School of Psychology
Ysgol Seicoleg

Mental Health of Doctors During the COVID-19 Pandemic

Thesis submitted in partial fulfilment of the requirement for

the degree of:

Doctorate of Clinical Psychology (DClinPsy)

South Wales Doctoral Programme in Clinical Psychology

Cardiff University

Gemma Johns

Supervised by:

Dr Louise Waddington **Dr Victoria Samuel**

11/06/2021

Contents

List of Figures and Tables

Paper 1: The Global Prevalence of Depression and Anxiety Among Doctors During the COVID-19 Pandemic: Systematic Review and Meta-Analysis

Paper 2: Prevalence and Predictors of Mental Health Outcomes in UK Doctors and Final Year Medical Students During the COVID-19 Pandemic

Abbreviations

ACT	Acceptance and Commitment Therapy
aMBI	Abbreviated Maslach Burnout Inventory
BMA	British Medical Association
CBT	Cognitive Behavioural Therapy
CD-RISC-10	Connor Davidson Resilience Scale – 10 Item
CompACT-SF	Comprehensive assessment of acceptance and commitment therapy processes – short form
DASS-21	Depression Anxiety Stress Scale – 21 Item
DP	Depersonalisation
DSM-5	Diagnostic and Statistical Manual – Fifth Edition
EE	Emotional Exhaustion
F1/ F2	Foundation Year 1/ 2
GAD7/ GAD-2	Generalised Anxiety Disorder Scale – 7 Item/ 2 Item
GDP	Gross Domestic Profit
GMC	General Medical Council
GRADE	Grading of Recommendations Assessment, Development and Evaluation
HADS	Hospital Anxiety and Depression Scale
IoU	Intolerance of Uncertainty
IUS-12	Intolerance of Uncertainty Scale – 12 Item
JBI	Joanna Briggs Checklist for Prevalence Studies
JD-R	Job Demands and Resources Model
LPA	Low Personal Achievement
MSC	Medical Schools Council
NHS	National Health Service
PCL-5	PTSD Checklist for DSM-5
PHQ-9 / PHQ-2	Patient Health Questionnaire – 9 Item / 2 Item
PTSD	Post-Traumatic Stress Disorder
WHO	World Health Organisation

Acknowledgments

Firstly, I'd like to express my gratitude to all of the current and future doctors who made the time to participate in this research.

I'd also like to thank my research supervisors, Dr Louise Waddington and Dr Victoria Samuel, for their continued support and guidance throughout the project.

Thank you to Lucy Freemantle and Jess Lewis, the wonderful Assistant Psychologists who offered their time for free to work as second reviewers for the systematic review.

Thanks to my elective placement supervisor, Dr Jimmy Jones, for being so understanding about the workload, and allowing me the flexibility to balance my research and clinical work.

Thank you to Jude and Laila for the numerous cups of tea, and for unquestioningly accepting my subpar parenting these past few months. And finally, thanks to the rest of my family and friends, and to the lovely 2018 cohort, for their patience, understanding and support throughout.

Preface

The mental health of doctors is an ongoing global concern. In response to the COVID-19 pandemic, the assessment of mental health problems in healthcare staff was outlined as a research priority. In addition, calls were made to develop research to understand the underlying mechanisms of distress, in order to inform intervention.

Paper 1 is a systematic review and meta-analysis of the global prevalence of depression and anxiety symptoms among doctors during the first year of the pandemic. Of the 55 studies selected through systematic review, 26 studies of depression and 30 studies of anxiety were assessed as medium or low risk of bias; these studies were included in the final meta-analyses. Findings indicate that doctors continue to be a population at high risk of depression and anxiety, though not conclusively higher than pre-pandemic levels. Differences in study design and variation in job demands and resources may account for some of the observed heterogeneity. However, findings must be interpretated with caution due to the low overall quality of the body of evidence. Implications and recommendations are discussed.

Paper 2 presents the findings from a cross-sectional online study of UK doctors and final year medical students conducted during the pandemic. Prevalence rates for symptoms of depression, anxiety, PTSD and burnout are reported. Regression analysis was also conducted to explore how much of the variance in outcomes could be explained by psychological variables. Psychological flexibility, intolerance of uncertainty and resilience all explained significant variance, but psychological flexibility was the most consistent predictor for all outcomes. Research and clinical implications are discussed.

The Global Prevalence of Depression and Anxiety Among Doctors During the COVID-19 Pandemic: Systematic Review and Meta-Analysis

Gemma Johns

Supervised by Dr Louise Waddington and Dr Victoria Samuel

School of Psychology, Cardiff University, Cardiff, UK

Journal: Brain, Behavior and Immunity

Word count: 6,625

The Global Prevalence of Depression and Anxiety Among Doctors During the COVID-19 Pandemic: Systematic Review and Meta-Analysis

Abstract

Background: The aim of this review is to provide an estimate of the global prevalence of depression and anxiety among doctors based on analysis of evidence from the first year of the COVID-19 pandemic.

Methods: A systematic review of four literature databases and one pre-print server was conducted to identify suitable studies. Final searches were conducted on 3rd March 2021.Identified papers were screened initially by title and abstract, based on pre-agreed inclusion criteria, followed by full-text review of all eligible papers. A second reviewer independently screened all papers to ensure reliability. Risk of bias was assessed using the Joanna Briggs Checklist for Prevalence Studies. A second reviewer conducted an independent assessment of all papers and ratings were reviewed to reach a consensus. Data from included studies rated as low or medium risk of bias were pooled using a random-effects meta-analysis to estimate the global prevalence of depression and anxiety among doctors.

Results: Fifty-five studies were included after full-text review. All studies were cross-sectional designs, the majority employed non-probability convenience sampling and were conducted online. Studies deemed low or medium risk of bias were included in primary analyses. These comprised twenty-six studies of depression, with a combined total of 31,447 participants, and thirty studies of anxiety, with a combined total of 33,281 participants. Pooled prevalence of depression and anxiety was 20.5% (95% CI 16.0%-25.3%) and 25.8% (95% CI 20.4%-31.5%) respectively. Sensitivity and subgroup analyses were conducted to explore the high heterogeneity. For depression, significant between-group heterogeneity was observed when studies were separated by GDP per capita. For anxiety, significant between-group heterogeneity was observed when studies were separated by measure (GAD7 vs HADS-A), reporting threshold (mild vs moderate), survey

timeframe (first three months vs April and onwards), and doctors per 10,000 population.

Interpretation: Evidence from the first twelve months of the pandemic suggests that a significant proportion of doctors are experiencing high levels of symptoms of depression and anxiety, although not conclusively more so than pre-pandemic levels. Differences in study methodology and variation in job demands and resources may account for some of the observed heterogeneity. Findings must be interpreted with caution due to the high heterogeneity across studies and the medium risk of bias evident in the majority of included studies.

Funding: This review was conducted as part of doctoral training and is funded by NHS Wales.

Registration: The review protocol was registered with PROSPERO and is available online (CRD42021228667).

Keywords: doctors, physicians, COVID-19, coronavirus, pandemic, depression, anxiety, mental health.

Highlights:

- Doctors continue to be a population at high risk of depression and anxiety.
- Symptoms during COVID-19 are high but not necessarily higher than pre-pandemic levels.
- Study design and variation in job demands may explain some of the heterogeneity.
- Multi-level interventions should be considered to support doctors' mental health.
- Better research methodology is needed to improve confidence in outcomes.

1. Introduction

On the 30th January 2020 the World Health Organisation (WHO) declared the coronavirus disease 2019 (COVID-19) outbreak a Public Health Emergency of International Concern, its highest level of alarm. An unparalleled global response followed, with local and national 'lockdowns', quarantines, travel restrictions, and physical distancing measures introduced in attempts to curb transmission rates. At the time of writing, there have been over 114 million confirmed cases and more than 2.5 million reported COVID-associated deaths (WHO, 2021).

In response to the unprecedented pressure on global health systems, there has been enhanced focus on the mental wellbeing of healthcare staff. In April 2020, The Lancet published a position paper outlining their suggested research priorities for the pandemic:

> *"The immediate research priorities are to monitor and report rates of anxiety, depression, self-harm, suicide, and other mental health issues both to understand mechanisms and crucially to inform interventions. This should be adopted across the general population and vulnerable groups, including front-line workers."*
>
> *(Holmes et al., 2020, p5)*

Poor mental health and wellbeing among healthcare staff has organisational implications for patient safety, experience, and satisfaction (Wallace et al., 2009), in addition to financial costs, impact on productivity, and the direct effects on the individual (Royal College of Psychiatrists, 2015). High pressured working environments, heavy workload, long hours, limited resources, organisational restructuring, and a culture of blame and fear have all been implicated as contributory factors (Wilkinson, 2015; Lemaire & Wallace, 2017); all factors that have become increasingly salient within the context of the current global crisis.

The Job Demand-Resources (JD-R) model of occupational stress (Demerouti et al., 2001) offers a framework to understand these problems. The model hypothesises that as job demands increase so too does emotional strain, which negatively affects performance. Whereas greater access to job resources is

associated with enhanced engagement and performance. Job demands are conceptualised as the physical, psychological, social, and organisational features of a job that require sustained physical and/or psychological effort. Examples of job demands are high workload or emotionally demanding interactions with patients. Job resources are defined as the physical, psychological, social, or organizational aspects of a job that facilitate achievement of work-based goals, reduce job demands, and stimulate personal growth, learning, and development. Examples of job resources are performance feedback, autonomy, and skill variety. The theory suggests that job demands are associated with health-impairments (e.g., poor mental or physical health), whereas job resources are associated with engagement and motivational processes (Bakker & Demerouti, 2017). The current pandemic can be considered a universal job demand on health care systems across the world. However, there will also be additional localised variability in job demands and resources. For example, insufficient staffing levels and underfunded services may create additional strain for healthcare workers.

Medics form an essential part of the global frontline pandemic response. Studies conducted outside of global crises have highlighted that medical students and doctors are already at increased risk of psychological distress, depression, anxiety, burnout, and suicidality, compared with the general population (De Sio et al., 2020; Dong et. al., 2020; Tian-Ci Quek, 2019; Hayes et.al, 2017; Dai et al., 2015; Dyrbye et al., 2006). As a result, there have been calls to improve the conceptual definition and measurement of wellbeing in medics (Brady et al., 2018; Wallace at al., 2009).

Studies conducted during the 2003 outbreak of severe acute respiratory syndrome (SARS) indicated significant psychological distress in 18% to 57% of health care workers (Tam et.al, 2004; Chan & Huak, 2004; Phua et al., 2005; Nickell et.al, 2004; Maunder et al., 2004). A study conducted one to two years post-SARS outbreak found high levels of burnout, psychological distress, and posttraumatic stress in healthcare workers (Maunder et al., 2006). However, a similar study by

Lancee et al. (2008) found incidence of new episodes of psychiatric disorders in community populations were similar to, or higher than, those observed in health care workers two years post-outbreak.

Although a number of studies have focused on the prevalence of mental health outcomes in doctors during the current COVID-19 pandemic, to the author's knowledge, there have been no systematic reviews conducted to analyse and synthesise data relating exclusively to doctors. Some meta-analyses of healthcare workers of multiple professions have included doctors (Santabárbara et al., 2021; Pappa et al., 2020; Salari et al., 2020; Luo et al., 2020), and sub-group analyses provide some evidence of high levels of psychological distress among medics. However, outcomes from these analyses are limited by review design (e.g., rapid reviews), and underpowered sub-group meta-analyses for doctors. In addition, given the rate of publications during the pandemic, an up-to-date review is needed.

The current review will focus on the prevalence of symptoms of depression and anxiety during the COVID-19 pandemic. Previous meta-analyses have estimated the global prevalence of major depressive disorder and anxiety disorders to be 4.7% (4.4–5.0%) (Ferrari et al., 2013) and 7.3% (4.8–10.9%) (Baxter et al., 2013) respectively. The core features of depression are persistent depressed mood and anhedonia; other symptoms included psychomotor agitation or retardation, appetite changes, sleep problems, fatigue, feelings of low self-worth, poor concentration, and suicidal ideation (Diagnostic and Statistical Manual-5th Edition [DSM-5], 2013). Anxiety is characterized by psychological and somatic symptoms, including autonomic arousal (e.g., palpitations, sweating, trembling, dry mouth, difficulty breathing, chest pain, nausea), restlessness, fatigue, difficulty concentrating, irritability, and sleep problems (DSM-5, 2013). Depression and anxiety are associated with impairments in cognitive functioning, including poorer performance on tests of memory, attention, executive function and motor function (Rock et al., 2014; Hallion et al., 2017; Moran, 2016; Eysenck et al., 2007; Runswick et.al., 2018; Wilson, 2012). These cognitive, physiological, and behavioural

consequences may be of particular concern among medical doctors, given the potential implications for professional competence and patient safety, as well as personal wellbeing.

The aim of this systematic review and meta-analysis is to analyse the evidence emerging from the first year of the COVID-19 pandemic to answer the following research questions:

- What is the global prevalence of depression and anxiety symptoms among doctors during the COVID-19 pandemic?

- What factors might explain differences in the prevalence of depression and anxiety symptoms among doctors during the COVID-19 pandemic?

2. Methods

This systematic review and meta-analysis was conducted in accordance with PRISMA (Page et al., 2021) and MOOSE (Meta-analyses of Observational Studies in Epidemiology) guidelines (Stroup et al., 2000).

2.1 Eligibility criteria

The CoCoPop framework (Condition, Context, Population), for prevalence and incidence reviews, was used to develop the following inclusion criteria (see appendix 1 for table): (i) assessment of depression and/ or general anxiety symptoms using a standardised and validated measure; (ii) conducted during the COVID-19 pandemic; (iii) practicing medical doctors working in any speciality, across the globe. Studies were excluded studies based on the following criteria: (i) studies conducted outside of the pandemic timeframe; (ii) studies using non-standardised or unvalidated measures; (iii) studies that do not report prevalence for the target population or do not provide sufficient information to calculate prevalence; (iv) studies that have not separated professions in the data; (v) studies relating exclusively to medical students, non-practicing doctors, or non-medical doctors; (vi) pre-prints, or studies not published in a peer reviewed journal; (vii) studies with a sample size <139 (calculated according to minimum expected

prevalence from previous literature [WHO, 1989]).; (viii) qualitative studies; (ix) articles inaccessible for full review or not published in English; (x) studies not reporting original research (e.g., literature review, article, commentary); (xi) studies focussing on mental health outcomes other than depression and/ or general anxiety (e.g., stress, burnout, specific anxiety disorders).

2.2 Search strategy

A search strategy was developed following consultation with an expert librarian. Search terms were selected to identify records reporting on prevalence data for depression and anxiety in doctors during the COVID-19 pandemic. Full text searches were conducted using the following key search terms: (covid OR covid-19 OR “sars cov 2” OR “sarscov2” OR “corona virus”) AND (doctor* OR physician* OR medic OR medics) AND (anxiety OR “anxiety symptoms” OR “anxiety disorder” OR anxious OR “generali?ed anxiety” OR panic OR worry OR depress* OR “mental health” OR “mental illness” OR “mental disorder*”). Four electronic databases (PubMed, CINAHL, Embase, PsychInfo) and one preprint database (MedRxiv) were searched. Final searches were conducted on 3rd March 2021. Search strategies were adapted for each database, where necessary. No restrictions were applied. An example of the search terms used is included in appendix 2. Identified records were extracted to Zotero and then uploaded to Covidence systematic review software (Veritas Health Innovation, 2021).

2.3 Selection process

The author screened titles and abstracts, followed by all eligible full text papers, based on the pre-agreed inclusion criteria. A second reviewer (L.F), an assistant psychologist, completed independent title and full text screening of all papers to ensure reliability in the papers selected for inclusion. Inter-rater reliability was substantial for title screening (K = .66) and full text review (K= .68). Any conflicts were discussed and resolved by the author and second reviewer. Two supervisors were available to resolve any disagreements.

2.4 Data extraction

Data were extracted by the author from each included paper. Another reviewer (J.L.), also an assistant psychologist, independently extracted data. The extracted information was cross-checked for reliability. Where essential data was missing, the corresponding authors were contacted to request information. The following data items were extracted: author, publication year, study design, recruitment method, data collection timeframe, geographical location, measures used, cut-off and severity thresholds. The following data were extracted for the target population only (i.e., doctors): sample size, sex, age, number of positive cases of depression and anxiety, response rate. In cases where prevalence information was missing, relevant calculations were made, where possible.

The primary outcome was the total number of positive cases of depression and/ or anxiety among doctors during the pandemic, determined by the number of participants scoring above a pre-defined threshold on a validated depression or anxiety measure. Frequency data were collected for total sample (N), anxiety and/or depression cases (n), and resulting proportions with 95% confidence intervals (CI).

2.5 Study risk of bias assessment

Risk of bias was assessed by the author for all included studies using the Joanna Briggs Inventory (JBI) Checklist for Prevalence Studies tool (Munn et al., 2015). The tool was developed for the purpose of increasing consistency in systematic reviews of prevalence data. It is considered to have the highest methodologic rigor in addressing the methodological quality of prevalence studies and has been recommended as the most appropriate tool for studies of this kind (Migliavaca et al., 2020). Study quality was evaluated based on the following nine criteria: 1) Was the sample frame appropriate to address the target population? 2) Were study participants recruited in an appropriate way? 3) Was the sample size adequate? 4) Were the study subjects and setting described in detail? 5) Was data analysis conducted with sufficient coverage of the identified sample? 6) Were valid methods used for the identification of the condition? 7) Was the condition measured

in a standard, reliable way for all participants? 8) Was there appropriate statistical analysis? 9) Was the response rate adequate, and if not, was the low response rate managed appropriately? (See appendix 3 for further information relating to the tool). Within the existing literature (Islam et al., 2020; Sarria-Santamera et al., 2021), level of bias is assessed by calculating the total number of criteria with a yes response and converting this score into a percentage (n/9). Studies scoring <50% are considered high risk of bias, 50-69% medium risk of bias, and ≥70% low risk of bias. The quality assessment tool was first piloted on a small number of studies. One of the additional reviewers (J.L) independently assessed all papers to ensure reliability. Two supervisors were available for consultation and to resolve any disagreements.

2.6 Data analysis

Studies assessed as high risk of bias were excluded from the primary analyses. Following consultation with expert statisticians, a meta-analysis for proportional data was conducted using the Metaprop (Nyaga et al., 2014) command of the software package STATA version 16.1 (StataCorp, 2019). To address potential weighting issues that can occur when including studies with proportions close to one or zero, which can disproportionately skew the outcome of meta-analysis, proportions were transformed using the Freeman-Tukey double arcsine method (Freeman & Tukey, 1950), and back-transformed for ease of interpretation (Barendregt et al., 2013). A DerSimonian & Laird (1986) random effects model was used to extract pooled prevalence, given the assumed differences in regional demographics and study design. The I^2 statistic was used to assess the statistical heterogeneity (Higgins et al., 2003). I^2 values < 50% are considered low, 50-75% moderate, and >75% high. Subgroup analyses were conducted to explore sources of heterogeneity, as expected in meta-analyses of cross-sectional studies.

2.7 Sensitivity and subgroup analysis

Sensitivity analysis was conducted to explore the impact of individual studies (leave one out and cumulative analyses), and the impact of study quality and design (risk of bias, type of measure, severity threshold, and survey timeframe). Only measures used in at least four studies were included in the type of measure analyses. Survey timeframe was split into first three months of the pandemic (January to March 2020), and April 2020 onwards. In line with the JD-R model, subgroup analysis was conducted to explore the potential for variability in job demands and resources to explain heterogeneity of outcomes during the pandemic. Gross domestic product (GDP) per capita and doctors per 10,000 population were used as potential indicators of job demands and resources for each study. GDP per capita was split into three groups <$10,000 per capita, $10-15,000 per capita, and >$25,000 per capita. Doctors per 10,000 population were split into four groups <15.5 per 10,000, 15.5-19 per 10,000, 20-29 per 10,000, and >30 per 10,000. Geographical region was also explored as a further potential source of heterogeneity; studies were grouped by continent. Two studies from South America and two from Africa were omitted as they did not meet the minimum number of studies to warrant sub-group analysis. Two multi-regional studies were also omitted. Reported outcomes are proportion (p), confidence interval (CI) and percentage prevalence (p × 100%). All statistical analyses were two-tailed and p <0.05 was considered statistically significant.

2.8 Publication bias

Publication bias was assessed via visual inspection of funnel plots and Egger's test (Egger et al., 1997), with p=<0.05 indicating publication bias.

2.9 Certainty assessment

The Grading of Recommendations Assessment, Development, and Evaluation (GRADE) system was used to assess the quality of the *overall* body of evidence and the level of confidence in the conclusions drawn (Guyatt et al., 2008). GRADE assessment considers factors over and above individual study risk of bias, such as imprecision, inconsistency, indirectness, study limitations

and publication bias. Overall quality of evidence may be rated as high, moderate, low, or very low. All observational research begins as low quality and can be (less commonly) upgraded or (more commonly) downgraded, based on the five criteria outlined above (Balshem et al., 2011).

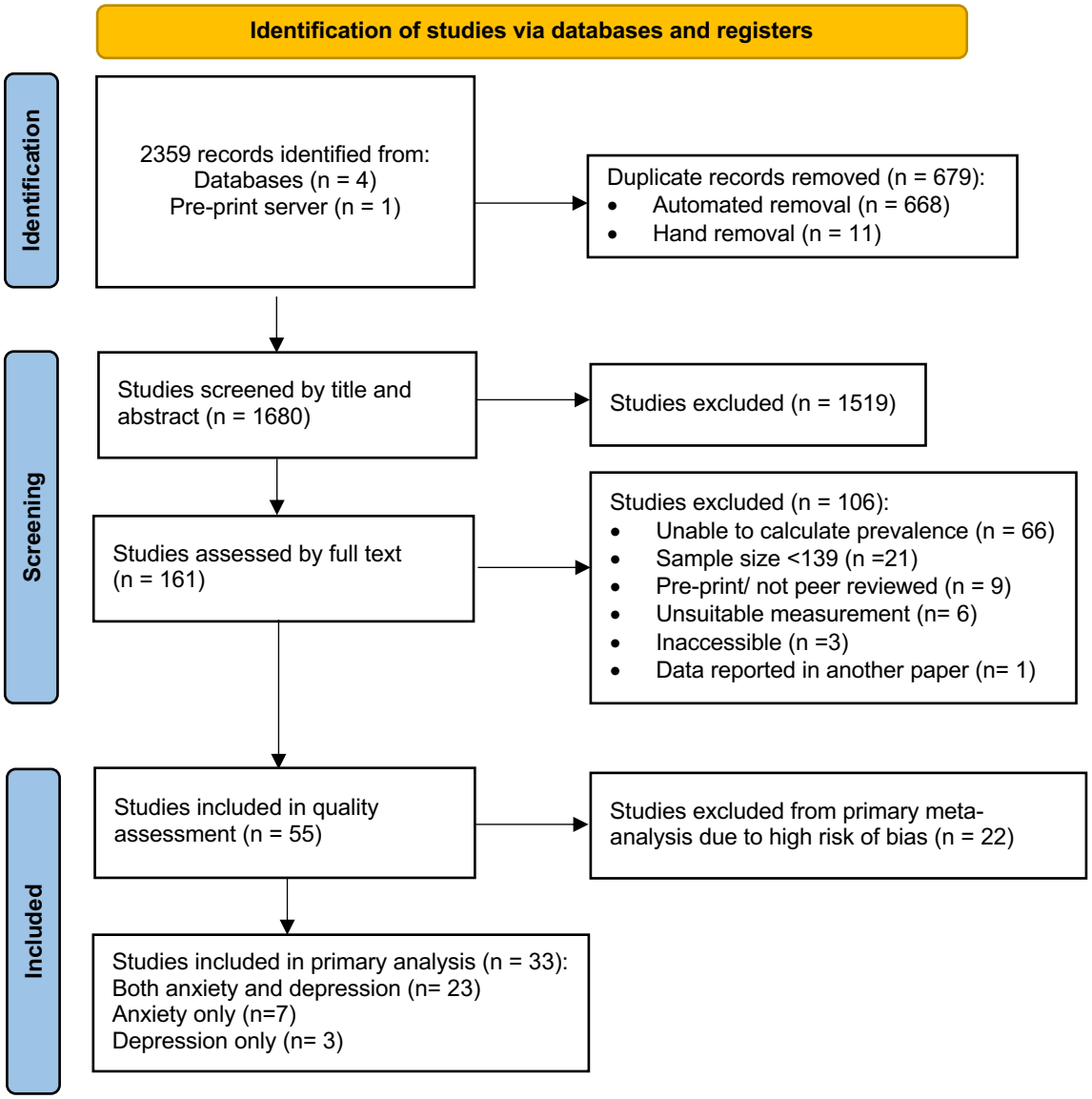


Fig 1. Prisma diagram presenting flow of information

3. Results

3.1 Study selection

After removal of duplicates, 1680 records were screened by title and abstract. Full text review was conducted on 161 papers, of which a further 106 studies were excluded. Fifty-five studies were included in the quality assessment process.

Table 1.

