korea	Asia	317	Mean: 30.44, SD: 2.98	214 (67.5)	Multiple	2013	MBI	NR	NR
Parr et al, 2016[135]	Australia	Australia & New Zealand	153	NR	68 (44.4)	Multiple	NR	Copenhagen Burnout Inventory	NR	>= 50
Pereira-Lima et al, 2015[136]	Brazil	South America	305	Mean: 28, SD: 2.53	159 (52.1)	Multiple	NR	Burnout Syndrome Inventory	58.36%	EE+ED or DH
Porrino et al, 2017[137]	USA	North America	58	NR	48 (83)	Radiology	2016	Modified MBI (2 Single Item Measures, & PA (5 items))	87.90%	High EE or DP or low PA

Prins et al, 2007[138]	The Netherlands	Europe	158	Mean: 31.9, SD: 3.2	76 (48.0)	Multiple	2003	Modified MBI (20 items)	13.00%	Moderate: >19.92 EE + >7.95 (women) or >8.95 (men) on DP. OR >19.92EE and >25.97 PA
Prins et al, 2010[139]	The Netherlands	Europe	2115	Mean: 31.5, SD: 3.5	820 (38.8)	Multiple	2005	Modified MBI (20 items)	21.00%	Moderate: >=19.92 EE + >7.95 (women) or >8.95 (men) on DP. OR >=19.92EE and <=25.97 PA
Purdy et al, 1987[140]	USA	North America	67	Mean: 29.1, SD: 3.8	53 (79)	General Practice	1984	MBI	NR	NR
Racic et al, 2018[141]	Bosnia and Herzegovina	Europe	26	NR	NR	General Practice	2014	Professional Quality of Life Index Version 5	NR	low <=22, moderate 23-41, high>=42
Ramey et al, 2017[142]	USA	North America	205	NR	141 (68.8)	Oncology	2016	MBI	33.20%	High EE or DP
Ratnakaran et al, 2016[143]	India	Asia	558	NR	326 (58.4)	Multiple	NR	Copenhagen Burnout Inventory	NR; burnout in 3 diff categories reported	50/100 score cutoff for high/low
Raviola et al, 2002[144]	Kenya	Africa	50	Mean: 33, SD/Range: NR	NR	Multiple	NS	Single item measure	82.00%	Self-report
Ringrose et al, 2009[145]	Netherlands	Europe	47	Mean: 30.3, SD: 3.3	23 (49)	Multiple	2007	Modified MBI (15 items)	31.00%	High EE and 1 of high DP or low PA)

Ripp et al, 2010[146]	USA	North America	145	NR	73 (50.3)	Internal Medicine	2007	MBI	34.00%	High EE or DP
Ripp et al, 2011[147]	USA	North America	191	Mean: 28, SD/Range: NR	126 (66.0)	Internal Medicine	2009	MBI	81.00%	High EE or DP
Ripp et al, 2015[148]	USA	North America	133	NR	77 (58.0)	Internal Medicine	2012	MBI	75.00%	High EE or DP
Robertson et al, 2017[149]	USA	North America	340	NR	143 (42.0)	Multiple	2015	Single item measure	34.00%	burnout was considered positive if respondent selected choice 3,4, or 5
Rogers et al, 2014[150]	Australia	Australia & New Zealand	349	Mean: 28, SD: 4.4	108 (31.0)	NR	2011	Copenhagen Burnout Inventory	NR	NR
Rogers et al, 2016[151]	Canada	North America	198	NR	55 (27.8)	Multiple	2014	Copenhagen Burnout Inventory	NR	NR
Rosen et al, 2006[152]	USA	North America	47	NR	23 (49)	Internal Medicine	2003	MBI	55.30%	High EE and DP
Rui et al, 2016[153]	China	Asia	149	NR	NR	Anesthesia	NS	MBI	NR	High EE, high DP and low PA
Ruitenburg et al, 2012[154]	Netherlands	Europe	181	Mean: 33, SD: 3.2	76 (42.0)	Multiple	2009	Modified MBI (13 items)	7.00%	High EE and DP
Sajjadi et al, 2017[155]	Canada	North America	43	Mean: 30, SD: 3	19 (45)	IM	2014	MBI	21.00%	High EE and DP and low PA
Salles et al, 2014[156]	USA	North America	141	Mean: 31.25, SD/Range: NR	89 (63.0)	Multiple	NR	MBI	NR	NR