Risk of bias assessments for all 55 studies

Study	1	2	3	4	5	6	7	8	9	Total	Risk of Bias
Abdellah	N	N	U	Y	N	Y	Y	Y	N	4	High
Arafa	N	N	N	N	N	Y	Y	N	N	2	High
Arshad	N	N	Y	Y	N	Y	Y	N	N	4	High
Azoulay	Y	N	Y	Y	N	Y	Y	Y	N	6	Medium
Caliskan	N	N	U	Y	U	Y	Y	Y	N	4	High
Campos	N	N	N	N	N	Y	Y	N	N	2	High
Chatterjee	N	N	N	Y	N	Y	Y	Y	N	4	High
Chatzittofis	Y	N	U	Y	N	Y	Y	Y	N	5	Medium
Civantos (a)	Y	N	N	Y	N	Y	Y	Y	N	5	Medium
Civantos (b)	Y	N	N	Y	N	Y	Y	Y	N	5	Medium
Elbay	N	N	Y	Y	N	Y	Y	Y	N	5	Medium
Elhadi (a)	U	N	Y	Y	U	Y	Y	Y	N	5	Medium
Elhadi (b)	U	N	U	Y	U	Y	Y	Y	Y	5	Medium
Fauzi	Y	Y	Y	Y	U	Y	Y	Y	N	7	Low
Fekih-Romdhane	N	N	U	Y	U	Y	Y	N	N	3	High
Florin	Y	N	Y	Y	N	Y	Y	Y	N	6	Medium
Gainer	Y	N	Y	Y	N	Y	Y	N	N	5	Medium
Gallopeni	N	N	Y	N	N	Y	Y	Y	N	4	High
Greenberg	Y	N	Y	N	N	Y	Y	Y	N	5	Medium
Grover	U	U	N	Y	N	Y	Y	Y	N	4	High
Guiroy	Y	N	N	Y	N	Y	Y	Y	N	5	Medium
Gupta, B.	N	N	N	N	N	Y	Y	Y	N	3	High
Gupta, S.	U	N	Y	Y	N	Y	Y	Y	Y	6	Medium
Hassan	U	U	N	Y	N	Y	Y	Y	N	4	High
Hilmi	Y	N	Y	Y	Y	Y	Y	Y	N	7	Low
Imran	Y	N	Y	Y	Y	Y	Y	Y	Y	8	Low
Jain	U	N	Y	Y	N	Y	Y	Y	N	5	Medium
Juan	Y	Y	U	N	U	Y	Y	Y	Y	6	Medium
Kannampallil	N	N	Y	Y	N	Y	Y	Y	N	5	Medium
Khanna	U	N	Y	Y	N	Y	Y	Y	N	5	Medium
Lai	Y	Y	Y	Y	U	Y	Y	Y	Y	8	Low
Li	Y	N	Y	N	N	Y	Y	N	Y	5	Medium
Linos	N	N	Y	N	N	Y	U	N	N	2	High
Liu	N	N	Y	N	U	Y	Y	Y	N	4	High
Malgor	Y	N	Y	Y	N	Y	Y	Y	N	6	Medium
Milgrom	N	N	Y	N	N	Y	Y	N	N	3	High

Monterrossa-Castro	N	N	Y	Y	N	Y	Y	Y	N	5	Medium
Ning	N	N	U	Y	N	Y	Y	Y	N	4	High
Patel	N	N	Y	N	N	Y	Y	N	N	3	High
Que	N	N	Y	Y	N	Y	Y	Y	N	5	Medium
Sahin	N	N	Y	N	N	Y	Y	Y	N	4	High
Shah	U	N	N	Y	N	Y	Y	Y	N	4	High
Shalhub	Y	N	Y	Y	N	Y	Y	N	N	5	Medium
Shechter	N	N	Y	N	N	Y	Y	N	N	3	High
Skoda	N	N	Y	Y	N	Y	Y	Y	N	5	Medium
Thomaier	N	N	Y	Y	N	Y	Y	Y	N	5	Medium
Tiete	Y	N	N	N	N	Y	Y	Y	N	4	High
Vallee	U	N	Y	Y	U	Y	Y	Y	Y	6	Medium
Vilovic	Y	N	Y	Y	N	Y	Y	Y	N	6	Medium
Wang, H.	Y	N	N	N	N	Y	Y	Y	Y	5	Medium
Wang, Y.	N	N	Y	N	N	Y	Y	Y	Y	5	Medium
Yang	N	N	U	N	N	Y	Y	Y	N	3	High
Yao	N	N	Y	Y	N	Y	Y	Y	N	5	Medium
Yilmaz	Y	Y	Y	Y	N	Y	Y	Y	N	7	Low
Zhang	N	N	Y	N	N	Y	Y	Y	N	4	High

1. Was the sample frame appropriate to address the target population? 2. Were study participants recruited in an appropriate way? 3. Was the sample size adequate? 4. Were the study subjects and setting described in detail? 5. Was data analysis conducted with sufficient coverage of the identified sample? 6. Were valid methods used for the identification of the condition? 7. Was the condition measured in a standard, reliable way for all participants? 8. Was there appropriate statistical analysis? 9. Was the response rate adequate, and if not, was the low response rate managed appropriately?

A further 22 studies were excluded from the primary analyses due to high risk of bias, leaving 33 studies assessed as medium or low risk of bias. Twenty-three studies reported data for depression and anxiety, seven reported data exclusively for anxiety, and three reported data exclusively for depression. Study characteristics and prevalence data for high risk of bias studies are presented in appendices 4 and 5. A PRISMA diagram detailing the flow of information is presented in Fig. 1.

3.2 Risk of bias in studies

Risk of bias ratings for all 55 studies, assessed using the JBI Checklist for Prevalence Studies tool, are presented in Table 1. Five studies were assessed as low, 28 as medium, and 22 as high risk of bias. Most studies used appropriate methods to

identify and measure the condition(s), and reported appropriate statistical analysis. Setting and characteristics were also largely well described although a small number of studies reporting on a wide range of health care workers were downgraded on this item, due to the lack of sufficient detail pertaining specifically to the target population of interest for this review (i.e., doctors). The predominant use of non-probability sampling methods reduced scores for many studies. This methodology typically indicates the absence of a sampling frame and random sampling approach, an inability to calculate a response rate, and introduces coverage bias. Some studies lost additional points due to inadequate reporting of data (e.g., absence of numerator and/or denominator), and some did not report sample size calculation, or provide sufficient information to calculate retrospectively.

3.3 Study characteristics

The sample size of the studies ranged from 149 to 10,178. All studies employed a cross-sectional design.

3.3.1 Characteristics of studies assessing depression

A total of 31,447 participants from 26 studies were included; ten studies were based in Asia, seven in Europe, four in North America, two in South America, two in Africa, and one multi-national. Participants' mean (SD) age ranged from 28 (3) to 45.2 (13.3). The proportion of female participants ranged from 3.4% to 80.10%. The median number of participants per study was 467.5. Male vs female split was 45.87% vs 54.0% respectively (11,119/24,239 vs 13,094/24,239; NB. sex data not reported for some studies).

3.3.2 Characteristics of studies assessing anxiety

A total of 33,281 participants from 30 studies were included. Ten studies were based in Asia, nine in Europe, five in North America, three in South America, two in Africa, and two were multi-national. The mean (SD) age of sample size ranged 28 (3) to 52 (11). The proportion of female participants ranged from 8.33% to 80.10%. The median number of participants per study was 502.5. Male vs female split was 46.56% vs 53.83% (12,139/ 26070 vs 14,033/26070). Study characteristics are summarised in Table 2.

Table 2.

Characteristics of studies included in meta-analysis

Author, year	Timeframe	Country	Speciality	Age	Sample N	Male N, %	Female N, %
Azoulay, 2020	May 20	Global	Critical Care	*Md* 45 (39-53)	848	Not calculable	Not calculable
Chatzittofis, 2021	May 20	Cyprus	Various	43.9 ± 12.6	178	88, 49%	90, 51%
Civantos a, 2020	May 20	Brazil	Head & Neck	Not reported	163	121, 74.23%	42, 25.77%
Civantos b, 2020	April 20	USA	Head & Neck	Not reported	349	212, 60.7%	137,39.3%
Elbay, 2020	March 20	Turkey	Various	36.05 ± 8.69	442	191, 43.2%	251,56.8%
Elhadi a, 2021	May 20	Libya	Surgery	32.8 ± 7.1	309	212, 68.6%	97,31.4%
Elhadi b, 2021	April 20	Libya	Emergency Medicine	31.66 ± 5.97	154	72, 46.8%	82,53.2%
Fauzi, 2020	May 20	Malaysia	Various	33.08 ±6.965	1050	299, 28.5%	751,71.52%
Florin, 2020	April 20	France	Radiology	45.2 ± 13.3	1515	844, 55.7%	671,44.3%
Gainer, 2021	Apr/ June 20	USA	Various	Not reported	1724	750, 43.9%	959,56.1%
Greenberg, 2020	Jun/July 20	UK	Critical Care	Not reported	291	Not reported	Not reported
Guiroy, 2020	April 20	South America	Spine surgeons	44.77	204	197, 96.6%	7, 3.4%
Gupta, S.2020	Mar/April 20	India	Armed Forces	Not reported	749	556, 74.2%	193, 25.8%
Hilmi, 2020	May 20	France	Oncology	28 ±3	222	98, 44.1%	124, 56%
Imran, 2020	Apr/May 20	Pakistan	Various	31.5 ± 6.9	10178	4402, 43.3%	5776, 56.7%
Jain, 2020	May 20	India	Anaesthesiology	Not reported	512	285, 44.3%	227, 44.3%
Juan, 2020	February 20	China	Various	Not reported	195	Not reported	Not reported
Kannampallil, 2020	April 20	USA	Various	Not reported	393	177,45.00%	216, 55.00%
Khanna, 2020	April 20	India	Ophthalmology	42.5 ±12.05	2355	1332, 56.7%	1018, 44.6%
Lai, 2020	Jan-Feb 20	China	Various	Not reported	493	223, 45.2%	270, 54.8%
Li, 2020	July 20	China	Imaging	Not reported	5331	Not reported	Not reported
Malgor, 2020	April 20	Brazil	Vascular	Not reported	405	301, 66.6%	151, 33.4%
Monterrossa- Castro, 2020	April 20	Columbia	General Practice	33 ±9.3	531	215,40.49%	316, 59.50%
Que, 2020	February 20	China	Various	33.69 ±7.44	1773	606,34.12%	1167, 65.82%
Shalhub, 2020	April 20	Global	Vascular	Not reported	1518	1134, 70.5%	461, 28.6%
Skoda, 2020	March 20	Germany	Various	Not reported	492	168, 34.15%	323, 65.65%
Thomaier, 2020	Mar-Apr 20	USA	Oncology	*Md* 43 (31-78)	374	133, 35.8%	235, 63.2%
Vallee, 2020	Apr-May 20	France	Surgery	Not reported	1001	484, 48.4%	517, 51.6%
Vilovic, 2021	Nov-Jan 21	Croatia	Paediatrics	*Md* 44 (35-55)	613	122,19.90	491, 80.10%
Wang. H, 2020	February 20	China	Various	Not reported	149	Not reported	Not reported
Wang. Y, 2020	Jan-Feb 20	China	COVID	Not reported	563	Not reported	Not reported
Yao, 2021	Apr-Jun 20	USA	Breast oncology	52 ±11	870	314,36.10%	556, 63.90%
Yilmaz, 2020	April 20	Turkey	Neurosurgery	Not reported	240	220, 91.7%	20, 8.33%

Table 3.

Point prevalence of depression and anxiety symptoms for studies included in meta-analysis

	Total	Depression cases					Anxiety cases				
Study	N	Measure	Cut-off	n	%	(95% CI)	Measure	Cut-off	n	%	(95% CI)
Azoulay, 2020	848	HADS-D	≥8	256	30.2%	(27.2-33.4)	HADS-A	≥8	395	46.6%	(43.2-49.9)
Chatzittofis, 2021	178	PHQ9	≥10	21	11.8%	(7.8-17.4)	Na	Na	Na	Na	Na
Civantos a, 2020	163	PHQ2	≥3	26	16.0%	(11.1-22.3)	GAD7	≥10	32	19.6%	(14.3-26.4)
Civantos b, 2020	349	PHQ2	≥3	37	10.6%	(7.8-14.3)	GAD7	≥10	66	18.9%	(15.1-23.3)
Elbay, 2020	442	DASS-21-D	Moderate*	208	47.1%	(42.5-51.7)	DASS-21-A	Moderate*	156	35.3%	(31.0-39.9)
Elhadi a, 2021	309	PHQ9	≥15	36	11.7%	(8.5-15.7)	GAD7	≥15	47	15.2%	(11.6-19.6)
Elhadi b, 2021	154	HADS-D	≥ 11	113	73.4%	(65.9-79.7)	HADS-A	≥ 11	101	65.6%	(57.8-72.6)
Fauzi, 2020	1050	DASS-21-D	Moderate*	181	17.2%	(15.1-19.6)	DASS-21-A	Moderate*	229	21.8%	(19.4-24.4)
Florin, 2020	1515	HADS-D	≥ 11	188	12.4%	(10.8-14.2)	HADS-A	≥ 11*	222	14.7%	(13.0-16.5)
Gainer, 2021	1574	PHQ9	≥5	620	39.5%	(37.1-41.9)	GAD7	≥5	574	36.5%	(34.1-38.9)
Greenberg, 2020	291	PHQ9	≥10	89	30.6%	(25.6-36.1)	GAD7	≥10	81	27.8%	(23.0-33.2)
Guiroy, 2020	204	PHQ9	≥10	45	22.1%	(16.9-28.2)	Na	Na	Na	Na	Na
Gupta, S. 2020	749	HADS-D	≥8	211	28.2%	(25.1-31.5)	HADS-A	≥8	264	35.2%	(31.9-38.7)
Hilmi, 2020	206	HADS-D	≥8	35	17.0%	(12.5-22.7)	HADS-A	≥8	66	32.0%	(26.0-38.7)
Imran, 2020	10178	PHQ9	≥8	2685	26.4%	(25.5-27.2)	GAD7	≥7	2301	22.6%	(21.8-23.4)
Jain, 2020	512	Na	Na	Na	Na	Na	GAD7	≥5	380	74.2%	(70.3-77.8)
Juan, 2020	195	PHQ9	≥10	14	7.2%	(4.3-11.7)	GAD7	≥10	12	6.2%	(3.6-10.4)
Kannampallil, 2020	393	DASS-21-D	≥10	107	27.2%	(23.1-31.8)	DASS-21-A	≥8	73	18.6%	(15.0-22.7)
Khanna, 2020	2355	PHQ9	Moderate*	264	11.2%	(10.0-12.5)	PHQ9	Moderate*	Na	Na	Na
Lai, 2020	493	PHQ9	≥10	68	13.8%	(11.0-17.1)	GAD7	≥7	57	11.6%	(9.0-14.7)

Li, 2020	5331	PHQ9	≥7	325,	6.1%	(5.5-6.8)	GAD7	≥7	346	6.5%	(5.9-7.2)
Malgor, 2020	405	Na	Na	Na	Na	Na	GAD7	Moderate*	76	18.8%	(15.3-22.9)
Monterrossa- Castro, 2020	531	Na	Na	Na	Na	Na	GAD7	≥10	209	39.4%	(35.3-43.6)
Que, 2020	1773	PHQ9	≥10	222	12.5%	(11.1-14.1)	GAD7	≥10	185	10.4%	(9.1-11.9)
Shalhub, 2020	1518	Na	Na	Na	Na	Na	GAD7	Moderate*	354	23.3%	(21.3-25.5)
Skoda, 2020	492	Na	Na	Na	Na	Na	GAD7	≥10	29	5.9%	(4.1-8.3)
Thomaier, 2020	374	PHQ4	≥3	88	23.5%	(19.5-28.1)	PHQ4	≥3	232	62.0%	(57.0-66.8)
Vallee, 2020	1001	PHQ9	Moderate*	146	14.6%	(12.5-16.9)	GAD7	Moderate*	107	10.7%	(8.9-12.8)
Vilovic, 2021	613	HADS-D	≥ 11*	136	22.2%	(19.1-25.6)	HADS-A	≥ 11*	250	40.8%	(37.0-44.7)
Wang. H, 2020	149	HADS-D	≥11	26	17.4%	(12.2-24.3)	HADS-A	≥11	30	20.1%	(14.5-27.3)
Wang. Y, 2020	563	PHQ9	≥10	77	13.7%	(11.1-16.8)	GAD7	≥7	133	23.6%	(20.3-27.3)
Yao, 2021	870	Na	Na	Na	Na	Na	PROMIS	≥55	384	44.1%	(40.9-47.5)
Yilmaz, 2020	240	Na	Na	Na	Na	Na	BAI	Moderate*	29	12.1%	(8.5-16.8)

* No cut-off provided, data extracted for moderate and above severity threshold; moderate cut-off specified where available.

3.3.3 Measures

Seventeen studies used the Generalised Anxiety Disorder Scale-7 Item (GAD-7; Spitzer et al., 2006), thirteen used the Patient Health Questionnaire- 9 Item (PHQ-9; Kroenke et al., 2001), seven used the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983), three used the Depression Anxiety Stress Scale-21 item (DASS-21, short version of the DASS; Lovibond & Lovibond, 1995), three used the Patient Health Questionnaire- 2 Item (PHQ-2; Löwe, et al., 2005), one used the Generalised Anxiety Disorder Scale-2 Item (GAD-2; Kroenke et al., 2007) one used the Beck Anxiety Inventory (BAI; Beck et al., 1998), and one used the Patient-Reported Outcomes Measurement Information System– Anxiety (PROMIS; Cella et al., 2010).

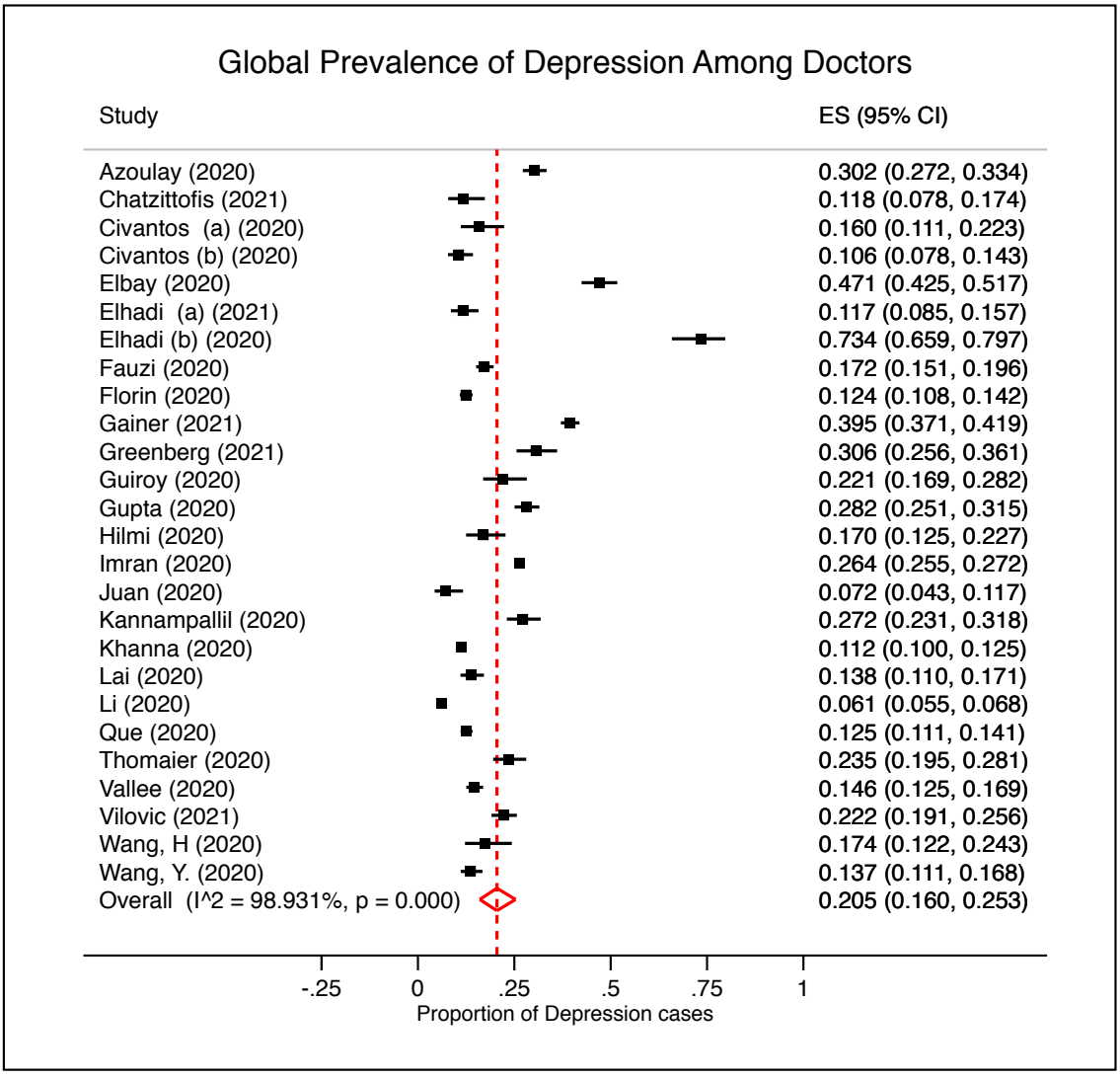


Fig 2. Forest plot showing the global prevalence of depression symptoms among doctors.

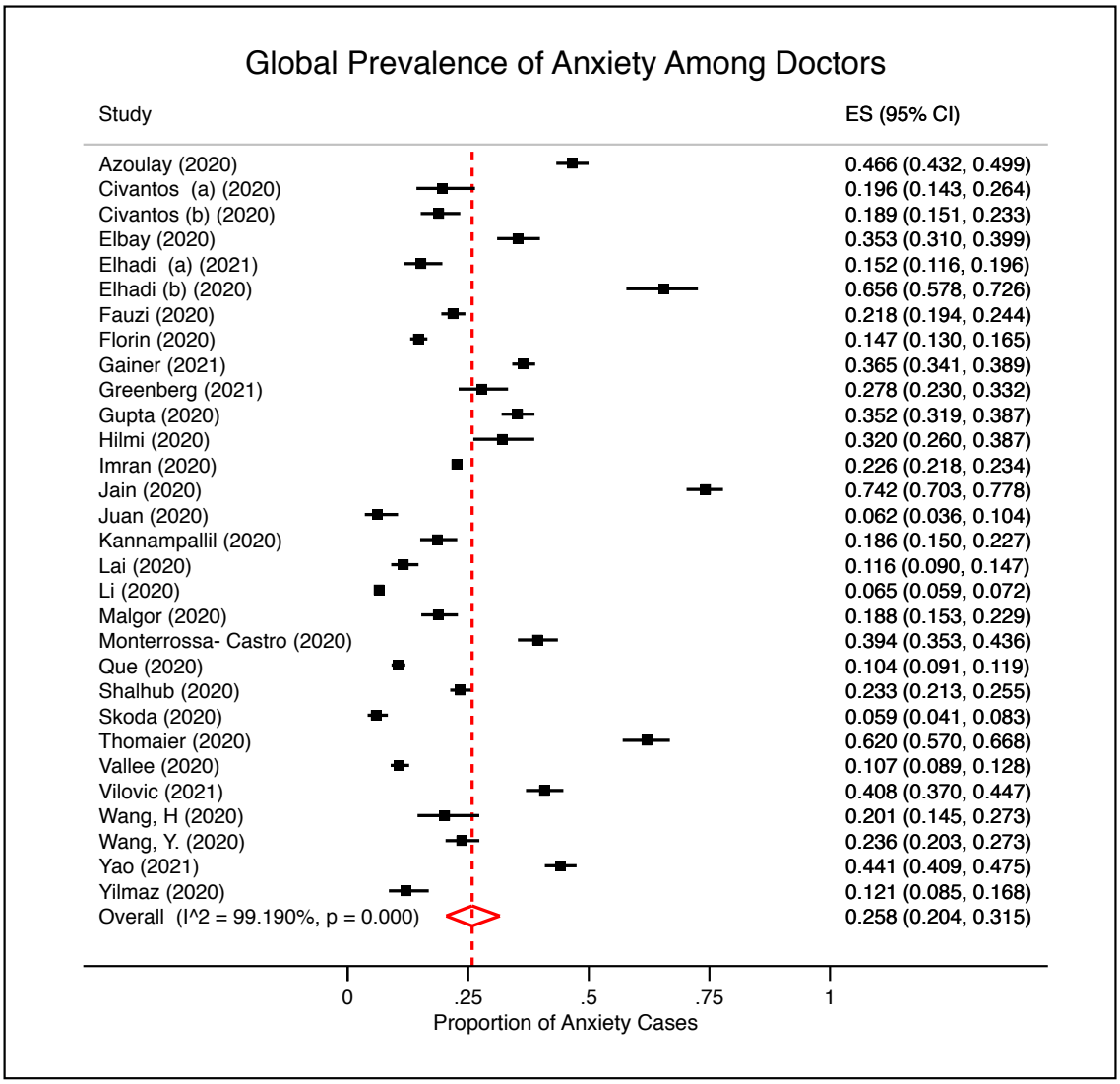


Fig 3. Forest plot showing the global prevalence of anxiety symptoms among doctors

3.4 Results of individual studies

Point prevalence of depression ranged from 6.1% (95% CI 5.5-6.8%) (Li, 2020) to 73.4% (95% CI 65.9-79.7%) (Elhadi b, 2021). Point prevalence of anxiety ranged from 5.9% (95% CI 4.1-8.3%) (Skoda, 2020) to 74.2% (95% CI 70.3-77.8%) (Jain, 2020), although only two out of the 26 depression studies and two out of the 30 anxiety studies reported prevalence of <10%. Point prevalence and confidence intervals for all individual studies are presented in table 3.

3.5 Results of synthesis

The pooled prevalence of depression for the 26 included studies was 20.5% (95% CI 16.0-25.3%), with a high degree of heterogeneity (I^2 = 98.931%), as presented in Fig 2. The pooled prevalence of anxiety for the 30 included studies was 25.8% (95% CI 20.4-31.5%), with a similarly high degree of heterogeneity (I^2 = 99.190%), presented in Fig 3.

3.6 Sensitivity analysis

3.6.1 Sensitivity analysis for studies of depression

One study affected the pooled prevalence of depression by ≥1%. The study in question (Elhadi (b), 2021) changed pooled prevalence by 1.7%. After running the analysis without this study, pooled prevalence was 18.8% (95% CI 14.6-23.3%). Cumulative analysis revealed heterogeneity only reached acceptability for a subset of thirteen studies (Chatzittofis, 2021; Ciavantos (a), 2020; Ciavantos (b), 2020 Elhadi (a), 2021; Fauzi, 2020; Florin, 2020; Hilmi, 2020; Khanna, 2020; Vallee, 2020; Lai, 2020; Que, 2020; Wang, H., 2020; Wang.Y., 2020), all with proportions falling within a 7% range (10.6-17.4%). For these studies, heterogeneity was reduced to moderate (I^2=65.063) and pooled prevalence was 13.5% (95% CI 12.2-14.8%). As presented in table 4, there was no statistically significant between-group heterogeneity when analysed by measure (p=0.062), severity threshold (p=0.330), survey timeframe (p=0.681), or risk of bias (p =0.600). (See appendices 6, 7, 8, 9 for forest plots).

3.6.2 Sensitivity analysis for studies of anxiety

Three studies affected the pooled prevalence of anxiety by ≥1% (Elhadi (b), 2021; Thomier, 2020; Jain, 2020), the largest impact was a 1.5% change (Jain, 2020). After removing the three largest influencing studies, pooled prevalence was 21.8% (17.3-26.7%). Cumulative analysis revealed that heterogeneity only reached acceptability for a subset of ten studies (Elhadi (a), 2021; Kannampallil, 2020; Malgor, 2020; Ciavantos (a), 2020; Ciavantos (b), 2020), Wang, H., 2020; Fauzi, 2020; Imran, 2020; Shalhub, 2020; Wang.Y., 2020), all with proprtions falling within

an 8.5% range (95% CI 15.2-23.6%). For these studies, heterogeneity was reduced to moderate (I^2=58.054) and pooled prevalence was 20.9% (95% CI 19.5-22.4%). As presented in table 4, between-group heterogeneity was statistically significant when analysed by measure (p=0.034), severity threshold (p=0.013), and survey timeframe (p=0.038), but not by risk of bias (p=0.089). (See appendices 10, 11, 12, 13 for forest plots).

Table 4.

Sensitivity analysis

Depression	Studies, N	Pooled, %	95% CI	I^2	*p*
Measure†:					
PHQ9	13	16.1	10.4-22.8	99.316	0.062
HADS-D	7	27.5	17.6-38.6.1	98.174	
Severity:					
Mild	10	23.5	15.0-33.2	99.487	0.330
Moderate	16	18.5	14.6-22.9	96.395	
Timeframe:					
First 3 months	7	18.9	10.9-28.3	97.994	0.681
April onwards	19	21.1	15.7-27.0	99.117	
Risk of bias:					
Low	4	18.5	12.3-25.7	96.856	0.600
Medium	22	20.9	15.6-26.7	98.849	
Anxiety	Studies, N	Pooled, %	95% CI	I^2	*p*
Measure†:					
GAD7	17	20.3	14.3-27.2	99.293	
HADS-A	7	35.5	23.2-49	98.639	**0.034***
Severity:					
Mild	10	37.2	25.0-50.4	99.665	
Moderate	20	20.5	15.9-25.6	97.690	**0.013***
Timeframe:					
First 3 months	8	17.2	9.7-26.3	98.206	
April onwards	22	29.2	22.5-36.4	99.327	**0.038***
Risk of bias:					
Low	5	19.4	14.7-24.6	94.133	0.089
Medium	25	27.1	20.0-35.0	98.314	

† Measures with fewer than four studies omitted * p = < 0.05

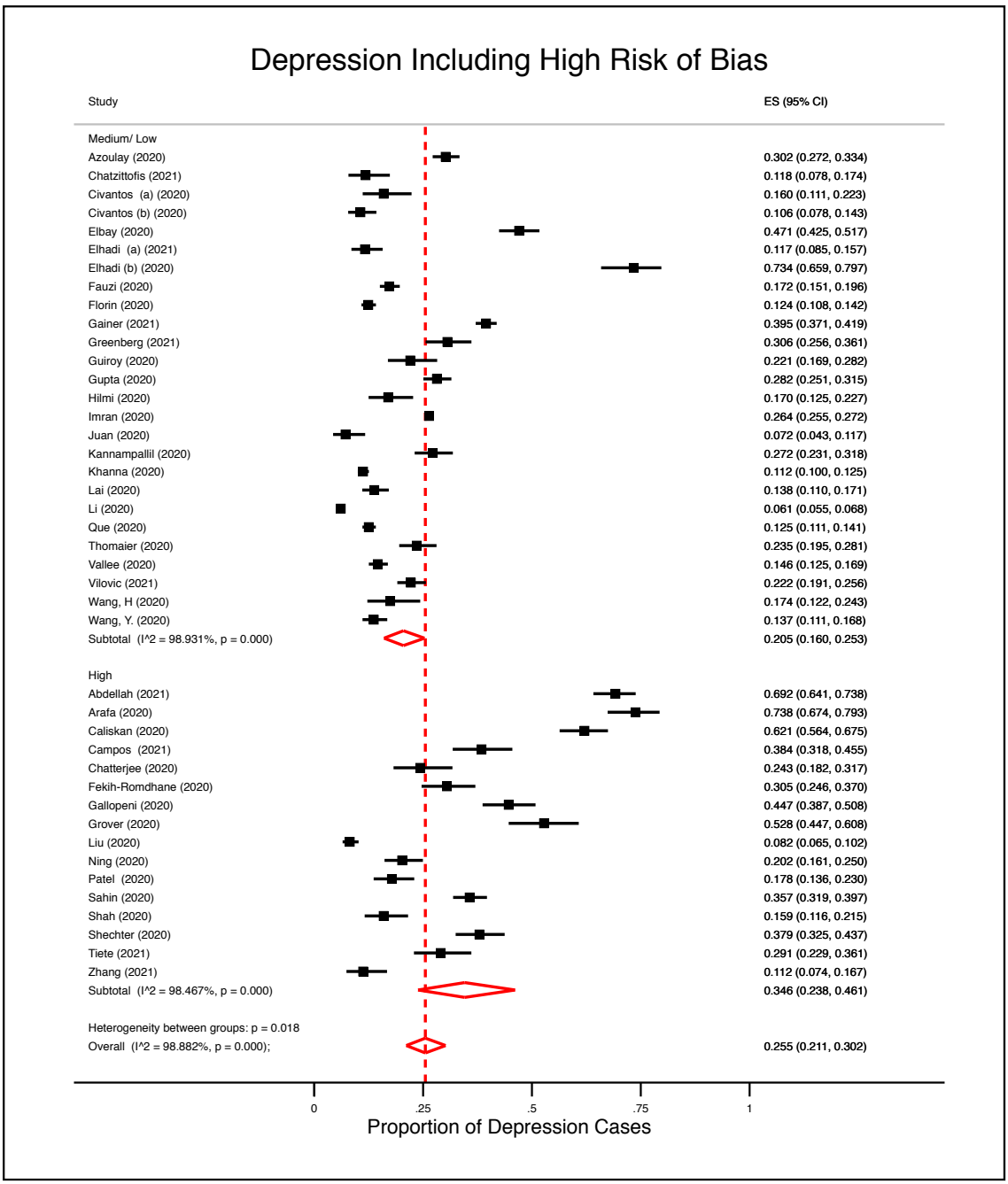


Fig 4. Forest plot showing depression studies including high risk of bias studies.

3.6.3 Secondary analysis

Secondary analyses were performed with all studies (i.e., including those assessed as high risk of bias). The prevalence of depression symptoms for the 16 studies assessed as high risk of bias was 34.6% (95% CI 23.8-46.1%, I^2=98.467). When compared with the 26 primary studies assessed as medium or low risk of bias, between-group heterogeneity was statistically significant (p=0.018) (see figure

4). By contrast, the prevalence of anxiety symptoms for the twenty-two studies assessed as high risk of bias (27.0%, 95% CI 20.5-34.0%, I^2=98.918) was not significantly different from the 30 studies assessed as medium or low risk of bias (p=0.787) (see figure 5).

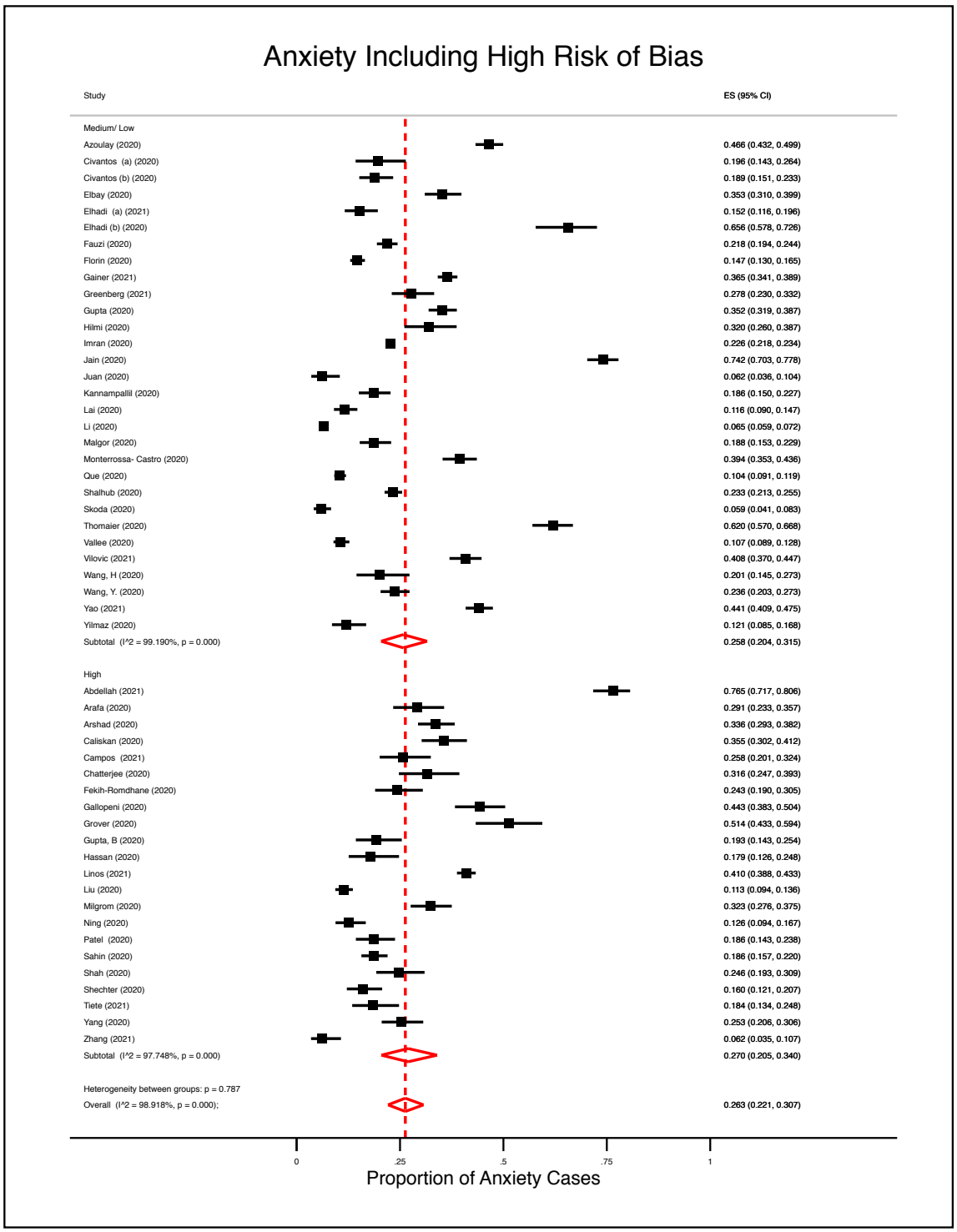


Fig 5. Forest plot showing anxiety studies including high risk of bias studies.

Table 5.

Subgroup analysis categorical information

Study, year	Continent	GDP per Capita	Doctors per 100k population
Azoulay, 2020	Global	Na	Na
Chatzittofis, 2021	Europe	27,858.40	19.5
Civantos a, 2020	South America	8,717.20	21.6
Civantos b, 2020	North America	65,297.50	26.1
Elbay, 2020	Europe	9,126.60	18.5
Elhadi a, 2021	Africa	7,685.90	20.9
Elhadi b, 2021	Africa	7,685.90	20.9
Fauzi, 2020	Asia	11,414.20	15.4
Florin, 2020	Europe	40,496.40	32.7
Gainer, 2021	North America	65,297.50	26.1
Greenberg, 2020	Europe	42,328.90	28.1
Guiroy, 2020	South America	Na	Na
Gupta, S. 2020	Asia	2,099.60	8.6
Hilmi, 2020	Europe	40,496.40	32.7
Imran, 2020	Asia	1,284.70	9.8
Jain, 2020	Asia	2,099.60	8.6
Juan, 2020	Asia	10,216.60	19.8
Kannampallil, 2020	North America	65,297.50	26.1
Khanna, 2020	Asia	2,099.60	8.6
Lai, 2020	Asia	10,216.60	19.8
Li, 2020	Asia	10,216.60	19.8
Malgor, 2020	South America	8,717.20	21.6
Monterrossa- Castro, 2020	South America	6,428.70	21.8
Que, 2020	Asia	10,216.60	19.8
Shalhub, 2020	Global	Na	Na
Skoda, 2020	Europe	46,467.50	42.5
Thomaier, 2020	North America	65,297.50	26.1
Vallee, 2020	Europe	40,496.40	32.7
Vilovic, 2021	Europe	14,944.40	30
Wang. H, 2020	Asia	10,216.60	19.8
Wang. Y, 2020	Asia	10,216.60	19.8
Yao, 2021	North America	65,297.50	26.1
Yilmaz, 2020	Europe	9,126.60	18.5

3.7 Subgroup analysis

Subgroup information for each study is provided in table 5.

3.7.1 Subgroup analysis for studies of depression

As presented in table 6, between-group heterogeneity was statistically significant for studies of depression when analysed by GDP per capita (p=0.014). Further analysis revealed significant heterogeneity between the <$10,000 and $10-15,000

groups (p=0.005) but differences were not significant between other groups. Differences were not explained by geographical region (p=0.282), or by doctors per 10,000 population (p=0.198). (See appendices 14, 15, 16 for forest plots).

Table 6

Subgroup analysis

Depression	Studies, N	Pooled, %	95% CI	I^2	*p*
Region†:					
Asia	10	14.8	9.0-21.7	99.339	0.282
Europe	7	21.3	13.4-30.5	97.697	
North America	4	24.5	12.8-38.6	98.064	
GDP per capita:					
>$25,000	9	20.1	12.8-28.6	98.150	
$10-15,000	8	13.3	9.0-18.4	97.349	**0.014***
>$10,000	7	28.8	19.1-39.6	99.030	
Doctors per 100K:					
>30	4	16.3	12.2-20.8	90.204	
20-29	8	27.7	17.2-39.7	98.073	0.198
15.5-19	8	15.0	8.4-23.0	98.541	
<15.5	4	20.3	12.2-29.8	99.095	
Anxiety					
Region†:					
Asia	10	21.5	13.1-21.3	99.508	
Europe	8	21.0	12.7-30.8	98.255	0.145
North America	5	35.3	23.0-48.6	98.330	
GDP per capita:					
>$25,000	10	25.6	16.0-36.6	98.980	
$10-15,000	10	16.4	9.4-24.9	98.870	0.054
>$10,000	8	32.7	22.3-44.1	98.934	
Doctors per 100K:					
>30	5	19.1	9.1-31.6	98.681	**0.003****
20-29	11	32.4	24.0-41.4	97.796	
15.5-19	8	14.7	9.0-21.5	98.050	
<15.5	4	37.9	20.6-56.9	99.51	

† Regions with fewer than four studies omitted * p = < 0.05 ** p = <0.01

3.7.2 Subgroup analysis for studies of anxiety

As presented in table 6, between-group heterogeneity was statistically significant among anxiety studies when analysed by doctors per 10,000 population (p=0.003). Further analysis revealed significant heterogeneity between the 15.5-19 group,

when compared with the <15.5 group (p=0.013), and when compared with the 20-29 group (p=0.001). GDP per capita was on the threshold of significance (p=0.054). Differences were not explained by geographical region (p=0.145), (See appendices 17, 18, 19 for forest plots).

3.8 Publication bias

Egger's test revealed that publication bias was not statistically significant for studies reporting prevalence of depression symptoms (p=0.6765), nor for studies reporting anxiety symptoms (p=0.8973) (see appendix 20 and 21).

4. DISCUSSION

4.1 Summary of evidence

The objective of this systematic review and meta-analysis was to provide an estimate of the global prevalence of depression and anxiety symptoms among doctors during the COVID-19 pandemic. The overall pooled prevalence of depression, calculated from 26 studies and 31,447 participants, was 20.5% (95% CI 16.0-25.3%). The overall pooled prevalence of anxiety, calculated from 30 studies and 33,281 participants, was 25.8% (95% CI 20.4-31.5%).

4.2 Comparison with existing evidence

Findings are broadly comparable to earlier estimates for doctors, conducted within the first three to six months of the pandemic. Pappa et al. (2020) conducted a meta-analysis of health care workers up until mid-April 2020. Their subgroup analysis of six studies reporting anxiety data specifically for doctors revealed a pooled prevalence of 21.73% (95% CI 15.27-28.96%); while five studies reported depression data with a pooled prevalence of 25.37% (95% CI 16·63-35.20%). In Santabárbara et al.'s (2021) meta-analysis of anxiety in health care workers, conducted up until mid-September 2020, a sub-group analysis of 13 studies of doctors reported a more modest pooled prevalence of 17% (95% CI 12–22%) for anxiety. This figure is comparable to the proportion calculated from the eight studies conducted in the first three months in the current study, but somewhat lower than the overall pooled estimate. However, direct comparisons are difficult due to

the wide and overlapping confidence intervals and significant heterogeneity found across reviews.

The prevalence of depression and anxiety symptoms among doctors also falls within the range reported in research conducted during previous epidemics ranging from 18% to 57% (Tam et.al, 2004; Chan & Huak, 2004; Phua, Tang & Tham, 2005; Nickell et.al, 2004; Maunder et al., 2004; Koh et al., 2005). However, these studies reported data on the prevalence of psychological distress rather than symptoms of depression and anxiety. Furthermore, many of these studies focussed on the broader population of healthcare workers, rather than doctors, so a direct comparison is not possible.

The results of the current study are also broadly consistent with previous studies conducted prior to the pandemic, indicating very high prevalence of depression and anxiety among doctors. However, evidence of a clear *increase* compared with pre-pandemic estimates is lacking. As above, direct comparisons are difficult to make as much of the pre-pandemic literature reports the prevalence of psychological distress and/ or burnout, rather than depression and anxiety, for this population. To the author's knowledge, there has only been one systematic review of depression and anxiety in qualified doctors prior to the pandemic (Beyond Blue, 2010); however, pooled prevalence was not calculated in this review due to the wide variation in point prevalence. The narrative summary reported depression as ranging from 14% to 60%, and anxiety ranging from 18% to 55%. Subsequently, a cross-sectional study based in the Netherlands reported prevalence of depression and anxiety among doctors to be 29% and 24% respectively (Ruitenburg et al., 2012). In 2017, a study conducted in Ireland reported 16.6% and 14.4% of doctors with symptoms of depression and anxiety of moderate severity or above (Hayes et.al, 2017); although these figures are more modest (particularly in relation to anxiety symptoms) than those reported in the current study, they remain considerably higher than rates in the general population. Previous research has also found higher levels of job demands are associated with reduced wellbeing in

doctors (Khan et al., 2018, Lee et al., 2013, Teoh et al., 2021). A tentative hypothesis is that the absence of a clear increase in prevalence of depression and anxiety among doctors during the COVID-19 pandemic, compared with previous estimates, might suggest either a ceiling effect of job demands has been reached, or that greater job resources have been made available during the pandemic to offset the increased demands.

Interestingly, a meta-analysis conducted for the general population, up to June 2020, estimated the global prevalence as 28.0% (95% CI 25.0–31.2%) for depression and 26.9% (95% CI 24.0–30.0%) for anxiety (Nochaiwong et al., 2021). These rates are significantly higher than pre-pandemic global estimates for the general population of 4.7% (4.4–5.0%) for depression (Ferrari et al., 2013) and 7.3% (4.8–10.9%) for anxiety (Baxter et al., 2013). This suggests there may have been a large increase in depression and anxiety symptoms among the general population within the first few months of the pandemic, reaching the consistently high levels reported among doctors. Furthermore, while levels of anxiety in the Nochaiwong study appear similar to those reported for doctors in the current study (26.9% vs 25.8%), levels of depression appear significantly higher in the global general population compared to those observed in doctors in the current study (28.0% vs 20.5%). Given that reduced activity is associated with depression, this finding might be explained by the presumed greater levels of inactivity within the general population, due to lockdown restrictions. Whereas doctors, as essential workers, may have experienced a less severe loss of routine. It is also of note that the pre-pandemic Ferrari and Baxter meta-analyses used studies that estimated prevalence based on ‘gold standard’ diagnostic interview procedures rather than self-report, which may account for some of the difference in outcomes.

The data from this study suggests that doctors continue to be a population at high risk of depression and anxiety, but the evidence does not support a clear increase in symptoms, compared with pre-pandemic data.

4.3 Sub-group heterogeneity

The subgroup analyses conducted in this review (geographical region, doctors per 10,000 population, GDP per capita) were able to explain some of the heterogeneity in depression and anxiety studies, but not consistently. The number of doctors per 10,000 population did not explain variance in depression studies (p=0.198), but was significant for anxiety (p=0.003). As expected, the highest pooled prevalence of anxiety was calculated for the group of studies with the lowest number of doctors per 10,000 population (<15.5) at 37.9% (95% CI 20.6-56.9%). However, the lowest rates of anxiety were not observed in either of the categories with the highest numbers of doctors per 10,000 population (20-29, >30) but rather for the group of studies within the 15.5-19 doctors per 10,000 population range, with a prevalence of 14.7% (95% CI 9.0-21.5%).

When comparing prevalence based on GDP per capita, there was significant between-group heterogeneity for depression (p=0.014), and threshold significance for anxiety (p=0.054). As expected, the highest prevalence rates were recorded for the lowest GDP per capita (<$10,000 studies), with pooled prevalence of 28.8% (95% CI 19.1-39.6%) for depression and 32.7% (95% CI 22.3-44.1%) for anxiety. However, notably, for both sub-group analyses, the lowest levels of depression and anxiety were not reported for countries with the highest GDP per capita (>$25,000), but for studies in the $10-15,000 level, with prevalence of depression at 13.3% (95% CI 9.0-18.4%) and of anxiety at 16.4% (95% CI 9.4-24.9%). These findings are consistent with previous research that suggests that beyond a certain level of wealth and resource, additional benefit to emotional wellbeing is minimal (Kahneman & Deaton, 2010).

These findings are somewhat consistent with the JD-R model, which was used to select the subgroup comparisons of GDP per capita and doctors per 10,000 population as factors that may be expected to increase job demands and reduce job resources for doctors during the pandemic. Lowest GDP corresponded

with highest rates of depression symptoms, and lowest numbers of doctors per 10,000 corresponded with highest rates of anxiety.

4.4 Methodological heterogeneity

The methodological differences explored in this analysis (risk of bias, measure, severity threshold, survey timeframe) did not explain the heterogeneity for depression studies, apart from when comparing high risk of bias with low/ medium risk of bias studies (p=0.018). High risk of bias studies produced a prevalence of 34.6% (23.8-46.1%) whereas low/medium risk of bias studies produced a prevalence of 20.5% (16.0-25.3%). Conversely, all of the methodological differences *were* relevant in explaining the heterogeneity in anxiety studies, *apart* from risk of bias (high vs low/medium p=0.787).

The type of measure used in depression studies (PHQ9 vs HADS-D) did not produce statistically significant differences in estimates (p=0.062). However, for anxiety, there was a significant difference between studies using the GAD7 vs those using the HADS-A (p=0.034). Pooled prevalence was 20.3% (95% CI 14.3-27.2%) for the GAD7 and 35.5% (95% CI 23.2-49.1%) for the HADS-A. This may be explained by potential differences in the underlying factor being measured. For example, a meta confirmatory factor analysis of the HADS identified a strong general factor. The authors suggested that it does not provide good separation between symptoms of anxiety and depression and recommended it may be best used as a measure of general distress (Norton et al., 2013).

Reporting of mild vs moderate and above symptoms did not produce statistically different prevalence estimates for depression (p=0.330), but did for anxiety (p=0.013). Studies reporting mild and above symptoms of anxiety produced a pooled prevalence of 37.2% (95% CI 25.0-50.4%) whereas studies reporting moderate and above symptoms produced a more modest estimate of 20.5% (95% CI 15.9-25.6%). The lack of consensus and consistency across studies regarding what constitutes clinically significant levels of anxiety symptoms, and the poor

equivalence when comparing severity levels across different measures, presents a challenge when attempting to estimate an overall prevalence (Clover et al., 2020).

The timeframe of data collection was not significant for depression studies (p=0.681), but was for anxiety studies (p=0.038). Interestingly, the pooled prevalence of anxiety symptoms was significantly lower in studies conducted within the first three months of the pandemic (17.2%, 95% CI 9.7-26.3%) compared with studies reporting data from April onwards (29.2%, 95% CI 22.5-36.4%). Although this was based on a small subgroup of eight studies. This finding is in contrast to research in the UK general population between 23rd March and 9th August 2020 that suggest symptoms of anxiety were *higher* in the first few months before gradually declining (Fancourt et al., 2021). This finding might be understood as the consequence of chronic stress on the medical workforce as the pandemic progressed. However, it is also of note that findings from the UK-based study (Fancourt, 2021) are not consistent with the pooled prevalence reported in a similar timeframe from the global meta-analysis (Nochaiwong et al., 2021). This inconsistency is reflective of the overall high variability in the evidence.

4.5 Limitations

This review has several limitations. Firstly, there are a number of limitations associated with the methodology of the studies of interest. As with all observational research, causation cannot be inferred. The predominant use of non-probability sampling methods introduced the highest levels of bias. This methodology means that a sampling frame and stratified random sampling approach is typically absent, which has implications for coverage bias and the ability to calculate a response rate. In addition, the widespread use of online-only survey, although appropriate given the global context, may have introduced further coverage bias by excluding people who were too busy or stressed to access their emails or social media. Other potential sources of bias include self-selection bias, which may be introduced by disproportionately attracting doctors with a past history or particular interest in mental health. Conversely, social desirability bias can also be introduced by the use

of self-report measures. All of which can influence study results. Another significant limitation is the high heterogeneity observed across studies. Heterogeneity is inherent in meta-analyses of this type of data, but limits confidence in the conclusions drawn. Given the between-study variability in geographical location, settings, and specialities, generalisability may be limited. Lack of consistency in methodological approaches also limits confidence in conclusions, including the use of a wide variety of questionnaires, differences in cut-offs and severity thresholds, and absence of 'gold standard' diagnostic interviews.

There are also several limitations associated with the methodology of the overall review. High risk of bias studies were excluded, with the aim of reducing overall bias and increasing homogeneity (Higgins et al., 2011; Detweiler et al., 2016). However, a drawback of analysis with a reduced sample is a reduction in overall precision. Sensitivity analysis incorporating high risk studies indicated that omitting these studies from the primary analyses of anxiety was not sufficient to explain heterogeneity. However, the significant difference in pooled prevalence in depression studies highlights the potential utility of this approach in avoiding overestimation of distress. Inter-rater reliability for risk of bias ratings was not an available as a function within the software used. Reporting bias may have been introduced by the exclusion of grey literature, non-English language papers, and inaccessible papers. While this study covered symptoms of depression and anxiety, specific anxiety disorders and other mental health conditions were excluded. Including studies assessing symptoms of PTSD and burnout would have provided additional relevant data. It may also have been useful to consider the influence of additional variables, including indicators of more localised job demands, such as local infection rates during the timeframe for each study, and indicators of resources, such as organisational, social and psychological factors. Finally, although this review covers more than twelve months of research conducted during the pandemic, any studies published after the 3rd March 2021 will be absent from

analyses. Given the rate at which new studies are being published, a more updated meta-analysis may soon be required.

4.6 Quality of evidence

The overall quality of evidence likely falls within the low to very low range, as per GRADE assessment guidelines. All observational research begins as low quality. Given the wide-ranging point prevalence observed across studies, the broad confidence intervals around pooled prevalence estimates, and the high level of heterogeneity observed, this assessment appears to be a fair reflection. This means that the estimate of effect is uncertain and future research may change this estimate. Recommendations for improving the quality of future research are outlined below.