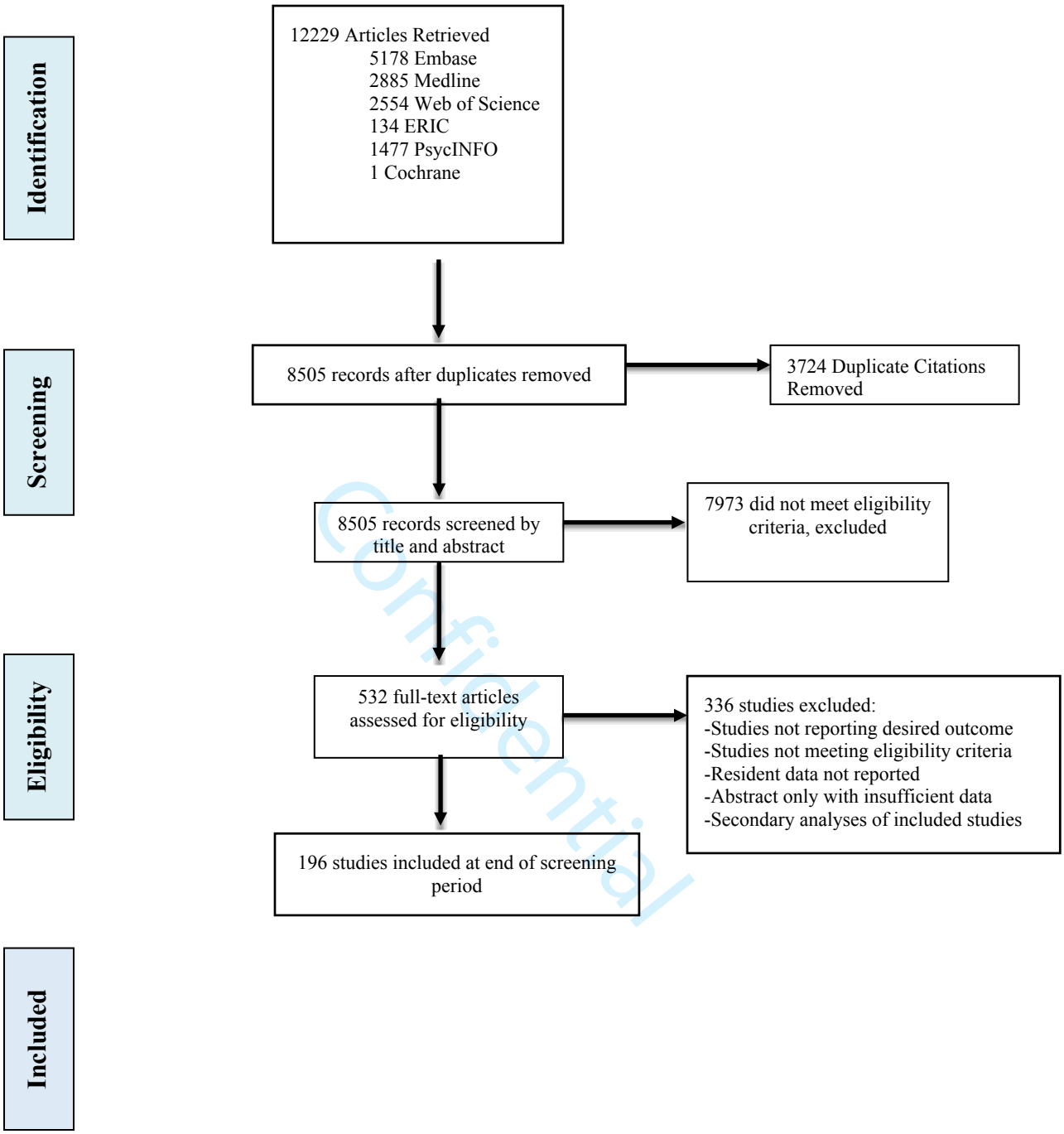
Salpigktidis et al, 2016[157]	Greece, UK, Germany	Europe	131	Mean: 30, SD: 3	66 (50.0)	Multiple	2016	MBI	NR	NR
Sargent et al, 2004[158]	USA	North America	21	Mean: 30, Range: 28-34	20 (97)	Orthopedic Surgery	NR	MBI	NR	NR
Sargent et al, 2009[159]	USA	North America	384	NR	338 (88.0)	Orthopedic Surgery	NR	MBI	56.00%	NR
Satterfield et al, 2009[160]	USA	North America	28	NR	9 (32)	Internal Medicine		Tedium index	NR	NR
Schweitzer, 1994[161]	South Africa	Africa	36	NR	NR	NR	NR	Single item measure	55.50%	Yes
See et al, 2016[162]	Singapore	Asia	64	NR	NR	Internal Medicine	2013	Copenhagen Burnout Inventory	71.80%	Score of 50/100 on any subscale
Selic et al, 2012[163]	Slovenia	Europe	117	Mean: 34.2, SD: 4.6	21 (17.9)	General Practice	2009	MBI	NR	NR
Shakir et al, 2017[164]	USA	North America	255	NR	205 (80.4)	Neurosurgery	2016	Modified MBI (9 items)	36.50%	High EE or DP
Shams and El-Masry, 2013[165]	Egypt	ME & NA	30	NR	NR	Anesthesia	2011	MBI	NR	High EE, DP and low PA
Shanafelt et al, 2002[166]	USA	North America	115	NR	54 (47.0)	Internal Medicine	2001	MBI	76.00%	High EE or DP
Shanafelt et al, 2014[167]	USA	North America	1345	Median: 33, IQR: NR	710 (52.8)	Oncology	2014	Modified MBI (2-Single Item Measures of EE and DP)	34.10%	High EE or DP
Shapiro et al, 2017[168]	USA	North America	217	NR	178 (82.0)	Oral and Maxillofacial Surgery	NS	MBI	NR	NR