4.7 Strengths

Despite these limitations, this review has a number of strengths. Firstly, risk of bias assessment highlighted a number of strengths in the individual studies. The vast majority of studies used appropriate and valid methods to identify depression and/or anxiety, and measured the condition(s) in a standard and reliable way for all participants. Most studies appropriately described and reported the statistical analyses conducted. Setting and characteristics were also largely well described, although a small number of studies reporting on a wide range of health care workers were downgraded on this item, due to the lack of sufficient detail pertaining specifically to doctors.

In consideration of the overall review, to the author's knowledge, this is the first systematic review and meta-analysis of the global prevalence of symptoms of depression and anxiety among doctors during the pandemic. The number of studies returned in our searches was unexpectedly high; enabling the author to be more selective in the quality of the studies included for full analysis. Although high risk of bias studies were excluded from the primary analyses, secondary analysis was also conducted to compare high vs medium/ low risk of bias studies. While between-group heterogeneity was not significant when comparing the risk of bias

for anxiety studies, heterogeneity was significant for depression studies. The more modest pooled prevalence for depression, using just the lower risk studies, may therefore be considered a more accurate estimate. Data were extracted for cases above clinical cut-off thresholds; for the majority of studies, reported cut-offs were within the moderate severity range. In the few studies where a specific cut-off score was not reported, data were extracted for cases in the moderate and above categories. Studies reporting prevalence estimates based on predominantly mild symptoms are likely to provide an overinflated estimation of mental health conditions in this population; therefore the pooling of predominantly moderate and above estimates may offer a more accurate reflection of the prevalence of clinically relevant symptoms in doctors than studies including data for all levels of symptom severity. Further strengths include the large number of overall participants from across the globe, spanning a wide range of clinical specialities and settings. Subgroup analyses, exploring the potential impact of job demands, provides some additional insight into factors that may be influencing prevalence.

4.8 Recommendations

Given the evidence for high levels of depression and anxiety symptoms among doctors across the world, health care services should consider multi-level approaches to support (Bakker & Demerouti, 2018). Firstly, organisational and structural changes are needed to ensure doctors have access to the most fundamental resources, such as time to sleep, eat, exercise, and spend time with others (Unadkat & Farquhar, 2020). Ongoing efforts should be made to destigmatise discussions around mental health (Galbraith et al., 2020). Formal and informal peer support systems may help to facilitate these conversations and should be encouraged (Behrman et al., 2020). Schwartz rounds are increasing in popularity, are well received by staff (Flanagan et al., 2020), and can normalise conversations around the emotional impact of work and reduce stigma. Similarly, formal and informal psychology input should be embedded within health services. Services should consider incorporating evidence based and high-quality

interventions, such as those based on mindfulness and cognitive-behavioural therapy, which have been found to be effective in reducing stress, anxiety, and depression for doctors and nurses (Melnyk et al., 2020; Murray et al., 2016). Systems to monitor the wellbeing of doctors should be in place, and in cases where one-to-one psychological support is required there should be clear and discreet pathways to referral.

Further longitudinal research is needed to monitor long term outcomes and to explore potential differences in trajectory of mental health outcomes for doctors compared with other populations. Future research may benefit from greater consideration of individual, social and organisational demands and resources. Improvements to research methodology would also increase the overall quality of the evidence base and enable greater confidence in conclusions. Specifically, the adoption of random probability sampling methods is needed. There also needs to be more consistency in measurement. Future studies would benefit from adopting 'gold standard' diagnostic interview methods, using only measures with the strongest psychometric properties, utilising cut-offs that optimise sensitivity and specificity in identifying clinically relevant symptoms, and reporting on a broader range of cut-offs in order to facilitate better comparisons with studies using alternative measures (Clover et al., 2020; Cameron et al., 2008).

4.9 Conclusion

This systematic review and meta-analysis provides a comprehensive analysis of the global prevalence of depression and anxiety symptoms among doctors during the first twelve months of the COVID-19 pandemic. Symptoms of depression and anxiety are elevated among doctors, compared with earlier research from the general population, but not conclusively more so than pre-pandemic levels among doctors. Differences in study design and variation in job demands may account for some of the observed heterogeneity. Findings may help to quantify the needs of this population and guide health care systems to plan support as we recover from the pandemic, and prepare for other times of national or global crisis.

5. Other information

5.1 Registration and protocol

The protocol was registered on PROSPERO and can be accessed online (CRD42021228667).

5.2 Support

This review was conducted as part of doctoral training and is funded by NHS Wales.

5.3 Competing interests

The author declares no competing interests.

References

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (DSM-5®). American Psychiatric Pub.

Bakker, A. B., & Demerouti, E. (2017). Job demands–resources theory: taking stock and looking forward. Journal of occupational health psychology, 22(3), 273.

Bakker, A. B., & Demerouti, E. (2018). Multiple levels in job demands-resources theory: implications for employee well-being and performance.

Balshem, H., Helfand, M., Schünemann, H. J., Oxman, A. D., Kunz, R., Brozek, J., ... & Guyatt, G. H. (2011). GRADE guidelines: 3. Rating the quality of evidence. Journal of clinical epidemiology, 64(4), 401-406.

Barendregt, J. J., Doi, S. A., Lee, Y. Y., Norman, R. E., & Vos, T. (2013). Meta-analysis of prevalence. J Epidemiol Community Health, 67(11), 974-978.

Baxter, A. J., Scott, K. M., Vos, T., & Whiteford, H. A. (2013). Global prevalence of anxiety disorders: a systematic review and meta-regression. Psychological medicine, 43(5), 897.

Beck, A. T., Epstein, N., Brown, G., & Steer, R. A. (1988). An inventory for measuring clinical anxiety: psychometric properties. Journal of consulting and clinical psychology, 56(6), 893.

Behrman, S., Baruch, N., & Stegen, G. (2020). Peer support for junior doctors: a positive outcome of the COVID-19 pandemic?. Future healthcare journal, 7(3), e64.

Beyond Blue. National Mental Health Survey of Doctors and Medical Students (2010). https://www.beyondblue.org.au/docs/default-source/research-project-files/bl1132-report---nmhdmss-full-report_web

Brady, K. J., Trockel, M. T., Khan, C. T., Raj, K. S., Murphy, M. L., Bohman, B., ... & Roberts, L. W. (2018). What do we mean by physician wellness? A systematic review of its definition and measurement. Academic Psychiatry, 42(1), 94-108.

Cameron, I. M., Crawford, J. R., Lawton, K., & Reid, I. C. (2008). Psychometric comparison of PHQ-9 and HADS for measuring depression severity in primary care. British Journal of General Practice, 58(546), 32-36.

Cella, D., Riley, W., Stone, A., Rothrock, N., Reeve, B., Yount, S., ... & PROMIS Cooperative Group. (2010). The Patient-Reported Outcomes Measurement Information System (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005–2008. Journal of clinical epidemiology, 63(11), 1179-1194.

Chan, A. O., & Huak, C. Y. (2004). Psychological impact of the 2003 severe acute respiratory syndrome outbreak on health care workers in a medium size regional general hospital in Singapore. Occupational Medicine, 54(3), 190-196.

Clover, K., Lambert, S. D., Oldmeadow, C., Britton, B., King, M. T., Mitchell, A. J., & Carter, G. L. (2020). Apples to apples? Comparison of the measurement properties of hospital anxiety and depression-anxiety subscale (HADS-A), depression, anxiety and stress scale-anxiety subscale (DASS-A), and generalised anxiety disorder (GAD-7) scale in an oncology setting using Rasch analysis and diagnostic accuracy statistics. Current Psychology, 1-10.

Covidence systematic review software (2021). Veritas Health Innovation, Australia. Available at www.covidence.org

Dai, Y., Zhang, B., Sun, H., Li, Z., Shen, L., & Liu, Y. (2015). Prevalence and correlates of psychological symptoms in Chinese doctors as measured with the SCL-90-R: A meta-analysis. Research in nursing & health, 38(5), 369-383.

De Sio, S., Buomprisco, G., Perri, R., Bruno, G., Mucci, N., Nieto, H. A., ... & Cedrone, F. (2020). Work-related stress risk and preventive measures of mental disorders in the medical environment: an umbrella review. Eur Rev Med Pharmacol Sci, 24(2), 821-830.

Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands-resources model of burnout. Journal of Applied psychology, 86(3), 499.

DerSimonian, R., & Laird, N. (1986). Meta-analysis in clinical trials. Controlled clinical trials, 7(3), 177-188.

Detweiler, B. N., Kollmorgen, L. E., Umberham, B. A., Hedin, R. J., & Vassar, B. M. (2016). Risk of bias and methodological appraisal practices in systematic reviews published in anaesthetic journals: a meta-epidemiological study. Anaesthesia, 71(8), 955-968.

Dong, M., Zhou, F. C., Xu, S. W., Zhang, Q., Ng, C. H., Ungvari, G. S., & Xiang, Y. T. (2020). Prevalence of suicide-related behaviors among physicians: A systematic review and meta-analysis. Suicide and Life-Threatening Behavior, 50(6), 1264-1275.

Dyrbye, L. N., Thomas, M. R., & Shanafelt, T. D. (2006). Systematic review of depression, anxiety, and other indicators of psychological distress among US and Canadian medical students. Academic medicine, 81(4), 354-373.

Egger, M., Smith, G. D., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. Bmj, 315(7109), 629-634.

Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: attentional control theory. Emotion, 7(2), 336.

Fancourt, D., Steptoe, A., & Bu, F. (2021). Trajectories of anxiety and depressive symptoms during enforced isolation due to COVID-19 in England: a longitudinal observational study. The Lancet Psychiatry, 8(2), 141-149.

Ferrari, A. J., Somerville, A. J., Baxter, A. J., Norman, R., Patten, S. B., Vos, T., & Whiteford, H. A. (2013). Global variation in the prevalence and incidence of major depressive disorder: a systematic review of the epidemiological literature. Psychological medicine, 43(3), 471.

Flanagan, E., Chadwick, R., Goodrich, J., Ford, C., & Wickens, R. (2020). Reflection for all healthcare staff: a national evaluation of Schwartz rounds. Journal of interprofessional care, 34(1), 140-142.

Freeman, M. F., & Tukey, J. W. (1950). Transformations related to the angular and the square root. The Annals of Mathematical Statistics, 607-611.

Galbraith, N., Boyda, D., McFeeters, D., & Hassan, T. (2020). The mental health of doctors during the COVID-19 pandemic. BJPsych bulletin, 1-4.

Guyatt, G. H., Oxman, A. D., Vist, G. E., Kunz, R., Falck-Ytter, Y., Alonso-Coello, P., & Schünemann, H. J. (2008). GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. Bmj, 336(7650), 924-926.

Hallion, L. S., Tolin, D. F., Assaf, M., Goethe, J., & Diefenbach, G. J. (2017). Cognitive control in generalized anxiety disorder: relation of inhibition impairments to worry and anxiety severity. Cognitive Therapy and Research, 41(4), 610-618.

Hayes, B., Prihodova, L., Walsh, G., Doyle, F., & Doherty, S. (2017). What's up doc? A national cross-sectional study of psychological wellbeing of hospital doctors in Ireland. BMJ open, 7(10), e018023.

Higgins, J. P., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. Bmj, 327(7414), 557-560.

Higgins, J. P., Altman, D. G., Gøtzsche, P. C., Jüni, P., Moher, D., Oxman, A. D., ... & Sterne, J. A. (2011). The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. Bmj, 343.

Holmes, E. A., O'Connor, R. C., Perry, V. H., Tracey, I., Wessely, S., Arseneault, L., ... & Bullmore, E. (2020). Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. The Lancet Psychiatry.

Islam, M. A., Alam, S. S., Kundu, S., Hossan, T., Kamal, M. A., & Cavestro, C. (2020). Prevalence of Headache in Patients with Coronavirus Disease 2019

(COVID-19): A Systematic Review and Meta-Analysis of 14,275 Patients. Frontiers in neurology, 11.

Khan, A., Teoh, K. R., Islam, S., & Hassard, J. (2018). Psychosocial work characteristics, burnout, psychological morbidity symptoms and early retirement intentions: a cross-sectional study of NHS consultants in the UK. BMJ open, 8(7), e018720.

Kahneman, D., & Deaton, A. (2010). High income improves evaluation of life but not emotional well-being. Proceedings of the national academy of sciences, 107(38), 16489-16493.

Koh, D., Lim, M. K., Chia, S. E., Ko, S. M., Qian, F., Ng, V., ... & Fones, C. (2005). Risk perception and impact of severe acute respiratory syndrome (SARS) on work and personal lives of healthcare Workers in Singapore What can we Learn?. Medical care, 676-682.

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: validity of a brief depression severity measure. Journal of general internal medicine, 16(9), 606-613.

Kroenke, K., Spitzer, R. L., Williams, J. B., Monahan, P. O., & Löwe, B. (2007). Anxiety disorders in primary care: prevalence, impairment, comorbidity, and detection. Annals of internal medicine, 146(5), 317-325.

Lancee, W. J., Maunder, R. G., & Goldbloom, D. S. (2008). Prevalence of psychiatric disorders among Toronto hospital workers one to two years after the SARS outbreak. Psychiatric services, 59(1), 91-95.

Lemaire, J. B., & Wallace, J. E. (2017). Burnout among doctors.

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. Behaviour research and therapy, 33(3), 335-343.

Löwe, B., Decker, O., Müller, S., Brähler, E., Schellberg, D., Herzog, W., & Herzberg, P. Y. (2008). Validation and standardization of the Generalized

Anxiety Disorder Screener (GAD-7) in the general population. Medical care, 266-274.

Löwe, B., Kroenke, K., & Gräfe, K. (2005). Detecting and monitoring depression with a two-item questionnaire (PHQ-2). Journal of psychosomatic research, 58(2), 163-171.

Luo, M., Guo, L., Yu, M., & Wang, H. (2020). The psychological and mental impact of coronavirus disease 2019 (COVID-19) on medical staff and general public–A systematic review and meta-analysis. Psychiatry research, 113190.

Maunder, R. G., Lancee, W. J., Rourke, S., Hunter, J. J., Goldbloom, D., Balderson, K., ... & Fones, C. S. (2004). Factors associated with the psychological impact of severe acute respiratory syndrome on nurses and other hospital workers in Toronto. Psychosomatic medicine, 66(6), 938-942.

Maunder, R. G., Lancee, W. J., Balderson, K. E., Bennett, J. P., Borgundvaag, B., Evans, S., ... & Wasylenki, D. A. (2006). Long-term psychological and occupational effects of providing hospital healthcare during SARS outbreak. Emerging infectious diseases, 12(12), 1924.

Melnyk, B. M., Kelly, S. A., Stephens, J., Dhakal, K., McGovern, C., Tucker, S., ... & Bird, S. B. (2020). Interventions to improve mental health, well-being, physical health, and lifestyle behaviors in physicians and nurses: a systematic review. American Journal of Health Promotion, 34(8), 929-941.

Migliavaca, C. B., Stein, C., Colpani, V., Munn, Z., & Falavigna, M. (2020). Quality assessment of prevalence studies: a systematic review. Journal of Clinical Epidemiology, 127, 59-68.

Moran, T. P. (2016). Anxiety and working memory capacity: A meta-analysis and narrative review. Psychological Bulletin, 142(8), 831.

Munn Z, Moola S, Lisy K, Riitano D, Tufanaru C. Methodological guidance for systematic reviews of observational epidemiological studies reporting prevalence and incidence data. Int J Evid Based Healthcare. 2015;13(3):147–153.

Murray, M., Murray, L., & Donnelly, M. (2016). Systematic review of interventions to improve the psychological well-being of general practitioners. BMC family practice, 17(1), 1-14.

Nickell, L. A., Crighton, E. J., Tracy, C. S., Al-Enazy, H., Bolaji, Y., Hanjrah, S., ... & Upshur, R. E. (2004). Psychosocial effects of SARS on hospital staff: survey of a large tertiary care institution. Cmaj, 170(5), 793-798.

Nochaiwong, S., Ruengorn, C., Thavorn, K., Hutton, B., Awiphan, R., Phosuya, C., ... & Wongpakaran, T. (2021). Global prevalence of mental health issues among the general population during the coronavirus disease-2019 pandemic: a systematic review and meta-analysis. Scientific Reports, 11(1), 1-18.

Norton, S., Cosco, T., Doyle, F., Done, J., & Sacker, A. (2013). The Hospital Anxiety and Depression Scale: a meta confirmatory factor analysis. Journal of psychosomatic research, 74(1), 74-81.

Nyaga, V. N., Arbyn, M., & Aerts, M. (2014). Metaprop: a Stata command to perform meta-analysis of binomial data. Archives of Public Health, 72(1), 1-10.

Page, M., J., McKenzie, J., E., Bossuyt, P., M., Boutron, I., Hoffmann, T., C., Mulrow, C., D., et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews BMJ (2021); 372 :n71 doi:10.1136/bmj.n7

Pappa, S., Ntella, V., Giannakas, T., Giannakoulis, V. G., Papoutsi, E., & Katsaounou, P. (2020). Prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic: A systematic review and meta-analysis. Brain, behavior, and immunity

Phua, D. H., Tang, H. K., & Tham, K. Y. (2005). Coping responses of emergency physicians and nurses to the 2003 severe acute respiratory syndrome outbreak. Academic emergency medicine, 12(4), 322-328.

Rock, P. L., Roiser, J. P., Riedel, W. J., & Blackwell, A. D. (2014). Cognitive impairment in depression: a systematic review and meta-analysis. Psychological medicine, 44(10), 2029.

Royal College of Physicians. (2015). Work and wellbeing in the NHS: why staff health matters to patient care. London: Royal College of Physicians.

Ruitenburg, M. M., Frings-Dresen, M. H., & Sluiter, J. K. (2012). The prevalence of common mental disorders among hospital physicians and their association with self-reported work ability: a cross-sectional study. BMC health services research, 12(1), 1-7.

Runswick, O. R., Roca, A., Williams, A. M., Bezodis, N. E., & North, J. S. (2018). The effects of anxiety and situation-specific context on perceptual–motor skill: A multi-level investigation. Psychological Research, 82(4), 708-719.

Salari, N., Khazaie, H., Hosseinian-Far, A., Khaledi-Paveh, B., Kazeminia, M., Mohammadi, M., ... & Eskandari, S. (2020). The prevalence of stress, anxiety and depression within front-line healthcare workers caring for COVID-19 patients: a systematic review and meta-regression. Human resources for health, 18(1), 1-14.

Santabárbara, J., Bueno-Notivol, J., Lipnicki, D. M., Olaya, B., Pérez-Moreno, M., Gracia-García, P., ... & Ozamiz-Etxebarria, N. (2021). Prevalence of anxiety in health care professionals during the COVID-19 pandemic: A rapid systematic review (on published articles in Medline) with meta-analysis. Progress in Neuro-Psychopharmacology and Biological Psychiatry, 110244.

Sarria-Santamera, A., Orazumbekova, B., Terzic, M., Issanov, A., Chaowen, C., & Asúnsolo-del-Barco, A. (2021). Systematic Review and Meta-Analysis of Incidence and Prevalence of Endometriosis. In Healthcare (Vol. 9, No. 1, p. 29). Multidisciplinary Digital Publishing Institute.

Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: the GAD-7. Archives of internal medicine, 166(10), 1092-1097.

StataCorp, 2019; Stata Statistical Software: Release 16. College Station, TX: StataCorp LLC.

Stroup, D. F., Berlin, J. A., Morton, S. C., Olkin, I., Williamson, G. D., Rennie, D., ... & Thacker, S. B. (2000). Meta-analysis of observational studies in epidemiology: a proposal for reporting. Jama, 283(15), 2008-2012.

Tam, C. W., Pang, E. P., Lam, L. C., & Chiu, H. F. (2004). Severe acute respiratory syndrome (SARS) in Hong Kong in 2003: stress and psychological impact among frontline healthcare workers. Psychological medicine, 34(7), 1197.

Teoh, K. R. H., Hassard, J., & Cox, T. (2021). Doctors' working conditions, wellbeing and hospital quality of care: A multilevel analysis. Safety Science, 135, 105115.

Tian-Ci Quek, T., Tam, W. S., X Tran, B., Zhang, M., Zhang, Z., Su-Hui Ho, C., & Chun-Man Ho, R. (2019). The global prevalence of anxiety among medical students: a meta-analysis. International journal of environmental research and public health, 16(15), 2735.

Unadkat, S., & Farquhar, M. (2020). Doctors' wellbeing: self-care during the covid-19 pandemic. Bmj, 368.

Vaughan, J. P., Morrow, R. H., & World Health Organization. (1989). Manual of epidemiology for district health management. World Health Organization.

Wallace, J. E., Lemaire, J. B., & Ghali, W. A. (2009). Physician wellness: a missing quality indicator. The Lancet, 374(9702), 1714-1721.

World Health Organisation. Coronavirus disease (COVID-19) pandemic. Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019

Wilkinson, E. (2015). UK NHS staff: stressed, exhausted, burnt out. The Lancet, 385(9971), 841-842.

Wilson, M. R. (2012). Anxiety: Attention, the brain, the body and performance. The Oxford handbook of sport and performance psychology, 173-190.

Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. Acta psychiatrica scandinavica, 67(6), 361-370.

Prevalence and Predictors of Mental Health Outcomes in UK Doctors and Final Year Medical Students During the COVID-19 Pandemic

Gemma Johns

Supervised by Dr Victoria Samuel and Dr Louise Waddington

School of Psychology, Cardiff University, Cardiff, UK

Journal: Brain, Behavior and Immunity

Word count: 8,248

Prevalence and Predictors of Mental Health Outcomes in UK Doctors and Final Year Medical Students During the COVID-19 Pandemic

Abstract

Background: The mental health of doctors is an ongoing concern, both prior to and during the COVID-19 pandemic. The aim of this study was to: i) assess the prevalence of symptoms of depression, anxiety, PTSD, and burnout in UK doctors and final year medical students during the pandemic, and ii) analyse the hypothesised relationships between psychological flexibility, intolerance of uncertainty and resilience with these mental health outcomes.

Methods: A cross-sectional online study of UK-based doctors and final year medical students was conducted between 27th September 2020 and 31st January 2021. Outcomes were measured using the PHQ9 (depression), GAD7 (anxiety), PCL-5 (PTSD), and aMBI (burnout). Independent variables included the CompACT-SF (psychological flexibility), IUS-12 (intolerance of uncertainty), and CD-RISC-10 (resilience). Descriptive statistics, between-group analyses, and regression models were performed.

Results: The overall prevalence of symptoms of anxiety was 25.3% (110/435), depression 22.4% (94/419) PTSD 11.6% (45/387), and burnout 10.8% (37/344). A sample of 346 complete responses were used for regression analyses. Psychological flexibility negatively predicted binary outcomes (i.e., cases above cut-off) and continuous scores for anxiety, depression, PTSD, but not burnout; it also negatively predicted continuous scores on emotional exhaustion and depersonalisation. Intolerance of uncertainty positively predicted anxiety and PTSD cases and scores. Resilience negatively predicted anxiety and burnout cases, and continuous scores on burnout subscales (emotional exhaustion and low personal achievement).

Conclusion: Doctors and medical students in the UK reported high levels of mental health symptoms during the pandemic, between September 2020 and January 2021. Psychological flexibility, intolerance of uncertainty and resilience explained

significant variance in mental health outcomes. Psychological flexibility was the most consistent predictor for all outcomes, over and above sociodemographic variables and other psychological predictors. These findings have implications for interventions to improve retention of our essential medical workforce, and for providing support at future times of national crisis.
Keywords: COVID-19, Doctor, Physician, Medical Student, Anxiety, Depression, PTSD, Burnout, Psychological Flexibility, Intolerance of Uncertainty, Resilience.

Highlights:

- There have been concerns about the mental health of UK doctors during the pandemic.
- Doctors reported high levels of anxiety, depression and PTSD symptoms.
- Females and those with pre-existing mental health conditions had worse symptoms.
- Psychological flexibility, intolerance of uncertainty and resilience explained significant variance.
- Psychological flexibility was the strongest and most consistent predictor of outcomes.

1. Introduction

On the 23rd March 2020, the United Kingdom (UK) government announced its first stay at home order, commencing on 26th March; with the aim of slowing the impact of the escalating COVID-19 pandemic. In subsequent months, the UK population has been subjected to various levels of movement restrictions, including a series of national and local lockdowns, with differing responses from each of the four devolved nations. Despite these measures, the UK maintained one of the highest reported COVID-19 mortality rates per 10,000 population (John Hopkins Coronavirus Resource Center, 2021).

The UK's National Health Service (NHS) has faced unparalleled challenges during the pandemic, including insufficient personal protective equipment, an inadequate supply of ventilators, and significant staff shortages. In response to frontline staffing concerns, the NHS implemented a number of strategic measures: retired staff were invited to return to practice; final year medical students and foundation doctors were offered the opportunity to expedite provisional registration (Medical Schools Council, 2020); and the general public were invited to sign up as NHS volunteer responders. In addition, at the time of writing, one in seven NHS staff had been redeployed to support the pandemic response (Yougov, 2021).

Prior to the pandemic, concerns had been raised for a number of years regarding the crisis in retention of UK doctors, with psychiatry, general practice and emergency medicine appearing to be the most affected specialities (Taylor, 2020). The UK is falling short of the European Union average for doctors per 10,000 population, with 28.1 per 10,000 compared with the 33.8 average (World Health Organisation, 2019). Concerns have been raised regarding insufficient numbers of medical student training places, despite an increasing number of patients being treated every year, and high demand for services (Royal College of Physicians, 2016). The proportion of doctors entering speciality training straight after foundation training continues to decrease every year. Of the 2018 cohort, just 37.7% progressed straight to higher-training posts, compared with 42.6% in 2017, and

71.3% in 2011 (Rimmer, 2019). It has been suggested that one in ten postgraduate speciality training posts go unfilled, which is of concern given the high numbers of job vacancies (Rolewicz & Palmer, 2019). Doctors in training are also increasingly taking career breaks, citing factors such as health and psychological wellbeing, dissatisfaction with training, and uncertainty around career choices (General Medical Council [GMC], 2019). Among trainees who choose to leave the profession entirely, feeling burnt out, bullied and undermined are some of the reasons most often cited (GMC, 2019). At the other end of the career spectrum, a survey of senior staff found 60% of hospital-based consultants intended to retire at or before the age of sixty (British Medical Association [BMA], 2019). Reports indicate the rate of early retirement in doctors has tripled over the past decade (Moberly, 2019), with highly demanding workloads and pension taxation issues suggested as important factors in these decisions (Cleland et al., 2020).