Shoimer et al, 2018[169]	Canada	North America	96	NR	NR	Dermatology	2014	MBI	NR	NR
Simpkin et al, 2018[170]	US and Canada	North America	49	NR	15 (30)	Pediatrics	2015	Modified MBI (2-Single Item Measures of EE and DP)	31.00%	High EE or DP
Siu et al, 2012[171]	Hong Kong	Asia	77	NR	NR	NR	2009	MBI	48.00%	High EE and DP and low PA
Sochos et al, 2012[172]	England	Europe	184	Mean: 30.6, SD: 4.4	73 (40.0)	Multiple	NS	MBI	NR	NR
Spataro et al, 2016[173]	USA	North America	198	Mean: 29.9, Range: 25.9-41.5	101 (51.0)	Internal Medicine	2014	MBI	22.00%	High EE or DP
Stodel et al, 2011[174]	South Africa	Africa	22	Mean: 30, SD: 3.26	6 (25)	NR	2009	MBI	NR	NR
Sulaiman et al, 2017[175]	Ireland	Europe	265	Mean: 28.5, SD: 0.26	140 (52.8)	Multiple	NS	MBI	26.40%	2/3 of high EE, high DP or low PA
Swami et al, 2013[176]	India	Asia	56	Mean: 27.8, SD: 2.37	NR	Multiple	NR	Shirom-Milam Burnout Measure	NR	NR
Talih et al, 2016[177]	Lebanon	ME & NA	118	NR	62 (53.0)	Multiple	2013	Burnout Measure (modified)	27.00%	>=3.5
Toral-Villanueva et al, 2009[178]	Mexico	North America	312	Mean: 28, SD: 2.5	178 (57.0)	Multiple	2003	MBI	40.00%	High EE or DP

Torppa et al, 2015[179]	Finland	Europe	97	NR	NR	General Practice	2011	Modified MBI (1 item)	16.50%	High EE
Trockel et al, 2018[180]	USA	North America	185	NR	NR	Multiple	NS	Modified MBI (2-Single Item Measures of EE and DP)	50.00%	NR
Turgut et al, 2016[181]	Turkey	Asia	127	Mean: 28.01, 2.41	56 (44.1)	NR	NS	MBI	NR	NR
Tzischinsky et al, 2001[182]	Israel	ME & NA	78	M/F 30.7/ 30.3	53 (68)	NR	NR	MBI	NR	NR
van der Wal et al, 2016[183]	Netherlands	Europe	141	Mean: 31, Range: 26-48	53 (37.6)	Anesthesia	2012	Modified MBI (20 items)	11.30%	High EE and 1 of high DP or low PA
van Vendeloo et al, 2014[184]	Netherlands	Europe	105	NR	83 (79.0)	Orthopedic Surgery	2011	Modified MBI (2-Single Item Measures of EE and DP)	27.60%	High EE or DP
van Vendeloo et al, 2018[185]	Belgium	Europe	236	Median: 28, Range: 26-40	96 (40.7)	Multiple	2016	Modified MBI (20 items)	41.50%	Mean EE >=2.5 AND DP >=1.8 (men) or >=1.6 (women) OR ….EE >=2.5 and <=3.7 on PA
van Vendeloo et al, 2018[186]	Netherlands	Europe	1231	Median: 32, Range: 26-40	325 (26.4)	Multiple	2015	Modified MBI (20 items)	15.00%	Mean EE >=2.5 AND DP >=1.8 (men) or >=1.6 (women) OR ….EE >=2.5 and

										<=3.7 on PA
Waheed et al, 2017[187]	Pakistan	Asia	102	Mean: 27.45, SD: 1.69	NR	Obstetrics and Gynecology	2016	MBI	NR	High EE or DP
Waldman et al, 2009[188]	Argentina	Europe	106	Mean: 29.1, SD: 2.4	73 (68.7)	Cardiology	2007	MBI	80.20%	High EE or DP
Weigl et al, 2015[189]	Germany	Europe	39	NR	NR	Pediatrics	NS	MBI	NR	NR
West et al, 2009[190]	USA	North America	239	NR	148 (62.1)	Internal Medicine	2003 to 2009	MBI	NR	NR
Willcock et al, 2004[191]	Australia	Australia & New Zealand	110	Mean: 28.3, SD: 3.8	62 (56.0)	Psychiatry	2001	MBI	54.00%	High EE or DP
Williford et al, 2018[192]	USA	North America	76	NR	NR	General Surgery	2017	MBI	75.00%	High EE or DP
Woodside Jr et al, 2008[193]	USA	North America	155	Mean: 35, SD: 7.5	88 (57.0)	Multiple	2002 to 2005	MBI	NR	NR
Yrondi et al, 2017[194]	France	Europe	271	Mean: 28.2	104 (38.4)	Multiple	NS	MBI	NR	NR
Zis et al, 2014[195]	Greece	Europe	263	Mean: 33.5, SD: 3.3	141 (53.6)	Multiple	2012	MBI	14.40%	High EE and 1 of high DP or low PA
Zis et al, 2015[196]	Greece	Europe	116	Mean: 34.5, SD: 3.6	52 (44.8)	Neurology	2014	MBI	18.10%	High EE and 1 of high DP or low PA
Zubairi and Noordin, 2016[197]	Pakistan	Asia	82	NR	44 (54)	Multiple	2013	MBI	NR	NR

Appendix Figure 1: The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Flow Diagram



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PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	3
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	3
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	3
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	3, Appendix Table 1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	4
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	4
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	4
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	4-5
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	4-5

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	4
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	4-5
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	5, Appendix Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Table 1, Appendix table 2
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	6
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	Figure 1, Table 1& 2, Appendix table 2
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	Page 6-7, Table 3, Figure 4
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	7
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	6-7
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	7-8
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	8
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	9
FUNDING			

PRISMA 2009 Checklist

Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	9

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

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