The global high prevalence of depression, anxiety and burnout has been documented in systematic reviews and meta-analyses focussing on doctors (Mata et al., 2016; Rotenstein, 2018), and medical students (Rotenstein, 2016; Hope, 2014; Puthran et al., 2016; Erschens et al., 2019). Reviews have also been conducted specifically for UK-based doctors (Kinman & Teoh, 2018; Imo, 2017). There have been disagreements regarding the conceptual distinction between burnout and depression or anxiety; however, a recent meta-analysis (Koutsimani et al., 2019) found no clear overlap, concluding that they are distinct and robust constructs. In addition to burnout being an often-cited reason for doctors leaving the profession, it is also associated with increased risk of psychiatric illness (Schwenk & Gold, 2018), reduced professional work effort, and negative patient outcomes (Rotenstein et al., 2018).

Since the start of the pandemic, a small number of studies focussing on doctors have been conducted in the UK, including a study of obstetrics and gynaecology doctors (Shah et al., 2020), which reported 24.64% of doctors had scores suggestive of anxiety, and 15.94% had scores suggestive of depression.

Another study of staff working in intensive care medicine in the UK (Greenberg et al., 2021) reported 32% of doctors had symptoms of probable PTSD, 31% scored in the moderate or severe ranges for depression, and 28% scored in the moderate or severe range for anxiety. A larger survey of doctors practising in emergency medicine, anaesthesia and intensive care medicine in the UK and Ireland (Roberts et al., 2021) found 44.2% of respondents scored ≥3 on the General Health Questionnaire-12, indicating psychological distress. A recent BMA survey (2021) of over 5000 doctors reported that half of respondents were planning to work fewer hours after the pandemic, a quarter reported being more likely to take a career break, and 21% are considering leaving the NHS altogether to change career. According to the survey, the number of UK doctors considering early retirement in April 2021 was 32%, compared with 14% last June. The BMA (2021) have called for immediate measures to address the health, safety, and mental wellbeing of doctors as we begin to recover from the pandemic.

Given that the NHS will likely be dealing with the residual effects of COVID-19 for many years to come, it is vitally important that both the physical and psychological needs of doctors are supported. In order to support the wellbeing of doctors as we emerge from the current pandemic, and in other times of national crisis, we need to quantify the prevalence of distress, and understand the individual factors that may reduce or increase vulnerability to emotional sequalae. Identifying the mechanisms underlying psychological distress may have implications for targeting support and suitable interventions, and ultimately improving retention of the essential medical workforce. The current study focusses on three psychological processes as hypothesised underlying mechanisms contributing to mental health outcomes for doctors during the pandemic.

1.1 Psychological flexibility

Psychological flexibility can be conceptualised as a central feature of many contemporary psychological approaches but is currently most closely aligned with the third-wave cognitive behavioural approach Acceptance and Commitment

Therapy (ACT). In ACT, psychological flexibility describes the ability to connect with the present moment and reflexively adapt to situational demands by changing or persisting with behaviour in accordance with one's values (Hayes et al. 2004). This is established via six core processes: acceptance (of difficult thoughts, feelings, or experiences; opposite to 'experiential avoidance'), cognitive defusion (ability to detach from thoughts, rather than accepting them literally), contact with the present moment, self-as-context (the 'observing self'), values, and committed action (aligning behaviours with values). Increased psychological flexibility has been described as fundamental to many aspects of health and is associated with reduced risk of a wide range of psychopathology (Gloster et al., 2020; Kashdan et al., 2010; Masuda et al., 2011; Tyndall et al., 2020).

Psychological flexibility has been studied in occupational, clinical and general populations, and has been found to moderate the relationship between stressful life events and a variety of mental health outcomes, including depression, anxiety, and PTSD (Palm & Follette, 2011; White et al., 2013; Bryan et al., 2015; Gloster et al., 2017; Fonseca et al., 2020; Kashdan et al., 2020). It has also been reported to play mediating and moderating roles in work-based interventions aimed at reducing burnout and improving mental health and work attendance (Bond et al., 2008; Lloyd et al., 2013). Studies focussing specifically on doctors (Solms et al., 2019; Wood et al., 2020; Jokić-Begić et al. 2020) found higher psychological flexibility was associated with lower burnout and lower psychological distress. Another study (Buck et al., 2019) found psychological flexibility to be associated with higher scores of personal accomplishment, one of three sub scales of the Maslach Burnout Inventory. Recent studies in the general population, conducted during the pandemic, found higher levels of psychological flexibility were associated with greater wellbeing, and inversely related to anxiety, depression, and distress (Kroska et al., 2020; Dawson & Golijani-Moghaddam, 2020; McCracken et al., 2021). Psychological flexibility is conceptualised as a transdiagnostic process

and is therefore potentially of relevance and value in targeting a wide range of psychological conditions.

Research on psychological flexibility has predominantly utilised the Acceptance and Action Questionnaire (AA-Q; Hayes et al., 2004) and the AAQ-II (Bond et al., 2011) to measure the construct. However, there have been recent criticisms regarding the measures' high correlation with depression, anxiety and stress (Doorley et al., 2020), suggesting that they may in fact be measuring psychological distress rather than psychological inflexibility and experiential avoidance (Tyndall et al., 2019). Subsequently, the Comprehensive assessment of Acceptance and Commitment Therapy processes (CompACT; Francis, et al., 2016) was developed to provide a more complete measure of the construct.

1.2 Intolerance of uncertainty

Intolerance of uncertainty (IoU) is frequently used interchangeably with tolerance and intolerance of ambiguity within the literature, despite some attempts to differentiate the concepts (Grenier et al., 2005; Rosen et al, 2014). IoU is considered to be associated with worry, anxiety, stress and maladaptive coping strategies (Rosen et al., 2014) and is a central feature in the cognitive model of generalised anxiety disorder (Dugas et al., 1998), and other related conditions.

IoU has been defined as *"The set of negative and positive psychological responses -cognitive, emotional and behavioural- provoked by the conscious awareness of ignorance about particular aspects of the world"* (Hillen et al., 2017*).* This definition attempts to integrate the body of literature pertaining to tolerance and intolerance of both uncertainty and ambiguity, in order to provide a transdisciplinary integrated definition.

IoU has primarily been described as a stable personality trait (Strout et al., 2018) however, some studies suggest that it may be a modifiable process (DeForge & Sobal, 1991; Merrill et al., 1994; Han et al., 2015). Recent systematic reviews (Strout et al., 2018; Hancock & Mattick, 2020) have found an association between lower tolerance of uncertainty with higher psychological distress (stress, burnout,

depression) in doctors and medical students, indicating a potential protective effect of tolerance of uncertainty for emotional well-being (Strout et al., 2018). Tolerance of uncertainty has also been associated with clinician behavioural outcomes, including willingness to recommend new medical interventions (Strout et al., 2018).

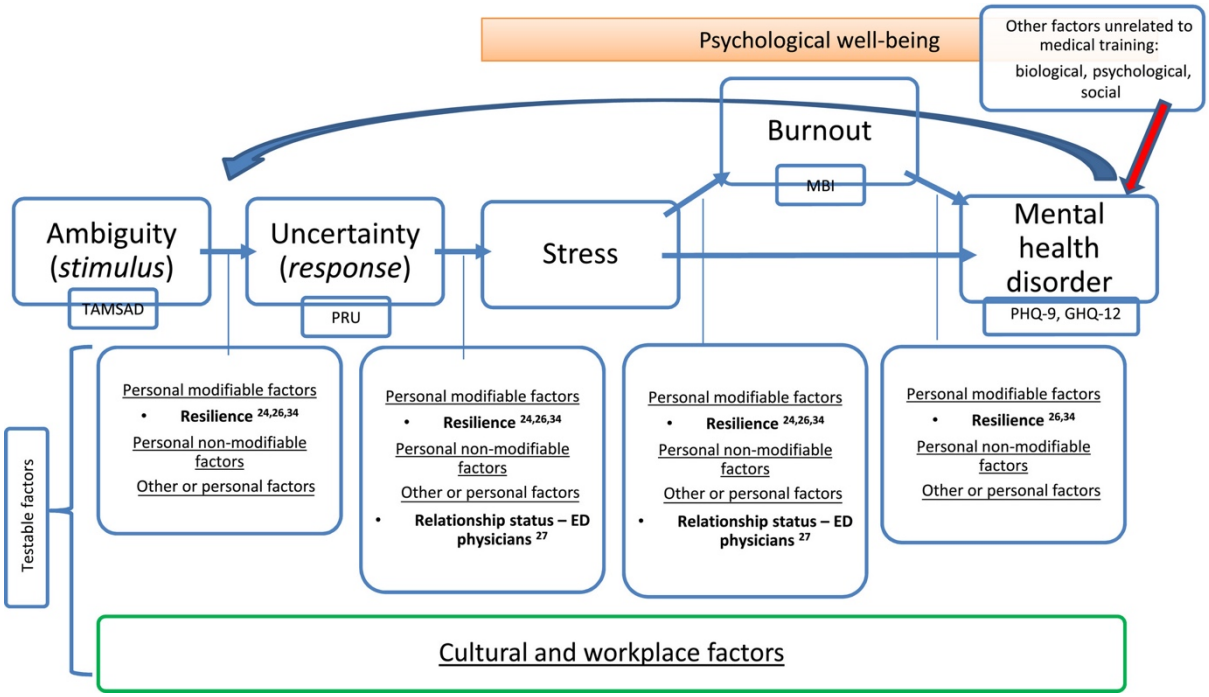


Fig. 1 Conceptual model of psychological distress in doctors and medical students (Hancock & Mattick, 2020)

Hancock and Mattick (2020) proposed a conceptual model (fig 1) linking ambiguity tolerance to psychological well-being in medical students, based on the findings from their systematic review. The authors hypothesised that IoU may be a feature in the pathway to developing burnout and mental health problems among medics. The model also highlights other potentially relevant features, including 'modifiable' factors (e.g., resilience), non-modifiable factors (e.g., age), and workplace and cultural factors.

1.3 Resilience

Resilience has been described as the ability to recover from significant stress or adversity (McKinley et al., 2019). A systematic review (McKinley et al., 2018) highlighted the complex, multifactorial nature of resilience in doctors. The

review identified personality factors, organisational factors, social support, outside interests and overcoming previous adversity as influencing resilience.

A study of US family doctors found that lower resilience was associated with increased emotional exhaustion and depersonalisation (Buck et al., 2019). Interestingly, a larger US study (West et al., 2020) found higher levels of resilience in physicians compared with the general population. The same study found lower resilience was associated with increased burnout symptoms, though these were substantial among even the most resilient doctors. Another US study found medical residents with higher resilience had lower levels of burnout (Nituica et al., 2020). In a study of Portuguese healthcare workers, resilience was found to partially mediate the association between depression and burnout (Serrao et al., 2021).

A meta-analysis of resilience training programmes and interventions (Joyce et al., 2018) concluded that interventions for adults, utilising a combination of CBT and mindfulness techniques, were effective in increasing individual resilience. Medical programme support has also been found to increase resilience and decrease risk of burnout (Nituica, 2020); however, a systematic review (McKinley, 2019) did not find mindfulness-based interventions were influential in improving resilience.

Psychological flexibility, IoU and resilience may therefore be relevant in understanding and predicting mental health outcomes in doctors. Increasing understanding of these psychological processes, and their relationship to mental health, may help to shape future interventions and support for doctors.

1.4 Study aims

The aims of this study were to 1) provide an estimate of the prevalence of symptoms of depression, anxiety, PTSD and burnout in UK-based doctors and final year medical students during the pandemic, and 2) explore the hypothesised relationships between psychological flexibility, IoU, and resilience with mental health outcomes.

Hypotheses:

1. Psychological flexibility and resilience will be negatively associated with symptoms of depression, anxiety, PTSD and burnout.
2. Intolerance of uncertainty will be positively associated with symptoms of depression, anxiety, PTSD and burnout.
3. Psychological flexibility, intolerance of uncertainty and resilience will predict dichotomous and continuous mental health outcomes, over and above sociodemographic control variables.

2 Methods

2. 1 Procedure and participants

An online survey was developed using Qualtrics software and was open from 27th September 2020 to 31st January 2021. Informed consent was obtained from all participants at the beginning of the survey. The survey took an average of ten minutes to complete and included demographic information, mental health outcome measures, and measures of predictor variables. The project proposal was reviewed by a senior doctor, and additional feedback was sought from junior doctors during the project development and recruitment phases. The study was open to final year medical students and all grades of medical doctors across the UK.

2.2 Sample and recruitment

For prevalence data, a minimum sample size of 384 was calculated, using the Qualtrics online sample size calculator. For regression analysis, a minimum sample size of 146 was calculated using the formula N>50+8m (Tabachnick & Fidell, 2013). Non-probability sampling methods were used. All UK medical and foundation schools were contacted via email to invite them to promote the study. The study was also promoted via social media and by sharing the study with friends, family and acquaintances. Participants were offered the opportunity to enter a prize draw for the chance to win a £100 high street voucher.

2.3 Ethics

The study was approved by the Cardiff University School of Psychology Ethics Committee. The NHS Health Research Authority tool (NHS, 2020) confirmed that NHS ethics was not required for this project.

2.4 Measures

2.4.1 Sociodemographic information

Baseline sociodemographic data were collected for sex, age range, ethnicity, career grade, early registration, geographical location, speciality, frequency of contact with COVID-19 patients, pre-existing mental health condition, clinically vulnerable status (self or close relative/ same household), experience of an adverse COVID-related event, experience of an adverse non-COVID-related event (past 12 months).

2.4.2 Dependant variables

The Patient Health Questionnaire-9 Item (PHQ-9; Kroenke et al., 2001) was used to measure symptoms of depression. Respondents are asked to rate the frequency with which they have been bothered by each of the nine items over the previous two weeks. Items are rated using a four-point Likert scale from *"not at all"* to *"every day"*. Item scores are summed (range 0-27), with higher scores reflecting greater severity of depression symptoms. The recommended severity thresholds are mild 5-9, moderate 10-14, moderately severe 15-19, and severe 20+. The PHQ-9 is a widely used standardised, reliable and valid measure (Manea et al., 2012). It has acceptable levels of sensitivity and specificity for detecting cases of depression (Mitchell et al., 2016) with a cut-off score of ≥10, and good internal consistency, α=.86-.89 (Kroenke et al., 2001). In the current study α=.86.

The Generalised Anxiety Disorder Scale-7 Item (GAD-7; Spitzer et al., 2006) was used to measure symptoms of anxiety. Respondents are asked to rate the frequency with which they have been bothered by each of the seven items over the previous two weeks. Items are rated using a four-point Likert scale from *"not at all"*

to *"every day*". Item scores are summed (range 0-21), with higher scores reflecting greater severity of anxiety. The recommended severity thresholds are mild 5-9, moderate 10-14, and severe 15+. The GAD-7 is a widely used standardised, reliable and valid measure (Löwe et al., 2008). It has acceptable sensitivity and specificity in identifying cases of generalised anxiety disorder (Plummer et al., 2016) with a cut-off score of ≥10, and excellent internal consistency, α=.92 (Spitzer et al., 2006). In the current study α=.90.

The PTSD Checklist for DSM-5 (PCL-5; Weathers et al., 2013) was used to measure symptoms of post-traumatic stress disorder (PTSD). Respondents are asked to rate the frequency with which they have been bothered by each of the twenty items over the previous month. Items are rated using a five-point Likert scale from *"not at all"* to *"extremely".* Item scores are summed (range 0-80), with higher scores reflecting greater severity of PTSD symptoms. Initial research suggests a cut-off score between 31-33 is indicative of probable PTSD, the current study adopted a cut-off of 31, to maximise sensitivity. The PCL-5 is a widely used standardised measure and is considered a reliable and valid tool for assessing symptoms of PTSD (Blevins et al., 2015). It has excellent internal consistency, α=.95 (Ashbaug et al., 2016). In the current study, α=.94. Given the study's focus on workplace experiences during the pandemic, the prefix *"Please answer the following set of questions in response to a stressful work-related experience"* was added.

The Abbreviated Maslach Burnout Inventory (aMBI) was used to measure symptoms of burnout. Respondents are asked to rate the frequency with which the nine statements describe the way they feel about being a doctor. Items are rated using a seven-point Likert scale from *"every day"* (0) to *"never"* (6). The aMBI contains subscales to assess the three domains of burnout: emotional exhaustion (EE; feeling emotionally exhausted by work), depersonalisation (DP; unfeeling/cynicism toward patients), and low personal accomplishment (LPA; feeling less competent, successful and satisfied at work). Scores on the aMBI are

pro-rated by calculating a mean for each subscale, then multiplying by the equivalent number of subscale items in the full MBI (i.e., nine for EE, five for DP, eight for LPA) as described in Colville et al. (2017). Subscale cut-offs are based on recommended cut-offs for the full MBI (i.e., EE≥27, DP≥10, LPA≤33, Maslach et al., 1996). Scoring above or below the specified cut-off for all three subscales is considered necessary for burnout (Maslach & Leiter, 2021). Research indicates that the aMBI is a valid and reliable substitute for the full MBI and retains the factor structure of the original version (Riley et al., 2017), Internal consistency has been reported as follows: α=.89 for emotional exhaustion, α=.76 for depersonalisation, α=.72 for low personal accomplishment. In the current study, Cronbach alpha coefficient was broadly acceptable (EE α=.73, DP α=.69, LPA α=.61).

2.4.3 Independent variables

The Comprehensive assessment of Acceptance and Commitment Therapy processes-Short Form (ComPACT-SF; Morris, 2019) was used to measure psychological flexibility. The CompACT-SF is an abbreviated version of the full CompACT (Francis et al., 2016), and assesses the six core psychological flexibility processes, as described above. Respondents are asked to rate their agreement with each of the eight statements. Sample items include, *"I act in ways that are consistent with how I wish to live my life"* and *"I get so caught up in my thoughts that I am unable to do the things that I most want to do"*. Items are rated using a seven-point Likert scale from *"strongly disagree"* to *"strongly agree"*. Items 2, 3, 4, 6, and 7 are reversed sored before being summed (range 0-48), with higher scores reflecting higher psychological flexibility. Initial research indicates that the CompACT-SF is a valid and reliable substitute for the full CompACT and retains the same factor structure of the original version (Morris, 2019). The CompACT-SF has acceptable internal consistency, α=.73 (Morris, 2019). In the current study α=.77.

The Intolerance of Uncertainty Scale–12 item (IUS-12; Carleton et al., 2007) is a 12-item self-report measure of IoU. Items are rated on a 5-point Likert scale ranging from *"not at all characteristic of me"* to *"entirely characteristic of me"*, with

higher scores indicating higher IoU (range 12-60). Sample items include *"Unforeseen events trouble me greatly"* and *"When I am uncertain I can't function well".* The IUS-12 is a widely used, valid and reliable scale, with excellent internal consistency, α=.91. In the current study α=.90.

The Conor Davidson Resilience Scale 10-item (CD-RISC-10; Davidson, 2003) was used to measure psychological resilience. CD-RISC-10 is an abbreviated version of the full CD-RISC (Connor & Davidson, 2003). Respondents are asked to rate their agreement with each of the ten items over the previous month. Items are scored from 0-4 using a five-point Likert scale from *"not true at all"* to *"true nearly all of the time"*. Items are summed (range 0-40), with higher scores reflecting greater psychological resilience. Sample items include, *"I try to see the humorous side of things when I am faced with problems"* and *"Having to cope with stress can make me stronger".* The CD-RSIC-10 is widely used and is considered a valid and reliable substitute for the full CD-RISC, with internal consistency reported as ranging from .81-.94 (Davidson, 2020). In the current study α=.88.

2.5 Data collection and storage

Data were collected anonymously using the Qualtrics secure online survey platform. Email addresses and/or telephone numbers, provided optionally for the prize draw, were submitted via a separate link to ensure data could not be linked to identifiable information. Following the prize draw, data were deleted.

2.6 Data analysis

Data analysis was conducted using IBM SPSS statistical software version 25.0 (IBM Corp). As some of the scores for the measurement scales were not normally distributed, medians (Md) and interquartile ranges (IQRs) are reported. Frequency data, such as the total number of positive cases, are presented as absolute values (n,%). Spearmans Rho analysis was conducted to explore associations between independent variables (IVs) and dependant variables (DVs). Nonparametric Mann-Whitney U and Kruskal-Wallis tests were performed to

compare median mental health scores among groups (e.g., male vs female; career grade).

Logistic regression was performed to assess the ability of the three key independent variables of psychological flexibility (COMPACT-SF), intolerance of uncertainty (IUS-12), and resilience (CD-RISC-10) to predict participants scoring above clinical 'caseness' cut-offs on mental health outcome measures (GAD-7, PHQ-9, PCL-5, aMBI), after controlling for the influence of: frequency of contact with COVID patients; sex; ethnicity; pre-existing mental health conditions; early registration; adverse COVID-related event; adverse non-COVID-related event (<12 months); clinically vulnerable group (self); clinically vulnerable group (close relative/ same household). Control variables were coded as dichotomous categorical variables, apart from career grade and age range (multiple categorical) and frequency of contact with COVID patients (continuous). All three primary IVs were continuous.

Hierarchical multiple regression was performed to assess how well the same set of variables could predict continuous scores on the mental health measures. Nine control variables were entered at step-one, and the three psychological predictor variables (COMPACT-SF, IUS-12, CD-RISC-10) were entered at step-two. Before conducting regression analyses, key assumptions were assessed. There was no evidence of multicollinearity, and residual and scatter plots indicated assumptions of normality, linearity and homoscedasticity were all broadly met (Hair et al., 1998; Pallant, 2016) for all outcomes, apart from the PCL-5 and depersonalisation scales. A square root transformation was applied to the data for these two scales before conducting multiple regression analyses, given the increased sensitivity to normality, linearity and homoscedasticity for multiple regression. A p-value of <.05 was considered significant, and all tests were 2-tailed.

3. Results

3.1 Demographic characteristics

The anonymous survey link was opened 508 times, and 464 progressed through consent. After removing participants that dropped out before completing the full set of questionnaires, 346 responses remained for final regression analyses. Due to the recruitment strategy used in this study, an accurate response rate was not calculable. Of those who opened the survey information, 88.2% went on to answer the first question, and 68.8% completed the survey. Table 1 provides a summary of the characteristics of those respondents who started the survey (i.e., those who answered at least the first question relating to career grade) but dropped out before completing all questionnaires. Middle grade doctors had the highest attrition rate, followed by final year medical students. Senior doctors (consultant and GP grade) had the lowest rate of attrition but were the least represented group overall.

Table 1

Analysis of drop out demographics

Current Career Grade	Total N	%	Dropped out n	%
Final Year Student	107	24.1	26	24.3
Foundation Y1	107	24.1	19	17.9
Foundation Y2	91	20.3	18	19.8
Junior and Senior Middle	104	23.4	32	30.1
Consultant/ GP	36	8.1	3	8.3
Total	448*	100	103	22.8

* demographics missing for 4 respondents, not included in calculations

Of the 346 complete responses, 23.7% were final year medical students, 25.1% were foundation year 1 doctors (F1), 21.1% were foundation year 2 doctors (F2), 20.8% were middle grade doctors, and 9.2% were senior doctors (consultants or GPs). A majority of participants were female (252, 75.0%), under thirty (242, 71.4%) and white (262, 78.2%).

Table 2

Characteristics of participants

Characteristic	Total (N = 346†, 100%)	Characteristic	Total (N = 346, 100%)
Sex	N = 336	Non-COVID adverse life event	N = 342
Female	252, 75.0	Agree or strongly agree	96, 27.9
Male	84, 25.0	Disagree, strongly disagree, neutral	246, 71.5
Age	N = 339	COVID-related adverse life event	N = 341
18-24	109, 32.2	Agree or strongly agree	52, 15.1
25-29	133, 39.2	Disagree, strongly disagree, neutral	290, 84.3
30-34	54, 15.9	Clinically vulnerable group (self)	N = 341
35-39	20, 5.9	Yes	29, 8.4
40-44	12, 3.5	No	312, 90.7
45+	11, 3.2	Clinically vulnerable group (relative)	N = 339
Career grade	N = 346	Yes	105, 31.0
Final year medical student	82, 23.7	No	234, 69.0
Foundation Year 1	87, 25.1	Pre-existing mental health diagnosis	N = 332
Foundation Year 2	73, 21.1	Yes	70, 21.7
Junior Middle Grade	29, 8.4	No	262, 78.9
Senior Middle Grade	43, 12.4	Clinical contact with COVID-19 patients	N = 344
Consultant or GP	32, 9.2	Not at all	45, 13.1
Early provisional/ full registration	N = 346	Rarely	54, 15.7
Yes	75, 21.7	Sometimes	75, 21.8
In progress	4, 1.2	Often	105, 30.5

No/ Not applicable	267, 77.2	All the time	65, 18.9
Geographical working location	N = 334	Current speciality	N = 331
South East	30, 9.0	General Internal Medicine	72, 22.4
East of England	17, 5.1	Surgery	54, 16.3
East Midlands	34, 10.2	General Practice (GP)	39, 11.8
West Midlands	43, 12.9	Psychiatry	27, 8.2
North West and North East	47, 14.1	Emergency Medicine	26, 7.9
Yorkshire and the Humber	55, 16.5	Paediatrics	17, 5.1
South West	33, 9.9	Intensive Care	11, 3.3
Scotland	32, 9.6	Anaesthesia	10, 3.0
Wales	43, 12.9	Other speciality and/or student rotation	77, 23.3
Ethnicity	N= 335	Previous speciality during pandemic*	N = 331
White/ White British	262, 78.2	General Internal Medicine	74, 18.2
South Asian/ South Asian British	37, 11.0	Surgery	41, 12.4
Mixed/ multiple ethnic background	12, 3.6	Intensive Care	34, 10.3
East Asian/ East Asian British	11, 3.3	Emergency Medicine	29, 8.8
Black/ Black British	2, 0.6	General Practice (GP)	28, 8.4
Any other ethnic background	11, 3.3	Other**	58, 17.5

† Sample N for each demographic category may vary due to missing demographic information for some respondents

* Percentages do not total 100 as multiple responses enabled.

** < 20 per speciality, including: psychiatry, acute, COVID wards, infectious diseases, paediatrics, palliative care.

Responses were received from across all regions of England, comprising 77.5% of the total participants. A further 12.9% of respondents were from Wales, and 9.6% from Scotland. Unfortunately, there were no participants from Northern Ireland as the foundation school declined invitations to promote the survey. The most frequently reported current or previous working specialities (during the pandemic) were General Internal Medicine, Surgery, General Practice, Emergency Medicine, Psychiatry, and Intensive Care. Pre-existing mental health condition(s) were reported by 21.7% of respondents, while 71.2% reported their frequency of contact with COVID-19 patients as either 'sometimes', 'often' or 'all the time'. Full details of respondent demographics can be found in Table 2.

3.2 Prevalence of mental health symptoms

In order to preserve data, and to provide an appropriately powered analysis of prevalence (i.e., N=>383), a preliminary analysis was carried out for the three primary outcome measures, using the full set of recorded responses for each questionnaire (GAD7=435; PHQ9=419; PCL-5=387). The proportion of participants scoring above cut-off was 25.3% for anxiety (110/435), 22.4% for depression (94/419) and 11.6% for PTSD (45/387). Further details, including summary statistics based on career grade, early registration, and severity levels, are provided in appendix 29. The remainder of this report will discuss findings in relation to the 346 participants who completed the full set of questionnaires.

Of the 346 complete responses, prevalence estimates for all three primary outcome measures were all within 1% of the proportions calculated for the full sample above (see tables 3 and 4). The proportion of participants scoring above cut-off for emotional exhaustion was 56.8% (196/345), for depersonalisation 36.4% (125, 345), for low personal achievement 27.2% (94/345), and for burnout 10.8% (37/344). Median (IQR) scores were 6.0 (3.0-10.0) for the GAD7, 5.0 (2.0-9.0) for the PHQ9, and 8.0 (2.0-19.0) for the PCL-5. For the aMBI subscales, median scores were 30.00 (18.00-39.00) for emotional exhaustion, 6.67 (1.67-11.67) for depersonalisation, and 37.33 (32.00-42.67) for low personal achievement.

Table 3

Prevalence of mental health symptoms by sex, career grade, and early registration status

N, %	Total (346)	Sex		Career Grade					Early registration	
		Male	Female	Student	F1	F2	Middle	Senior	No	Yes
Anxiety (GAD7)										
None	137, 39.6	47, 56.0	85, 33.7	28, 34.1	33, 37.9	26, 35.6	38, 52.8	12, 37.5	112, 41.3	25, 33.3
Mild	118, 34.1	20, 23.8	96, 38.1	27, 32.9	27, 31.0	31, 42.5	23, 31.9	10, 31.3	91, 33.6	27, 36.0
Moderate	59, 17.1	8, 9.5	49, 19.4	20, 24.4	16, 18.4	7, 9.6	8, 11.1	8, 25.0	44, 16.2	15, 20.0
Severe	32, 9.2	9, 10.7	22, 8.7	7, 8.5	11, 12.6	9, 12.3	3, 4.2	2, 6.3	24, 8.9	8, 10.7
< 10	225, 73.7	67, 79.8	181, 71.8	55, 67.1	60, 69.0	57, 78.1	61, 84.7	22, 68.8	203, 74.9	52, 69.3
≥ 10	91, 26.3	17, 20.2	71, 28.2	27, 32.9	27, 31.0	16, 21.9	11, 15.3	10, 31.3	68, 25.1	23, 30.7
Depression (PHQ9)										
None	165, 47.7	51, 60.7	109, 43.3	35, 42.7	45, 51.7	31, 42.5	37, 51.4	17, 53.1	129, 47.6	36, 48.0
Mild	105, 30.3	19, 22.6	84, 33.3	25, 30.5	21, 24.1	24, 32.9	28, 38.9	7, 21.9	84, 31.0	21, 28.0
Moderate	52, 15.0	9, 10.7	41, 16.3	19, 23.2	12, 13.8	10, 13.7	5, 6.9	6, 18.8	41, 15.1	11, 14.7
Mod. severe	14, 4.0	1, 1.2	12, 4.8	3, 3.7	4, 4.6	4, 5.5	2, 2.8	1, 3.1	11, 4.1	3, 4.0
Severe	10, 2.9	4, 4.8	6, 2.4	0, 0.0	5, 5.7	4, 5.5	0, 0.0	1, 3.1	6, 2.2	4, 5.3
< 10	270, 78.0	70, 83.3	193, 76.6	60, 73.2	66, 75.9	55, 75.3	65, 90.3	24, 75.0	213, 78.6	57, 76.0
≥ 10	76, 22.0	14, 16.7	59, 23.4	22, 26.8	21, 24.1	18, 24.7	7, 9.7	8, 25.0	58, 21.4	18, 24.0
PTSD (PCL-5)										
< 31	305,88.2	76, 90.5	221, 87.7	73, 89.0	75, 86.2	64, 87.7	65, 90.3	28, 87.5	240, 88.6	65, 86.7
≥ 31	41,11.8	8, 9.5	31, 12.3	9, 11.0	12, 13.8	9,12.3	7, 9.7	4, 12.5	31, 11.4	10, 13.3
Missing in category	0	10		0					0	

Table 3 continued

	Total	Sex		Career grade					Early registration	
	N, %	Male	Female	Student	F1	F2	Middle	Senior	No	Yes
EE, aMBI										
<27	149, 43.2	52, 61.9	95, 37.7	43, 52.4	34, 39.1	25, 34.2	38, 52.8	9, 28.1	122, 45.0	27, 36.0
≥ 27	196, 56.8	31, 36.9	157, 62.3	38, 46.3	53, 60.9	48, 65.8	34, 47.2	23, 71.9	148, 54.6	48, 64.0
LPA, aMBI										
>33	251, 72.8	62, 73.8	183, 72.6	53, 64.6	65, 74.7	54, 74.0	56, 77.8	23, 71.9	195, 72.0	56, 74.7
≤ 33	94, 27.2	21, 25.0	69, 27.4	28, 34.1	22, 25.3	19, 26.0	16, 22.2	9, 28.1	75, 27.7	19, 25.3
Missing in category	1	11		1					1	
DP, aMBI										
<10	218, 63.6	51, 60.7	160, 63.5	62, 75.6	56, 64.4	35, 47.9	46, 63.9	19, 59.4	170, 62.7	48, 64.0
≥ 10	125, 36.4	31, 36.9	91, 36.1	19, 23.2	30, 34.5	37, 50.7	26, 36.1	13, 40.6	99, 36.5	26, 34.7
Missing in category	3	13		3					3	
Burnout										
No burnout	307, 89.2	76, 90.5	221, 87.7	73, 89.0	78, 89.7	63, 86.3	65, 90.3	28, 87.5	241, 88.9	66, 88.0
Burnout	37, 10.8	6, 7.1	31, 12.3	8, 9.8	9, 10.3	9, 12.3	7, 9.7	4, 12.5	28, 10.3	9, 12.0
Missing in category	2	12		2					2	

EE = emotional exhaustion scale; LPA = low personal achievement scale; DP = depersonalisation scale; Student = final year medical student; F1 = foundation year 1 doctor; F2 = foundation year 2 doctor; Middle = junior and senior middle grade doctors; Senior = consultant or GP grade.

Table 4

Prevalence of mental health symptoms by age range, pre-existing mental health condition, adverse life events

	Total	Age			Pre-existing MH condition		Adverse event (non COVID)		Adverse event (COVID)	
	N = 346	18-24	25-29	30+	No	Yes	No	Yes	No	Yes
Anxiety (GAD7)										
None		38, 34.9	52, 39.1	25, 44.3	118, 45.0	15, 21.4	104, 42.3	30, 31.3	121, 41.7	13, 25.0
Mild		42, 38.5	47, 35.3	29, 29.9	84, 32.1	28, 40.0	86, 35.0	32, 33.3	96, 33.1	22, 42.3
Moderate		20, 18.3	20, 15.0	17, 17.5	39, 14.9	17, 24.3	39, 15.9	19, 19.8	48, 16.6	10, 19.2
Severe		9, 8.3	14, 10.5	8, 8.8	21, 8.0	10, 14.3	17, 6.9	15, 15.6	25, 8.6	7, 13.5
< 10		80, 73.4	99, 74.4	72, 79.1	202, 77.1	43, 61.4	190, 77.2	62, 64.6	217, 74.8	35, 67.3
≥ 10		29, 26.6	34, 25.6	25, 27.4	60, 22.9	27, 38.6	56, 22.8	34, 35.4	73, 25.2	17, 32.7
Depression (PHQ9)										
None		54, 49.5	64, 48.1	44, 48.3	141, 53.8	20, 28.6	131, 53.3	32, 33.3	149, 51.4	14, 26.9
Mild		34, 31.2	36, 27.1	33, 36.3	78, 29.8	22, 31.4	74, 30.1	20, 30.2	84, 29.0	19, 36.5
Moderate		18, 16.5	20, 15.0	13, 14.3	31, 11.8	16, 22.9	29, 11.8	23, 24.0	39, 13.4	13, 25.0
Mod. severe		2, 1.8	7, 5.3	4, 4.4	6, 2.3	8, 11.4	7, 2.8	7, 7.3	11, 3.8	3, 5.8
Severe		1, 0.9	6, 4.5	3, 3.3	6, 2.3	4, 5.7	5, 2.0	5, 5.2	7, 2.4	3, 5.8
< 10		88, 80.7	100, 75.2	77, 84.6	219, 83.6	42, 60.0	205, 83.3	61, 63.5	233, 80.3	33, 63.5
≥ 10		21, 19.3	33, 24.8	20, 22.0	43, 16.4	28, 40.0	41, 16.7	35, 36.5	57, 19.7	19, 36.5
PTSD (PCL-5)										
< 31		101, 92.7	116, 87.2	82, 90.1	237, 90.5	55, 78.6	224, 91.1	77, 80.2	261, 90.0	40, 76.9
≥ 31		8, 7.3	17, 12.8	15, 16.5	25, 9.5	15, 21.4	22, 8.9	19, 19.8	29, 10.0	12, 23.1
Missing in category		7			14		4		4	

		Age			Pre-existing MH condition		Adverse event (non COVID)		Adverse event (COVID)	
		18-24	25-29	30+	No	Yes	No	Yes	No	Yes
EE, aMBI										
<27		47, 43.1	56, 42.1	44, 48.3	123, 46.9	22, 31.4	118, 48.0	30, 31.3	128, 44.1	20, 38.5
≥ 27		61, 56.0	77, 57.9	53, 58.2	138, 52.7	48, 68.6	127, 51.6	66, 68.8	161, 55.5	32, 61.5
LPA, aMBI										
>33		78, 71.6	99, 74.4	70, 77.0	191, 72.9	50, 71.4	180, 73.2	68, 70.8	209, 72.1	39, 75.0
≤ 33		30, 27.5	34, 25.6	27, 30.0	70, 26.7	20, 28.6	65, 26.4	28, 29.2	80, 27.6	13, 25.0
Missing	1	8			15		5		5	
DP, aMBI										
<10		72, 66.1	77, 57.9	64, 70.3	162, 61.8	46, 65.7	151, 61.4	64, 66.7	176, 60.7	39, 75.0
≥ 10		35, 32.1	55, 41.4	33, 36.3	97, 37.0	24, 34.3	92, 37.4	32, 33.3	111, 38.3	13, 25.0
Missing	3	10			17		7		7	
Burnout										
No burnout		98, 89.9	116, 87.2	86, 94.5	231, 88.2	62, 88.6	222, 90.2	81, 84.4	255, 87.9	48, 92.3
Burnout		10, 9.2	16, 12.0	11, 12.0	29, 11.1	8, 11.4	22, 8.9	15, 15.6	33, 11.4	4, 7.7
Missing	2	9			16		6		6	

EE = emotional exhaustion scale; LPA = low personal achievement scale; DP = depersonalisation scale; MH = mental health.

3.3 Prevalence of suicidal thoughts

The prevalence of suicidal thoughts was assessed by question nine on the PHQ9 *"Thoughts that you would be better off dead, or of hurting yourself in some way".* Overall prevalence was 7.34% (32/346). Those who reported a pre-existing mental health condition had the highest rate of suicidal thoughts at 24.29% (17/70). Rates were higher in early career medics compared with just 2.98% of middle and senior grade medics (3/104). Table 5 provides further detail by sex, career grade, and pre-existing mental health condition.

Table 5

Frequency of answers to PHQ9 Q9 "Thoughts that you would be better off dead, or of hurting yourself in some way" (in the previous two weeks)

	N,%	Sex		Pre-existing MH		Career Grade			
PHQ9-Q9	Total (346)	Male (84)	Female (252)	No (249)	Yes (70)	Student (82)	F1 (87)	F2 (73)	Middle/ Senior (104)
Several days	21, 6.07	4, 4.76	15, 5.95	8, 3.21	11, 15.71	7, 8.54	5, 5.75	6, 8.22	3, 2.98
More than half the days	3, 0.87	0, 0	2, 0.79	2, 0.80	1, 1.43	0, 0	0, 0	3, 4.11	0, 0
Nearly every day	8, 2.31	2, 2.38	6, 2.38	3, 1.20	5, 7.14	1, 1.22	4, 4.60	3, 4.11	0, 0
Total	32, 7.34	6, 7.14	23, 9.13	13, 5.22	17, 24.29	8, 9.76	9, 10.34	12, 16.44	3 2.98

Student = final year medical student; F1 = foundation year 1 doctor; F2 = foundation year 2 doctor.

3.4 Group differences in mental health symptoms

Analysis of median GAD-7 anxiety scores revealed significant differences in males vs females, in those reporting pre-existing mental health conditions vs those without, in those reporting a significant non-COVID-related adverse event in the past twelve months vs those who had not, and in those reporting a significant COVID-related adverse event vs those who had not.

Similarly, for median PHQ9 depression scores, there were significant differences between males vs females, in those reporting pre-existing mental health conditions vs those without, in those reporting a significant non-COVID-related

adverse event in the previous twelve months vs those who had not, and in those reporting a significant COVID-related adverse event vs those who had not.

Analysis of median PCL-5 PTSD scores revealed significant group differences in those reporting pre-existing mental health conditions vs those without, in those reporting a significant non-COVID-related adverse event in the previous twelve months vs those who had not, and in those reporting a significant COVID-related adverse event vs those who had not.

For median emotional exhaustion (EE) scores there were significant differences between males vs females. There were also significant differences across career grades. F2s and senior grades recorded the same median scores, higher than the other groups. Post hoc Mann Whitney U analysis, with Bonferroni corrections applied (p=.017), confirmed a significant difference between F2s and final year medical students (U =2130.500, z=–2.996, p=.003, r=-.24), close to significance with middle grades (U=2031.00, z=–2.367, p=.018, r=.19656866), but no significant difference when compared with F1s (U=3.103.500, z=–.247, p=.805, r=.02). Senior grades were significantly different when compared with final year medical students (U=896.500, z=–2.551, p=.011, r =-.24), but not with F1s (U=1258.500, z=–.803, p=.422, r=-.07), or middle grades (U=844.00, z=–2.176, p=.030, r=-.21).

Analysis of median depersonalisation (DP) scores revealed significant differences across career grades. F2s recorded a higher median score other groups. Post hoc analysis with Bonferroni corrections (p=.0125) confirmed a significant difference between F2s compared with final year medical students (U=1959.0, z=–3.522, p=.000, r=-.28), but no significant difference when compared with F1s (U=2612.500, z=–1.697, p=.090, r=.13), senior grades (U=1074.00, z=–.551, p=.581, r=-.05), or middle grades (U=2036.00, z=–2.235, p=.025, r=.19).

For median scores on low personal achievement (LPA), none of the sub-group were statistically significantly different.

Tables 6-11 present full statistics for all group comparisons for all measures.

Table 6

Mann Whitney U test: group differences by sex and ethnicity

	Missing	Male	Female	U	*z*	*p*	*r*	Missing	EM	White	*U*	*z*	*p*	*r*
GAD7	10	84	252	13056.5	3.215	.001**	.18	11	73	262				
Md	-	4.0	6.0					-	5.0	6.0	9413.00	-.206	.837	-.01
PHQ9	10	84	252					11	73	262				
Md	-	3.5	5.0	12986.5	3.125	.002*	.17	-	5.0	5.0	9274.50	-.258	.796	-.01
PCL-5	10	84	252					11	73	262				
Md	-	6.0	9.0	11875.5	1.678	.093	.09	-	8.0	7.00	9972.00	.560	.576	.03
aMBI EE	11	83	252					12	73	261				
Md	-	21.00	30.00	13224	3.623	.000**	.20	-	30.00	30.00	10205.00	.933	.351	.05
aMBI DP	12	82	251					14	71	261				
Md	-	6.67	6.67	9447.5	-1.122	.262	-.06	-	6.67	6.67	9908.50	.903	.367	.05
aMBI LPA	11	83	252					12	73	261				
Md	-	37.33	37.33	10790.5	.438	.662	.02	-	37.33	37.33	9050.00	-.658	.510	-.04

*p = < .05 **p = < .001. GAD7 = generalised anxiety disorder scale; PHQ9 = patient health questionnaire' PCL-5 = PTSD checklist for DSM-5; aMBI = abbreviated Maslach burnout inventory; EE = emotional exhaustion scale; DP = depersonalisation scale; LPA = low personal achievement scale; EM = ethnic minority; Md = median.

Table 7

Mann Whitney U test: group differences by pre-existing mental health condition and early registration

	Pre-existing MH condition							Early registration						
	Missing	No	Yes	U	*z*	*p*	*r*	Missing	No	Yes	U	*z*	*p*	*r*
GAD7	14	262	70					0	271	75				
Md	-	5.0	7.0	11412	3.151	**.002***	.17	-	5.0	6.0	11399.00	1.617	.106	.09
PHQ9	14	262	70					0	271	75				
Md	-	4.0	8.0	12522	4.713	**.000****	.26	-	5.0	5.0	10874.50	.932	.352	.05
PCL-5	14	262	70					0	271	75				
Md	-	6.5	13.00	11819	3.721	**.000****	.20	-	7.0	8.0	10877.50	.934	.350	.05
aMBI EE	15	261	70					1	270	75				
Md	-	27.00	31.50	10298	1.640	.101	.09	-	27.00	30.00	11582.00	1.911	.056	.10
aMBI DP	17	259	70					3	269	74				
Md	-	6.67	6.67	9040.5	-.035	.972	-.00	-	6.67	6.67	10143.00	.253	.800	.01
aMBI LPA	15	261	70					1	270	75				
Md	-	37.33	40.00	9943	1.145	.252	.06	-	37.33	40.00	11367.50	1.638	.101	.09

*p = < .05 **p = < .001. GAD7 = generalised anxiety disorder scale; PHQ9 = patient health questionnaire; PCL-5 = PTSD checklist for DSM-5; aMBI = abbreviated Maslach burnout inventory; EE = emotional exhaustion scale; DP = depersonalisation scale; LPA = low personal achievement scale; Md = median; MH = mental health.

Table 8

Mann Whitney U test: group differences by adverse life event in past 12 months

	Adverse event (Non-COVID)							Adverse event (COVID)						
	Missing	No	Yes	U	*z*	*p*	*r*	Missing	No	Yes	U	*z*	*p*	*r*
GAD7	4	246	96					4	290	52				
Md	-	5.00	6.50	13459.5	2.015	**.044***	.11	-	5.00	7.00	9029	2.274	**.023***	.12
PHQ9	4	246	96					4	290	52				
Md	-	4.00	7.00	15655.5	4.697	**.000****	.25	-	4.00	7.00	9813.5	3.473	**.001****	.19
PCL-5	4	246	96					4	290	52				
Md	-	7.00	13.00	14637.5	3.451	**.001****	.19	-	7.00	14.50	10059.5	3.845	**.000****	.21
aMBI EE	5	245	96					5	289	52				
Md	-	27.00	30.00	12746.5	1.208	.227	.07	-	30.00	28.50	7596.5	.236	.899	.01
aMBI DP	7	243	96					7	287	52				
Md	-	6.67	6.67	11201	-.573	.566	-.03	-	6.67	6.67	6497	-1.494	.135	-.08
aMBI LPA	5	245	96					5	289	52				
Md	-	37.33	40.00	12749.5	1.218	.223	.07	-	37.33	37.33	7561	.072	.942	.00

*p = < .05 **p = < .001 GAD7 = generalised anxiety disorder scale; PHQ9 = patient health questionnaire; PCL-5 = PTSD checklist for DSM-5; aMBI = abbreviated Maslach burnout inventory; EE = emotional exhaustion scale; DP = depersonalisation scale; LPA = low personal achievement scale; Md = median.

Table 9

Mann Whitney U test: group differences by vulnerable group (self/ relative)

	Vulnerable group (self)							Vulnerable group (close relative/ live with)						
	Missing	No	Yes	U	*z*	*p*	*r*	Missing	No	Yes	U	*z*	*p*	*r*
GAD7	5	312	29					7	234	105				
Md	-	6.0	6.0	4505.500	-.037	.971	.002	-	6.0	5.0	11675.00	-.733	.464	.04
PHQ9	5	312	29					7	234	105				
Md	-	5.0	6.0	4822.00	.589	.556	.03	-	5.0	5.0	12862.00	.694	.488	.04
PCL-5	5	312	29					7	234	105				
Md	-	7.0	11.00	5361.00	1.651	.099	.09	-	7.0	8.0	12795.50	.613	.540	.03
aMBI EE	6	311	29					8	234	104				
Md	-	27.00	30.00	4991.00	.953	.340	.05	-	27.0	30.00	12488.50	.387	.698	.02
aMBI DP	8	309	29					10	233	103				
Md	-	6.67	6.67	4643.00	.325	.745	.02	-	6.67	6.67	11925.00	-.091	.927	-.00
aMBI LPA	6	311	29					8	234	104				
Md	-	37.33	37.33	4755.500	.490	.624	.03	-	37.33	37.33	12435.00	.324	.746	.02

*p = < .05 **p = < .001 GAD7 = generalised anxiety disorder scale; PHQ9 = patient health questionnaire; PCL-5 = PTSD checklist for DSM-5; aMBI = abbreviated Maslach burnout inventory; EE = emotional exhaustion scale; DP = depersonalisation scale; LPA = low personal achievement scale; Md = median.

Table 10

Kruskal-Wallis Test: Group differences by age range

		Age range						
	Missing	18-24	25-29	30-34	35+	H	*df*	*p*
GAD7	7	109	133	54	33			
Md	-	6.00	5.00	5.00	6.00	1.59	3	.661
PHQ9	7	109	133	54	33			
Md	-	5.00	5.00	5.00	4.00	.148	3	.986
PCL-5	7	109	133	54	33			
Md	-	7.00	8.00	8.00	10.00	2.28	3	.516
aMBI EE	8	108	133	54	43			
Md	-	30.00	30.00	25.50	30.00	.133	3	.988
aMBI DP	10	107	132	54	43			
Md	-	6.67	6.67	6.67	6.67	.750	3	.861
aMBI LPA	8	108	133	54	43			
Md	-	37.33	37.33	40.00	37.33	1.257	3	.739

*p = < .05 **p = < .001 GAD7 = generalised anxiety disorder scale; PHQ9 = patient health questionnaire; PCL-5 = PTSD checklist for DSM-5; aMBI = abbreviated Maslach burnout inventory; EE = emotional exhaustion scale; DP = depersonalisation scale; LPA = low personal achievement scale; Md = median.

Table 11

Kruskal-Wallis Test: Group differences by career grade

		Career Grade							
	Missing	Student	F1	F2	Middle	Senior	H	*df*	*p*
GAD7	0	82	87	73	72	32			
Md	-	6.00	6.00	6.00	4.00	5.50	8.66	4	.070
PHQ9	0	82	87	73	72	32			
Md	-	5.00	4.00	5.00	4.00	4.00	5.51	4	.239
PCL-5	0	82	87	73	72	32			
Md	-	7.00	7.00	9.00	7.00	9.50	2.93	4	.569
aMBI EE	1	81	87	73	72	32			
Md	-	24.00	30.00	33.00	24.00	33.00	16.75	4	.002*
aMBI DP	3	82	86	72	72	32			
Md	-	5.00	6.67	10.00	6.67	7.50	13.15	4	.011*
aMBI LPA	1	81	87	73	72	32			
Md	-	37.33	40.00	37.33	37.33	37.33	6.92	4	.140

*p = < .05 **p = < .001. GAD7 = generalised anxiety disorder scale; PHQ9 = patient health questionnaire; PCL-5 = PTSD checklist for DSM-5; aMBI = abbreviated Maslach burnout inventory; EE = emotional exhaustion scale; DP = depersonalisation scale; LPA = low personal achievement scale; Md = median; Student = final year medical student; F1 = foundation year 1; F2 = foundation year 2; Middle = junior and senior middle grades; Senior = consultant and GP grade.

Table 13
Spearman's Rho Correlations

	1	2	3	4	5	6	7	8	9	10
1. GAD7	-									
2. PHQ9	.723**	-								
3. PCL-5	.641**	.718**	-							
4. aMBI EE	.432**	.414**	.404**	-						
5. aMBI DP	.124*	.115*	.150**	.424**	-					
6. aMBI LPA	-.109*	-.109*	-.037	-.221**	-.195**	-				
7. CompACT-SF	-.589**	-.638**	-.621**	-.437**	-.235**	.148**	-			
8. IUS-12	.436**	.347**	.384**	.309**	.129*	-.176**	-.407**	-		
9. CD-RISC-10	-.372**	-.332**	-.274**	-.425**	-.219**	.407**	.473**	-.415**	-	
10. COVID Pt Contact	.080	.105	.157**	.107*	.176**	.057	-.071	.052	.024	-

* p = <.05 **p = < .01. GAD7 = Generalised Anxiety Disorder -7 Item; PHQ9 = Patient Health Questionnaire- 9 Item; PCL-5 = PTSD checklist for DSM-5; aMBI = abbreviated Maslach Burnout Inventory; EE = emotional exhaustion scale; DP = depersonalisation scale; LPA = low personal achievement scale; CompACT-SF = Comprehensive assessment of Acceptance and Commitment Therapy processes - short form; IUS-12 = Intolerance of Uncertainty Scale – 12 Item; CD-RISC-10 = Connor Davidson Resilience Scale- 10 Item; COVID pt Contact = frequency of contact with COVID-19 patients.

3.5 Associations between primary IVs and mental health outcomes

Spearmans rho correlation analysis revealed all primary IVs were statistically significantly associated with all mental health outcomes. Psychological flexibility showed a large effect size for anxiety, depression and PTSD; a medium effect size for EE; and small effect size for DP and LPA. IoU showed a medium effect sized for depression, anxiety, PTSD and EE, and small effect sizes for DP and LPA. Resilience showed a medium effect size for anxiety, depression, EE and LPA, and a small association with PTSD and DP. Further details, including strength of associations, are presented in tables 12-13.

Table 12

Coefficient of determination for psychological predictors

%	GAD7	PHQ9	PCL-5	aMBI EE	aMBI DP	aMBI LPA
CompACT-SF	34.69	40.70	38.56	19.09	5.52	2.19
IUS-12	19.0	12.04	14.74	9.54	1.66	3.09
CD-RISC-10	13.83	11.02	7.50	18.06	4.79	16.56

3.6 Predictors of binary outcomes

The anxiety model containing all predictors was statistically significant, $\chi 2$ (12, N=318) =87.851, p=<.0005, indicating that the model was able to distinguish respondents scoring above clinical cut-off on the GAD7. The model as a whole explained between 24.1% (Cox and Snell) and 35.2% (Nagelkerke) of the variance in probable anxiety cases, and correctly classified 80.2% of cases, up from 73.6% at block 0. Psychological flexibility, IoU and resilience all made unique statistically significant contributions. The strongest predictor of probable cases of anxiety was psychological flexibility; the odds ratio reveals that for each one-point increase on the scale participants were .91 times less likely to have anxiety symptoms above cut-off.

The depression model containing all predictors was statistically significant, $\chi 2$ (12, N=318) =91.787, p=<.0005, indicating that the model was able to distinguish respondents scoring above clinical cut-off on the PHQ9. The model as a whole

explained between 25.1% (Cox and Snell) and 39.4% (Nagelkerke) of the variance in probable depression cases, and correctly classified 80.2% of cases, up from 79.6% at block 0. Only psychological flexibility made a unique statistically significant contribution; the odds ratio reveals that for each one-point increase on the CompACT-SF participants were .84 times less likely have depression symptoms above cut-off.

The PTSD model containing all predictors was statistically significant, $\chi 2$ (12, N=318) =61.323, p=<.0005, indicating that the model was able to distinguish respondents scoring above clinical cut-off on the PCL-5. The model as a whole explained between 17.5% (Cox and Snell) and 35.5% (Nagelkerke) of the variance in probable PTSD cases, and correctly classified 91.2% of cases, up from 89.3% at block 0. Only psychological flexibility and intolerance of uncertainty made a unique statistically significant contribution. The strongest predictor of probable cases of PTSD was psychological flexibility; the odds ratio reveals that for each one-point increase on the CompACT-SF participants were .83 times less likely to have PTSD symptoms above cut-off.

The burnout model containing all predictors was statistically significant, $\chi 2$ (12, N=316) =59.596, p=<.0005, indicating that the model was able to distinguish respondents scoring above/ below the specified cut-offs on all three subscales of the aMBI. The model as a whole explained between 17.2% (Cox and Snell) and 34.3% (Nagelkerke) of the variance in burnout cases, and correctly classified 88.9% of cases, the same as for block 0. Adverse non-COVID-related event and resilience were the only variables that made a unique statistically significant contribution. The strongest predictor of clinical cases of burnout was adverse non-COVID-related event; the odds ratio reveals that people reporting having experienced such an event were 2.873 times more likely to meet the criteria for burnout.

Tables 14-17 present full details of all logistic regression analyses.

Table 14

Logistic regression: predictors of GAD7 scores ≥ 10

Variable	β	S.E.	Wald	*df*	*p*	Odds Ratio	95% C.I. for Odds Ratio	
							Lower	Upper
Early registration	.621	.364	2.900	1	.089	1.860	.911	3.799
Ethnicity	-.703	.378	3.452	1	.063	.495	.236	1.039
Vulnerable group (self)	.251	.541	.215	1	.643	1.285	.445	3.708
Vulnerable group (relative)	.050	.338	.022	1	.882	1.052	.542	2.042
Adverse COVID event	.260	.412	.400	1	.527	1.297	.579	2.907
Adverse non-COVID event	.155	.338	.211	1	.646	1.168	.602	2.263
Pre-existing mental health	-.092	.360	.065	1	.799	.912	.451	1.847
Sex	.528	.399	1.750	1	.186	1.696	.776	3.707
COVID patient contact	-.094	.123	.583	1	.445	.910	.716	1.158
Psychological flexibility	-.097	.025	15.767	1	**.000****	.907	.865	.952
Resilience	-.064	.030	4.635	1	**.031***	.938	.886	.994
Intolerance of uncertainty	.064	.019	11.277	1	**.001****	1.066	1.027	1.106

*p = < .05 **p = < .001

Table 15

Logistic regression: predictors of PHQ9 scores ≥ 10

Variable	β	S.E.	Wald	*df*	*p*	Odds Ratio	95% C.I. for Odds Ratio	
							Lower	Upper
Early registration	.027	.415	.004	1	.948	1.027	.455	2.139
Ethnicity	-.363	.408	.791	1	.274	.696	.312	1.548
Vulnerable group (self)	.081	.580	.020	1	.889	1.085	.348	3.377
Vulnerable group (relative)	.578	.370	2.443	1	.118	1.782	.864	3.676
Adverse COVID event	.125	.438	.081	1	.776	1.133	.480	2.672
Adverse non-COVID event	.658	.359	3.362	1	.067	1.932	.956	3.905
Pre-existing mental health	.507	.378	1.802	1	.180	1.660	.792	3.279
Sex	.460	.450	1.043	1	.307	1.584	.655	3.829
COVID patient contact	.126	.139	.819	1	.365	1.134	.864	1.488
Psychological flexibility	-.173	.030	32.680	1	.000**	.841	.792	.892
Resilience	.002	.031	.006	1	.937	1.002	.943	1.065
Intolerance of uncertainty	.025	.020	1.546	1	.214	1.026	.985	1.068

*p = < .05 **p = < .001

Psychological flexibility- measured by CompACT-SF; Resilience – measured by CD-RISC-10; Intolerance of uncertainty – measured by IUS-12.

Table 16

Logistic regression: predictors of PCL-5 scores ≥ 31

Variable	β	S.E.	Wald	*df*	*p*	Odds Ratio	95% C.I. for Odds Ratio	
							Lower	Upper
Early registration	.105	.514	.042	1	.838	1.111	.405	3.044
Ethnicity	.434	.477	.828	1	.363	1.543	.606	3.929
Vulnerable group (self)	.636	.635	1.003	1	.317	1.889	.544	6.557
Vulnerable group (relative)	.106	.476	.050	1	.824	1.112	.437	2.827
Adverse COVID event	.500	.529	.893	1	.345	1.649	.585	4.648
Adverse non-COVID event	.408	.452	.814	1	.367	1.503	.620	3.643
Pre-existing mental health	-.122	.491	.062	1	.803	.885	.338	2.317
Sex	.327	.567	.333	1	.564	1.387	.456	4.216
COVID patient contact	-.078	.175	.199	1	.655	.925	.656	1.303
Psychological flexibility	-.186	.040	21.985	1	**.000****	.830	.768	.897
Resilience	.036	.038	.864	1	.353	1.036	.961	1.117
Intolerance of uncertainty	.051	.026	3.870	1	**.049***	1.052	1.000	1.107

*p = < .05 **p = < .001.

Psychological flexibility- measured by CompACT-SF; Resilience – measured by CD-RISC-10; Intolerance of uncertainty – measured by IUS-12.

Table 17

Logistic regression: predictors of burnout (above/ below cut-off on all three subscales)

Variable	β	S.E.	Wald	*df*	*p*	Odds Ratio	95% C.I. for Odds Ratio	
							Lower	Upper
Early registration	.375	.503	.555	1	.456	1.454	.543	3.895
Ethnicity	.133	.483	.076	1	.783	1.142	.444	2.942
Vulnerable group (self)	.237	.818	.084	1	.772	1.268	.255	6.297
Vulnerable group (relative)	.600	.442	1.841	1	.175	1.822	.766	4.334
Adverse COVID event	-1.089	.646	2.841	1	.092	.337	.095	1.194
Adverse non-COVID event	1.055	.473	4.979	1	**.026***	2.873	1.137	7.260
Pre-existing mental health	-.489	.511	.913	1	.339	.613	.225	1.671
Sex	.446	.549	.658	1	.417	1.561	.532	4.584
COVID patient contact	.279	.181	2.376	1	.123	1.322	.927	1.886
Psychological flexibility	-.041	.035	1.336	1	.248	.960	.896	1.029
Resilience	-.235	.049	23.088	1	**.000****	.791	.719	.870
Intolerance of uncertainty	-.011	.024	.223	1	.637	.989	.943	1.036

*p = < .05 **p = < .001

Psychological flexibility- measured by CompACT-SF; Resilience – measured by CD-RISC-10; Intolerance of uncertainty – measured by IUS-12.

Table 18

Hierarchical multiple regression: predictors of anxiety symptoms (GAD7)

	Step 1 (control variables)				Step 2			
	B	*SE B*	*β*	*p*	B	SE B	*β*	*p*
Early registration	.980	.697	.077	.161	.974	.577	.077	.092
Ethnicity	-.073	.693	-.006	.916	-.880	.576	-.069	.128
Vul. group (self)	.433	1.025	.023	.673	-.276	.851	-.015	.745
Vul. group (rel.)	-.204	.623	-.018	.744	.273	.514	.024	.596
AE COVID	.918	.817	.063	.262	.473	.679	.032	.487
AE non-COVID	1.223	.655	.105	.063	.501	.543	.043	.357
Pre mental health	1.832	.725	.143	**.012***	.156	.611	.012	.798
Sex	1.438	.665	.119	**.031***	.706	.549	.058	.200
COVID pt contact	.220	.226	.054	.330	.045	.186	.011	.807
Psych flexibility	-	-	-	-	-.256	.036	-.400	**.000****
Resilience	-	-	-	-	-.058	.044	-.071	.186
IoU	-	-	-	-	.135	.029	.243	**.000****
R^2			.073				.382	
R^2 Change			.073				.310	
F Change			2.740				52.143	
Sig F Change			**.004***				**.000****	

*p = < .05 **p = < .001 Vul. group = clinically vulnerable group; AE = adverse event; Pre mental health = pre-existing mental health condition; COVID pt contact = frequency of contact with COVID-19 patients.

3.7 Predictors of continuous scores

For the anxiety model, the control variables entered at step-one explained 7.3% of the variance in symptoms. At step-two, the total variance explained by the model as a whole was 38.2%, F (12, 312) =16.10, p=<.0005. The three primary IVs explained an additional 31% of the variance in anxiety, after controlling for step-one variables. In the final model, only psychological flexibility and IoU were statistically significant.

Table 19

Hierarchical multiple regression: predictors of depression symptoms (PHQ9)

	Step 1 (control variables)				Step 2			
	B	*SE B*	*β*	*p*	B	SE B	*β*	*p*
Early registration	.572	.659	.045	.387	.610	.547	.049	.266
Ethnicity	-.316	.655	-.25	.630	-.817	.547	-.065	.136
Vul. group (self)	.834	.969	.045	.390	.008	.808	.000	.992
Vul. group (rel.)	.217	.589	.019	.713	.784	.488	.070	.109
AE COVID	1.277	.772	.089	.099	.512	.645	.036	.427
AE non-COVID	2.306	.619	.200	**.000****	1.554	.516	.135	**.003***
Pre mental health	2.707	.686	.213	**.000****	1.083	.580	.085	.063
Sex	1.364	.629	.114	**.031***	.810	.521	.068	.121
COVID pt contact	.326	.213	.082	.127	.177	.177	.044	.316
Psych flexibility	-	-	-	-	-.319	.034	-.505	**.000****
Resilience	-	-	-	-	-.042	.041	-.052	.316
IoU	-	-	-	-	.036	.028	.066	.192
R^2			.151				.430	
R^2 Change			.151				.279	
F Change			6.228				50.867	
Sig F Change			**.000****				**.000****	

*p = < .05 **p = < .001 Vul. group = clinically vulnerable group; AE = adverse event; Pre mental health = pre-existing mental health condition; COVID pt contact = frequency of contact with COVID-19 patients.

For the depression model, the variables entered at step-one explained 15.1% of the variance in symptoms. At step-two, the total variance explained by the model as a whole was 43%, F (12, 312) =19.606, p=<.0005. The three primary IVs explained an additional 28% of the variance in anxiety, after controlling for step-one variables. In the final model, only psychological flexibility and adverse non-COVID life event were statistically significant.

Table 20

Hierarchical multiple regression: predictors of PTSD symptoms (PCL-5)

	Step 1 (control variables)				Step 2			
	B	*SE B*	*β*	*p*	B	SE B	*β*	*p*
Early registration	.212	.251	.045	.399	.160	.202	.034	.428
Ethnicity	.068	.250	.014	.786	-.189	.201	-.040	.350
Vul. group (self)	.771	.369	.110	**.038***	.375	.297	.054	.208
Vul. group (rel.)	.139	.224	.033	.536	.332	.180	.079	.066
AE COVID	.754	.294	.139	**.011***	.495	.237	.091	**.038***
AE non-COVID	.508	.236	.117	.032*	.177	.190	.042	.351
Pre mental health	.841	.261	.176	**.001****	.206	.214	.043	.335
Sex	.361	.239	.080	.132	.113	.192	.025	.558
COVID pt contact	.207	.081	.137	**.011***	.133	.065	.088	**.042***
Psych flexibility	-	-	-	-	-.127	.013	-.535	**.000****
Resilience	-	-	-	-	.017	.015	.057	.262
IoU	-	-	-	-	.038	.010	.183	**.000****
R^2			.133				.455	
R^2 Change			.133				.322	
F Change			5.374				61.558	
Sig F Change			**.000****				**.000****	

*p = < .05 **p = < .001 Vul. group = clinically vulnerable group; AE = adverse event; Pre mental health = pre-existing mental health condition; COVID pt contact = frequency of contact with COVID-19 patients.

For the PTSD model, the variables entered at step-one explained 13.3% of the variance in symptoms. At step-two, the total variance explained by the model as a whole was 45.5%, F (12, 312) =21.75, p=<.0005. The three primary IVs explained an additional 32.2% of the variance in PTSD symptoms, after controlling for step-one variables. In the final model, statistically significant step-one variables were: COVID-related adverse life event and frequency of contact with COVID patients; significant step-two variables were psychological flexibility and IoU.

Table 21

Hierarchical multiple regression: predictors of emotional exhaustion symptoms

	Step 1 (control variables)				Step 2			
	B	*SE B*	*β*	*p*	B	SE B	*β*	*p*
Early registration	3.072	1.738	.097	.078	3.756	1.516	.118	**.014***
Ethnicity	1.245	1.728	.039	.472	-.097	1.515	-.003	.949
Vul. group (self)	2.383	2.554	.051	.352	1.741	2.237	.037	.437
Vul. group (rel.)	1.444	1.551	.051	.353	2.709	1.351	.096	**.046***
AE COVID	-1.594	2.035	-.044	.434	-2.714	1.786	-.074	.130
AE non-COVID	1.034	1.633	.035	.527	-.093	1.429	-.003	.948
Pre mental health	2.425	1.807	.075	.181	-1.235	1.606	-.038	.442
Sex	6.384	1.657	.211	**.000****	5.003	1.444	.165	**.001***
COVID pt contact	1.186	.562	.117	**.036***	.957	.489	.094	.051*
Psych flexibility	-	-	-	-	-.469	.095	-.293	**.000****
Resilience	-	-	-	-	-.506	.115	-.249	**.000****
IoU	-	-	-	-	.116	.077	.084	.130
R^2			.079				.317	
R^2 Change			.079				.238	
F Change			3.005				36.236	
Sig F Change			**.002***				**.000****	

*p = < .05 **p = < .001 Vul. group = clinically vulnerable group; AE = adverse event; Pre mental health = pre-existing mental health condition; COVID pt contact = frequency of contact with COVID-19 patients.

For the emotional exhaustion (burnout subscale) model, the variables entered at step-one explained 7.9% of the variance in symptoms. At step-two, the total variance explained by the model as a whole was 31.7%, F (12, 312) =12.069, p=<.0005. The three primary IVs explained an additional 23.8% of the variance in symptoms, after controlling for step-one variables. In the final model, statistically significant step-one variables were: sex, early registration, close relative/same household with a clinically vulnerable group; significant step-two variables were psychological flexibility and resilience.

Table 22

Hierarchical multiple regression: predictors of depersonalisation symptoms

	Step 1 (control variables)				Step 2			
	B	*SE B*	*β*	*p*	B	SE B	*β*	*p*
Early registration	-.043	.205	-.012	.834	-.004	.198	-.001	.985
Ethnicity	.098	.204	.027	.631	.031	.198	.008	.876
Vul. group (self)	.124	.301	.023	.552	.043	.293	.008	.884
Vul. group (rel.)	-.022	.183	-.007	.905	.076	.177	023	.670
AE COVID	-.458	.240	-.108	.057	-.575	.234	-.136	**.014***
AE non-COVID	-.119	.192	-.035	.536	-.214	.187	-.063	.253
Pre mental health	.168	.213	.045	.429	-.088	.210	-.024	.677
Sex	-.278	.195	-.079	.156	-.359	.189	-.102	.058
COVID pt contact	.229	.066	.2195	**.001****	.212	.064	.180	**.001****
Psych flexibility	-	-	-	-	-.044	.012	-.236	**.000****
Resilience	-	-	-	-	-.026	.015	-.109	.088
IoU	-	-	-	-	.000	.010	-.001	.987
R^2			.051				.133	
R^2 Change			.051				.082	
F Change			1.889				9.785	
Sig F Change			.053				**.000****	

*p = < .05 **p = < .001 Vul. group = clinically vulnerable group; AE = adverse event; Pre mental health = pre-existing mental health condition; COVID pt contact = frequency of contact with COVID-19 patients.

For the depersonalisation (burnout subscale) model, the variables entered at step-one explained 5.1% of the variance in symptoms. At step-two, the total variance explained by the model as a whole was 13.3%, F (12, 312) =3.981, p =<.0005. The three primary IVs explained an additional 8.2% of the variance in symptoms, after controlling for step-one variables. In the final model, statistically significant step-one variables were: adverse COVID life event and frequency of contact with COVID patients. The only significant step-two variable was psychological flexibility.

Table 23

Hierarchical multiple regression: predictors of low personal achievement symptoms

	Step 1 (control variables)				Step 2			
	B	*SE B*	*β*	*p*	B	SE B	*β*	*p*
Early registration	1.868	1.111	.095	.094	1.127	1.023	.057	.271
Ethnicity	-.515	1.104	-.026	.642	.049	1.021	.003	.962
Vul. group (self)	1.191	1.633	.041	.466	.525	1.509	.018	.728
Vul. group (rel.)	.285	.992	.016	.774	-.219	.911	-.013	.810
AE COVID	-.333	1.301	-.015	.798	-.262	1.204	-.012	.828
AE non-COVID	.259	1.044	.014	.804	.255	.963	.014	.791
Pre mental health	.398	1.155	.020	.731	1.768	1.083	.089	.104
Sex	.250	1.059	.013	.814	.812	.974	.043	.405
COVID pt contact	.335	.359	.053	.352	.328	.330	.052	.321
Psych flexibility	-	-	-	-	.006	.064	.006	.930
Resilience	-	-	-	-	.507	.077	.404	**.000****
IoU	-	-	-	-	-.035	.052	-.041	.499
R^2			.016				.187	
R^2 Change			.016				.172	
F Change			.552				21.999	
Sig F Change			.836				**.000****	

*p = < .05 **p = < .001 Vul. group = clinically vulnerable group; AE = adverse event; Pre mental health = pre-existing mental health condition; COVID pt contact = frequency of contact with COVID-19 patients.

For the low personal achievement (burnout subscale) model, the variables entered at step-one explained 1.6% of the variance in symptoms. At step-two, the total variance explained by the model as a whole was 18.7%, F (12, 312) =5.997, p=<.0005. The three primary IVs explained an additional 17.2% of the variance in symptoms, after controlling for step-one variables. In the final model, the only statistically significant variable was resilience.

Tables 18-23 present full details of all multiple regression analyses.

4. Discussion

4.1 Summary of prevalence of mental health symptoms

This cross-sectional study provides an estimate of the prevalence of mental health symptoms among UK doctors and final year medical students during the COVID-19 pandemic. The 25.3% prevalence of anxiety reported is similar to other recent UK-based studies of doctors during the pandemic (24.6%, Shah et al., 2020; 28%, Greenberg et al., 2021). It is also very close to the 25.8% (95% CI 20.4-31.5%) global prevalence of anxiety among doctors, found in a meta-analysis covering the first year of the pandemic (Johns, 2021). The rate for depression (22.4%) falls between the 15.9% reported by Shah et al. (2020) for obstetrics and gynaecology doctors, and the 31% reported by Greenberg (2021) for ICU doctors. It is also comparable with the estimated 20.5% (95% CI 16.0-25.3%) global prevalence among doctors during the pandemic (Johns, 2021). Symptoms of probable PTSD (11.6%) were significantly lower than the 32% reported by Greenberg et al. (2021), perhaps due to the emotive nature of ICU work. Burnout (10.8%) was considerably lower in this study, compared with previous reports. Although rates on the subscales of emotional exhaustion (56.8%) and depersonalisation (i.e., unfeeling or impersonal response toward patients) (36.4%) were very high, indicating risk of future burnout.

Data from a longitudinal study of adults in the general population in England (Fancourt et al., 2021), conducted between March and August 2020, indicated higher levels of depression (26%) and anxiety (22%) during the early stages of the pandemic, followed by a rapid decline, potentially as people adapted to the situation. By week twenty, prevalence had dropped significantly to 16.3% for depression and 11.5% for anxiety. Considering the current study was conducted from September 2020 onwards, the prevalence for doctors in the UK appears not to have followed the same declining trajectory as observed in the general population in England.

4.2 Sociodemographic risk factors for poor mental health

In the current study, females were significantly more likely to have higher symptoms of anxiety, depression and emotional exhaustion, a finding that has been widely reported in the literature for doctors (Kinman & Teoh, 2018). Medics reporting a pre-existing mental health condition were also significantly more likely to have increased symptoms of anxiety, depression and PTSD. Nearly a quarter (24.29%) of medics in this category reported thoughts of suicide or self-harm within the previous two weeks, compared with 5.22% of doctors without a pre-existing mental health condition. The increased suicide risk among doctors has previously been highlighted (Ventriglio et al., 2020). F2 and senior doctors were statistically more likely to have higher symptoms of emotional exhaustion compared with final year medial students, although there were no significant differences when compared with other groups. F2s were also statistically more likely to have higher symptoms of depersonalisation compared with final year medial students, but not in comparison with other groups. These findings provide some support for previous reports that burnout seems to peak at F2 (Taylor, 2020). Participants who had experienced a COVID-related adverse event were also more likely to have higher symptoms of depression, anxiety and PTSD, as were participants who had experienced a non-COVID-related adverse event within the previous twelve months. Collectively these results suggest it may be beneficial for support for doctors and medical students to be targeted towards those at greater risk of poor mental health (i.e., females, those with pre-existing mental health conditions) and for greater consideration and support to be given to the impact of recent adverse life experiences, both inside and outside of the workplace. Given the high rates observed across career grades, support should be targeted towards doctors at all career stages.

Frequency of contact with COVID patients and experience of a COVID-related adverse event were only significant in the multiple regression models as

predictors of PTSD and depersonalisation (burnout subscales). Interestingly, although experience of a COVID-related adverse event was *positively* associated in all other significant relationships, it was *negatively* associated with depersonalisation. A tentative hypothesis for this finding is that these experiences lead to increased empathy towards patients. Specifically, doctors who have recent first-hand experiences similar to those of their patients may be partially protected from feelings of depersonalisation (cynicism) towards them. This may be an area worthy of further research.

4.3 Psychological predictors of poor mental health

The current study found that psychological flexibility negatively predicted binary outcomes (i.e., cases above cut-off) for all outcomes apart from burnout. Psychological flexibility also demonstrated incremental negative predictive validity for all mental health outcomes in multiple regression models, over and above sociodemographic variables. These results are consistent with recent findings from studies conducted with the general population during the pandemic (Dawson & Golijani-Moghaddam, 2020; Kroska et al., 2020; McCracken et al., 2021). In contrast to some of the pre-pandemic literature (Solms et al., 2019; Wood et al., 2020; Buck et al., 2019), categorical burnout and low personal achievement were the only outcomes for which psychological flexibility was not a significant predictor. For categorical burnout, this may be due to the more stringent criteria adopted in the current study, following concerns around over-estimation of burnout in doctors (Lim et al., 2020).

IoU and resilience were both significantly associated with all mental health outcomes in Spearmans correlational analyses. In regression analyses, IoU positively predicted cases (i.e., above cut-off) of anxiety and PTSD, and demonstrated positive incremental validity for symptoms of both. Resilience negatively predicted emotional exhaustion and low personal achievement scores, it also predicted anxiety cases and was the only primary IV to predict burnout.

However, neither processes were able to predict outcomes as consistently or as strongly as psychological flexibility.

4.4. Conceptual similarities and differences

It is important to consider the potential overlap in the underlying constructs of the three primary IVs in this study, as well as the features that distinguish them. Psychological flexibility appears to be a much broader concept than IoU, but both incorporate the idea that distress arises from avoidance. While IoU is predominantly focussed on the avoidance of uncertainty, reduced psychological flexibility is associated with avoidance of a wider range of experiences. Psychological flexibility, as assessed by the CompACT, has a three-factor structure: openness to experience, behavioural awareness, and valued action (Francis et al., 2016). Whereas IoU is thought to have a two-factor structure: prospective (i.e., desire for predictability) and inhibitory (i.e., uncertainty paralysis) (Hong & Lee, 2015). Although IoU has historically been associated more closely with generalised anxiety disorder, the inhibitory factor has been found to be associated with social phobia, depression, and obsessive-compulsive disorder; indicating it may also be a transdiagnostic construct (Mahoney & McEvoy, 2012; Einstein, 2014). Further, resilience has been conceptualised as a contextual behavioural factor, or set of behaviours (Gentili et al, 2019), closely related to the behavioural aspects of psychological flexibility (i.e., ability to act in line with values in the presence of discomfort).

One hypothesis is that IoU and/ or resilience may be subsumed under the broader concept of psychological flexibility. However, further research is needed to parse out these psychological concepts and explore which, if any, of their underlying constructs are convergent. Dismantling studies may help to clarify which factors are most amenable to change through therapeutic intervention. Another consideration is the potential overlap with other related concepts. For example, close parallels have been drawn between psychological flexibility and executive function (Cherry et al., 2020), a concept most closely associated with the field of

neuropsychology and with its own extensive body of research. Indeed, some have suggested executive functioning is one of the 'building blocks' of psychological flexibility (Kashdan et al., 2010). Executive function is the 'top-down' process of engaging in goal-directed behaviour by overriding pre-potent responses; a feature that could be considered common to all three IVs in this study. However, executive function is similarly not a unitary concept and there has been much debate regarding its conceptual definition. Adopting a transdisciplinary approach to future research into the underlying mechanisms of these processes may help to bridge the conceptual gap and establish a more accurate cognitive ontology (Poldrack, et al., 2011). Coming to a consensus regarding definition will help to direct and coordinate future research, and in turn help to shape more effective interventions (Cherry et al., 2020; Kashdan et al., 2020).

4.4. Implications and recommendations

The findings from the current study may be relevant to future iterations of conceptual models that seek to explain the pathway to mental health difficulties for medical students and doctors, such as the one proposed by Hancock and Mattick (2020). Further analysis of the potential moderating or mediating roles of IoU and resilience, as proposed by the model, is needed. Though, based on the current study, psychological flexibility should be considered as a potentially more salient variable in future research designs. In order to effectively address the question of mediating or moderating relationships, further longitudinal research is first needed to adequately explore mechanisms of causality.

Another theoretical model for understanding occupational stress, that is often applied to healthcare settings, is the Job Demands-Resources (JD-R) theory. Job demands are defined as the physical, psychological, social, and organisational elements of a role that require sustained effort, and their associated physical and/or psychological costs (Demerouti et al., 2001). Job resources are defined as the aspects of the job that function to reduce demands and facilitate growth, learning, and development (Bakker & Demerouti et al., 2007). More recently, the model has

been expanded to incorporate the concepts of personal demands and resources (Bakker & Demerouti, 2017). The COVID-19 pandemic has generated unprecedented job demands, leading the BMA to call for organisational changes to reduce their impact on the medical workforce. As crucial as these structural changes are, the relevance of personal psychological resources should not be overlooked. Particularly in light of the substantial variance explained by the psychological processes explored in this study. For example, psychological flexibility can be considered a personal resource that may buffer the emotional strain arising from job demands via the flexible use of coping strategies (Onwezen et al., 2014).

Psychological flexibility is a construct that is considered amenable to change. A meta-analysis (Levin et al., 2012) of lab-based component studies found evidence to support the usefulness and theoretical coherence of components of the psychological flexibility model. Significant effect sizes were identified for acceptance, defusion, present moment, values, mixed mindfulness, and values plus mindfulness components. A recent review of meta-analyses for ACT (Gloster et al., 2020) found positive effects for a broad range of conditions. There is also emerging meta-analytic evidence for the use of specific approaches with doctors, such as mindfulness (Scheepers et al., 2020) ACT (Reeve & Moghaddam, 2018) and CBT (Petrie et al., 2019); all approaches in which psychological flexibility is central. Indeed, it has been suggested that psychological flexibility is an integral mechanism of many therapeutic approaches, even when it is not the explicit aim (Kashdan et al., 2010). Given that psychological flexibility is a transdiagnostic process, interventions could be universally targeted, as part of medical student induction and/or embedded within the ongoing curriculum. For example, there is preliminary evidence to suggest that even brief ACT-based interventions may be effective for NHS and non-NHS care staff (Waters et al., 2018; Reeve et al., 2021).

Finally, it is important to highlight the need for organisational sensitivity. Exclusive focus on individual responsibility can contribute to a culture of blame. Targeting individual factors, without wider structural changes, can feed into unhelpful narratives and stigma around “failure to cope” (Kinman & Teoh, 2018). However, as outlined above, it is equally important not to disregard the relevance of personal resources, such as those highlighted in this study. Involving doctors in the co-construction of interventions and support systems may help to enhance acceptability, feasibility, and engagement (Petrie et al., 2019). It is imperative that interventions targeting the mental health and wellbeing of doctors are implemented at multiple levels, in partnership with doctors, and with appropriate consideration given to organisational, team and individual factors (Bakker & Demerouti, 2018; West et al., 2016; Petrie et al., 2019).

4.5 Limitations

This study has some important limitations. A cross-sectional survey-based design was adopted, which means that assumptions about causality cannot be made. Similarly, since a non-probability sampling method was used, a sampling frame could not be established, and it was not possible to calculate a response rate. More senior staff grades and male doctors were under-represented, and there were no participants from Northern Ireland. At-risk doctors may have been too busy or distressed to take part in the study or, alternatively, the study may have attracted a greater number of doctors with a history of mental health conditions, due to personal relevance and interest. Self-report measures can also introduce bias due to social desirability. Due to the survey design (i.e., requesting only minimal demographics at the beginning of survey, with the intention of maintaining participant interest), full demographics are missing for the preliminary prevalence data reported for each dependant variable. Further, in not collecting full demographic information upfront, it was not possible to adequately assess the randomness of missing data. An associated limitation is the choice of pairwise

deletion in handling missing data; this decision was made due to uncertainty around the plausibility of the assumptions necessary for multiple imputation, based on the preceding issue. All of these factors may have implications for the risk of bias and generalisability of results. Finally, since 'gold standard' diagnostic interviews were not possible, the reported estimates may not reflect the true prevalence of mental health conditions within this population.

4.6 Strengths

There has been a wealth of research assessing the prevalence of mental health problems in healthcare workers during the pandemic and their associated sociodemographic risk factors. However, few studies have explored the hypothesised underlying psychological processes that may be modifying these outcomes. Further strengths of this study include the UK-wide coverage and sample size. In addition, the use of standardised and validated outcome measures offers more robust support to findings from larger-scale staff surveys (e.g., BMA tracker survey) that predominantly utilise idiosyncratic measures to estimate prevalence of mental health problems. Finally, while some studies have looked at the role of resilience and intolerance of uncertainty in doctors (Di Monte et al., 2020; Mosheva et al., 2020), to the author's knowledge, this is the only study to date to assess the role of psychological flexibility within this population during the pandemic. The strength of findings in relation to psychological flexibility suggests that this may be an important variable to target in future research; particularly in relation to models of wellbeing for this population, in which the potential moderating role of psychological flexibility has not yet been adequately explored.

4.7 Conclusion

The findings from this study help to quantity the prevalence of distress experienced by doctors in the UK during the pandemic, which may help to plan and prepare for other times of national crisis. Furthermore, the risk factors and psychological predictors identified in this study may help to inform future support and interventions for doctors. Improving support systems should form a central role

in our recovery plan as we emerge from the pandemic, and may ultimately improve the retention and wellbeing of the essential medical workforce in the years to come.

References

Ashbaugh, A. R., Houle-Johnson, S., Herbert, C., El-Hage, W., & Brunet, A. (2016). Psychometric validation of the English and French versions of the Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5). PloS one, 11(10), e0161645.

Bakker, A. B., & Demerouti, E. (2007). The job demands-resources model: State of the art. Journal of managerial psychology.

Bakker, A. B., & Demerouti, E. (2017). Job demands–resources theory: taking stock and looking forward. Journal of occupational health psychology, 22(3), 273.

Bakker, A. B., & Demerouti, E. (2018). Multiple levels in job demands-resources theory: Implications for employee well-being and performance. Handbook of well-being.

Blevins, C. A., Weathers, F. W., Davis, M. T., Witte, T. K., & Domino, J. L. (2015). The posttraumatic stress disorder checklist for DSM-5 (PCL-5): Development and initial psychometric evaluation. Journal of traumatic stress, 28(6), 489-498.

Bond, F. W., Flaxman, P. E., & Bunce, D. (2008). The influence of psychological flexibility on work redesign: mediated moderation of a work reorganization intervention. Journal of Applied Psychology, 93(3), 645.

Bond, F. W., Hayes, S. C., Baer, R. A., Carpenter, K. C., Guenole, N., Orcutt, H. K., Waltz, T., & Zettle, R. D. (2011). Preliminary psychometric properties of the Acceptance and Action Questionnaire – II: A revised measure of psychological flexibility and acceptance. Behavior Therapy, 42, 676-688.

British Medical Association. (2019). Consultants pension survey.

British Medical Association (2021). Rest, recover, restore: Getting UK health services back on track. https://www.bma.org.uk/media/3910/nhs-staff-recover-report-final.pdf

Bryan, C. J., Ray-Sannerud, B., & Heron, E. A. (2015). Psychological flexibility as a dimension of resilience for posttraumatic stress, depression, and risk for

suicidal ideation among Air Force personnel. Journal of Contextual Behavioral Science, 4(4), 263-268.

Buck, K., Williamson, M., Ogbeide, S., & Norberg, B. (2019). Family physician burnout and resilience: a cross-sectional analysis. Family medicine, 51(8), 657-663.

Carleton, R. N., Norton, M. P. J., & Asmundson, G. J. (2007). Fearing the unknown: A short version of the Intolerance of Uncertainty Scale. Journal of anxiety disorders, 21(1), 105-117.

Cherry, K. M., Vander Hoeven, E., Patterson, T. S., & Lumley, M. N. (2021). Defining and measuring "psychological flexibility": A narrative scoping review of diverse flexibility and rigidity constructs and perspectives. Clinical Psychology Review, 101973.

Cleland, J., Porteous, T., Ejebu, O. Z., & Skåtun, D. (2020). 'Should I stay or should I go now?': A qualitative study of why UK doctors retire. Medical education, 54(9), 821-831.

Colville, G. A., Smith, J. G., Brierley, J., Citron, K., Nguru, N. M., Shaunak, P. D., ... & Perkins-Porras, L. (2017). Coping with staff burnout and work-related posttraumatic stress in intensive care. Pediatric Critical Care Medicine, 18(7), e267-e273.

Davidson, J. R. T., (2020). Connor-Davidson Resilience Scale (CD-RISC) Manual. Unpublished. Accessible at www.cd-risc.com.

Dawson, D. L., & N., Golijani-Moghaddam, N. (2020). COVID-19: Psychological flexibility, coping, mental health, and wellbeing in the UK during the pandemic. Journal of contextual behavioral science, 17, 126-134.

DeForge, B. R., & Sobal, J. (1991). Intolerance of ambiguity among family practice residents. Family medicine, 23(6), 466-468.

Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands-resources model of burnout. Journal of Applied psychology, 86(3), 499.

Di Monte, C., Monaco, S., Mariani, R., & Di Trani, M. (2020). From Resilience to Burnout: psychological features of Italian General Practitioners during COVID-19 emergency. Frontiers in Psychology, 11, 2476.

Doorley, J. D., Goodman, F. R., Kelso, K. C., & Kashdan, T. B. (2020). Psychological flexibility: What we know, what we do not know, and what we think we know. Social and Personality Psychology Compass, 14(12), 1-11.

Dugas, M. J., Gagnon, F., Ladouceur, R., & Freeston, M. H. (1998). Generalized anxiety disorder: A preliminary test of a conceptual model. Behaviour research and therapy, 36(2), 215-226.

Dyrbye, L. N., Thomas, M. R., & Shanafelt, T. D. (2006). Systematic review of depression, anxiety, and other indicators of psychological distress among US and Canadian medical students. Academic medicine, 81(4), 354-373.

Einstein, D. A. (2014). Extension of the transdiagnostic model to focus on intolerance of uncertainty: a review of the literature and implications for treatment. Clinical Psychology: Science and Practice, 21(3), 280-300.

Erschens, R., Keifenheim, K. E., Herrmann-Werner, A., Loda, T., Schwille-Kiuntke, J., Bugaj, T. J., ... & Junne, F. (2019). Professional burnout among medical students: systematic literature review and meta-analysis. Medical teacher, 41(2), 172-183.

Fancourt, D., Steptoe, A., & Bu, F. (2021). Trajectories of anxiety and depressive symptoms during enforced isolation due to COVID-19 in England: a longitudinal observational study. The Lancet Psychiatry, 8(2), 141-149.

Fonseca, S., Trindade, I. A., Mendes, A. L., & Ferreira, C. (2020). The buffer role of psychological flexibility against the impact of major life events on depression symptoms. Clinical Psychologist, 24(1), 82-90.

Francis, A.W., Dawson, D.L., Golijani-Moghaddam, N., 2016. The development and validation of the Comprehensive assessment of Acceptance and Commitment Therapy processes (CompACT). J.Context. Behav. Sci. 5, 134–145.

Gentili, C., Rickardsson, J., Zetterqvist, V., Simons, L. E., Lekander, M., & Wicksell, R. K. (2019). Psychological flexibility as a resilience factor in individuals with chronic pain. Frontiers in psychology, 10, 2016.

Gloster, A. T., Meyer, A. H., & Lieb, R. (2017). Psychological flexibility as a malleable public health target: Evidence from a representative sample. Journal of Contextual Behavioral Science, 6(2), 166-171.

Gloster, A. T., Walder, N., Levin, M., Twohig, M., & Karekla, M. (2020). The empirical status of acceptance and commitment therapy: A review of meta-analyses. Journal of Contextual Behavioral Science.

Greenberg, N., Weston, D., Hall, C., Caulfield, T., Williamson, V., & Fong, K. (2021). Mental health of staff working in intensive care during COVID-19. Occupational Medicine, 71(2), 62-67.

Grenier, S., Barrette, A. M., & Ladouceur, R. (2005). Intolerance of uncertainty and intolerance of ambiguity: Similarities and differences. Personality and individual differences, 39(3), 593-600.

Hair, J., F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (1998). Multivariate data analysis. New Jersey.

Han, P. K., Schupack, D., Daggett, S., Holt, C. T., & Strout, T. D. (2015). Temporal changes in tolerance of uncertainty among medical students: insights from an exploratory study. Medical education online, 20(1), 28285.

Hancock, J., & Mattick, K. (2020). Tolerance of ambiguity and psychological well-being in medical training: A systematic review. Medical education, 54(2), 125-137.

Have NHS staff been redeployed due to COVID-19? | YouGov. Yougov.co.uk. (2021). Retrieved 3 May 2021, from https://yougov.co.uk/topics/health/articles-reports/2021/02/19/nhs-staff-redeployed-ICU-covid-19.

Hayes, S. C., Strosahl, K. D., Wilson, K. G., Bissett, R. T., Pistorello, J., Toarmino, D., Polusny, M., A., Dykstra, T. A., Batten, S. V., Bergan, J., Stewart, S. H., Zvolensky, M. J., Eifert, G. H., Bond, F. W., Forsyth J. P., Karekla, M.,

McCurry, S. M. (2004). Measuring experiential avoidance: A preliminary test of a working model. The Psychological Record, 54, 553-578.

Hillen, M. A., Gutheil, C. M., Strout, T. D., Smets, E. M., & Han, P. K. (2017). Tolerance of uncertainty: Conceptual analysis, integrative model, and implications for healthcare. Social Science & Medicine, 180, 62-75.

Hong, R. Y., & Lee, S. S. (2015). Further clarifying prospective and inhibitory intolerance of uncertainty: Factorial and construct validity of test scores from the Intolerance of Uncertainty Scale. *Psychological assessment*, *27*(2), 605.

Hope, V., & Henderson, M. (2014). Medical student depression, anxiety and distress outside North America: a systematic review. Medical education, 48(10), 963-979. https://www.nuffieldtrust.org.uk/public/resource/the-nhs-workforce-in-numbers

Imo, U. O. (2017). Burnout and psychiatric morbidity among doctors in the UK: a systematic literature review of prevalence and associated factors. BJPsych bulletin, 41(4), 197-204.

John Hopkins Coronavirus Resource Center. (n.d.). United States cases by county. Johns Hopkins University & Medicine. Last retrieved 3rd May 2021, from https://coronavirus.jhu.edu/data/mortality

Johns, G. (2021). The Global Prevalence of Depression and Anxiety Among Doctors During the COVID-19 Pandemic: Systematic Review and Meta-Analysis. [Unpublished manuscript].

Jokić-Begić, N., Korajlija, A. L., & Begić, D. (2020). Mental health of psychiatrists and physicians of other specialties in early covid-19 pandemic: risk and protective factors. Psychiatria Danubina, 32(3-4), 536-548.

Joyce, S., Shand, F., Tighe, J., Laurent, S. J., Bryant, R. A., & Harvey, S. B. (2018). Road to resilience: a systematic review and meta-analysis of resilience training programmes and interventions. BMJ open, 8(6).

Kashdan, T. B., & Rottenberg, J. (2010). Psychological flexibility as a fundamental aspect of health. Clinical psychology review, 30(7), 865-878.

Kashdan, T. B., Disabato, D. J., Goodman, F. R., Doorley, J. D., & McKnight, P. E. (2020). Understanding psychological flexibility: A multimethod exploration of pursuing valued goals despite the presence of distress. Psychological Assessment, 32(9), 829.

Kinman, G., & Teoh, K. (2018). What could make a difference to the mental health of UK doctors? A review of the research evidence.

Koutsimani, P., Montgomery, A., & Georganta, K. (2019). The relationship between burnout, depression, and anxiety: A systematic review and meta-analysis. Frontiers in psychology, 10, 284.

Kroska, E. B., Roche, A. I., Adamowicz, J. L., & Stegall, M. S. (2020). Psychological flexibility in the context of COVID-19 adversity: Associations with distress. Journal of Contextual Behavioral Science, 18, 28-33.

Lee, R. T., Seo, B., Hladkyj, S., Lovell, B. L., & Schwartzmann, L. (2013). Correlates of physician burnout across regions and specialties: a meta-analysis. Human resources for health, 11(1), 1-16.

Levin, M. E., Hildebrandt, M. J., Lillis, J., & Hayes, S. C. (2012). The impact of treatment components suggested by the psychological flexibility model: A meta-analysis of laboratory-based component studies. Behavior therapy, 43(4), 741-756.

Lim, W. Y., Ong, J., Ong, S., Hao, Y., Abdullah, H. R., Koh, D. L., & Mok, U. S. M. (2020). The abbreviated Maslach burnout inventory can overestimate burnout: a study of anesthesiology residents. Journal of clinical medicine, 9(1), 61.

Lloyd, J., Bond, F. W., & Flaxman, P. E. (2013). The value of psychological flexibility: Examining psychological mechanisms underpinning a cognitive behavioural therapy intervention for burnout. Work & Stress, 27(2), 181-199.

Löwe, B., Decker, O., Müller, S., Brähler, E., Schellberg, D., Herzog, W., & Herzberg, P. Y. (2008). Validation and standardization of the Generalized Anxiety Disorder Screener (GAD-7) in the general population. Medical care, 266-274.

Masuda, A., Anderson, P. L., Wendell, J. W., Chou, Y. Y., Price, M., & Feinstein, A. B. (2011). Psychological flexibility mediates the relations between self-concealment and negative psychological outcomes. Personality and Individual Differences, 50(2), 243-247.

Mahoney, A. E., & McEvoy, P. M. (2012). A transdiagnostic examination of intolerance of uncertainty across anxiety and depressive disorders. Cognitive Behaviour Therapy, 41(3), 212-222.

Manea, L., Gilbody, S., & McMillan, D. (2012). Optimal cut-off score for diagnosing depression with the Patient Health Questionnaire (PHQ-9): a meta-analysis. Cmaj, 184(3), E191-E196.

Maslach, C., Jackson, S. E., & Leiter, M. P. (1996). MBI: Maslach burnout inventory. Sunnyvale, CA: CPP, Incorporated.

Maslach, C., and Leiter, M.P, (2021). How to Measure Burnout Accurately and Ethically. Harvard Buisness Review. Retrieved from https://hbr.org/2021/03/how-to-measure-burnout-accurately-and-ethically on 4th May 2021.

Mata, D. A., Ramos, M. A., Bansal, N., Khan, R., Guille, C., Di Angelantonio, E., & Sen, S. (2016). Prevalence of Depression and Depressive Symptoms Among Resident Physicians: A Systematic Review and Meta-analysis. Survey of Anesthesiology, 60(4), 146.

McCracken, L. M., Badinlou, F., Buhrman, M., & Brocki, K. C. (2021). The role of psychological flexibility in the context of COVID-19: Associations with

depression, anxiety, and insomnia. Journal of Contextual Behavioral Science, 19, 28-35.

McKinley, N., Karayiannis, P. N., Convie, L., Clarke, M., Kirk, S. J., & Campbell, W. J. (2019). Resilience in medical doctors: a systematic review. Postgraduate medical journal, 95(1121), 140-147.

Medical Schools Council. Joint statement on registration arrangements for final year students and F1 doctors. MSC, 2020. Retrieved from: https://www.medschools.ac.uk/news/joint-statement-on-registration-arrangements-for-final-year-students-and-f1-doctors

Merrill, J. M., Camacho, Z., Laux, L. F., Lorimor, R., Thornby, J. I., & Vallbona, C. (1994). Uncertainties and ambiguities: measuring how medical students cope. Medical education, 28(4), 316-322.

Mitchell, A. J., Yadegarfar, M., Gill, J., & Stubbs, B. (2016). Case finding and screening clinical utility of the Patient Health Questionnaire (PHQ-9 and PHQ-2) for depression in primary care: a diagnostic meta-analysis of 40 studies. BJPsych open, 2(2), 127-138.

Moberly, T. (2019). Doctors' early retirement triples in a decade.

Mosheva, M., Hertz-Palmor, N., Dorman Ilan, S., Matalon, N., Pessach, I. M., Afek, A., ... & Gothelf, D. (2020). Anxiety, pandemic-related stress and resilience among physicians during the COVID-19 pandemic. Depression and anxiety, 37(10), 965-971.

Morris, J. (2019). Development and validation of a short form of the Comprehensive assessment of Acceptance and Commitment Therapy processes (CompACT-SF) (Doctoral dissertation, University of Nottingham).

NHS Health Research Authority (2020) Is my study research? Retrieved 30 July 2021, from http://www.hra-decisiontools.org.uk/research

Nituica, C., Bota, O. A., & Blebea, J. (2020). Specialty differences in resident resilience and burnout-A national survey. The American Journal of Surgery.

Onwezen, M. C., Van Veldhoven, M. J. P. M., & Biron, M. (2014). The role of psychological flexibility in the demands–exhaustion–performance relationship. European Journal of Work and Organizational Psychology, 23(2), 163-176.

Pallant, J. S. P. S. S. (2016). Survival manual: A step by step guide to data analysis using SPSS program.

Palm, K. M., & Follette, V. M. (2011). The roles of cognitive flexibility and experiential avoidance in explaining psychological distress in survivors of interpersonal victimization. Journal of Psychopathology and Behavioral Assessment, 33(1), 79-86.

Petrie, K., Crawford, J., Baker, S. T., Dean, K., Robinson, J., Veness, B. G., ... & Harvey, S. B. (2019). Interventions to reduce symptoms of common mental disorders and suicidal ideation in physicians: a systematic review and meta-analysis. The Lancet Psychiatry, 6(3), 225-234.

Plummer, F., Manea, L., Trepel, D., & McMillan, D. (2016). Screening for anxiety disorders with the GAD-7 and GAD-2: a systematic review and diagnostic metaanalysis. General hospital psychiatry, 39, 24-31.

Poldrack, R. A., Kittur, A., Kalar, D., Miller, E., Seppa, C., Gil, Y., ... & Bilder, R. M. (2011). The cognitive atlas: toward a knowledge foundation for cognitive neuroscience. Frontiers in neuroinformatics, 5, 17.

Puthran, R., Zhang, M. W., Tam, W. W., & Ho, R. C. (2016). Prevalence of depression amongst medical students: A meta-analysis. Medical education, 50(4), 456-468.

Reeve, A., Tickle, A., & Moghaddam, N. (2018). Are acceptance and commitment therapy-based interventions effective for reducing burnout in direct-care staff? A systematic review and meta-analysis. Mental Health Review Journal.

Reeve, A., Moghaddam, N., Tickle, A., & Young, D. (2021). A brief acceptance and commitment intervention for work-related stress and burnout amongst

frontline homelessness staff: A single case experimental design series. Clinical Psychology & Psychotherapy.

Rimmer, A. (2019). Number of FY2 doctors moving straight into specialty training falls again.

Riley, M. R., Mohr, D. C., & Waddimba, A. C. (2018). The reliability and validity of three-item screening measures for burnout: Evidence from group-employed health care practitioners in upstate New York. Stress and Health, 34(1), 187-193.

Roberts, T., Daniels, J., Hulme, W., Hirst, R., Horner, D., Lyttle, M. D., ... & Carlton, E. (2021). Psychological distress during the acceleration phase of the COVID-19 pandemic: a survey of doctors practising in emergency medicine, anaesthesia and intensive care medicine in the UK and Ireland. Emergency Medicine Journal.

Rolewicz, L., & Palmer, B. (2019). The NHS workforce in numbers. The Nuffield Trust.(https://www. nuffieldtrust. org. uk/resource/the-nhs-workforce-in-numbers).

Rosen, N. O., Ivanova, E., & Knäuper, B. (2014). Differentiating intolerance of uncertainty from three related but distinct constructs. Anxiety, Stress & Coping, 27(1), 55-73.

Rotenstein, L. S., Ramos, M. A., Torre, M., Segal, J. B., Peluso, M. J., Guille, C., ... & Mata, D. A. (2016). Prevalence of depression, depressive symptoms, and suicidal ideation among medical students: a systematic review and meta-analysis. Jama, 316(21), 2214-2236.

Rotenstein, L. S., Torre, M., Ramos, M. A., Rosales, R. C., Guille, C., Sen, S., & Mata, D. A. (2018). Prevalence of burnout among physicians: a systematic review. Jama, 320(11), 1131-1150.

Royal College of Physicians. (2016). Underfunded. Underdoctored. Overstretched. The NHS in 2016. London: RCP.

Scheepers, R. A., Emke, H., Epstein, R. M., & Lombarts, K. M. (2020). The impact of mindfulness-based interventions on doctors' well-being and performance: A systematic review. Medical education, 54(2), 138-149.

Schwenk, T. L., & Gold, K. J. (2018). Physician burnout—a serious symptom, but of what?. Jama, 320(11), 1109-1110.

Serrão, C., Duarte, I., Castro, L., & Teixeira, A. (2021). Burnout and Depression in Portuguese Healthcare Workers during the COVID-19 Pandemic—The Mediating Role of Psychological Resilience. International Journal of Environmental Research and Public Health, 18(2), 636.

Shah, N., Raheem, A., Sideris, M., Velauthar, L., & Saeed, F. (2020). Mental health amongst obstetrics and gynaecology doctors during the COVID-19 pandemic: Results of a UK-wide study. European Journal of Obstetrics & Gynecology and Reproductive Biology, 253, 90-94.

Solms, L., van Vianen, A. E., Theeboom, T., Koen, J., De Pagter, A. P., & de Hoog, M. (2019). Keep the fire burning: a survey study on the role of personal resources for work engagement and burnout in medical residents and specialists in the Netherlands. BMJ open, 9(11), e031053.

Strout, T. D., Hillen, M., Gutheil, C., Anderson, E., Hutchinson, R., Ward, H., ... & Han, P. K. (2018). Tolerance of uncertainty: A systematic review of health and healthcare-related outcomes. Patient education and counseling, 101(9), 1518-1537.

Tabachnick, B.G. & Fidell, L.S. (2013). Using multivariate statistics (6th edn). Boston: Pearson Education.

Taylor, M. (2020). Why is there a shortage of doctors in the UK?. The Bulletin of the Royal College of Surgeons of England, 102(3), 78-81.

The NHS workforce in numbers. Nuffieldtrust.org.uk (2019). Retrieved 3rd May 2021

Tyndall, I., Waldeck, D., Pancani, L., Whelan, R., Roche, B., & Dawson, D. L. (2019). The Acceptance and Action Questionnaire-II (AAQ-II) as a measure of

experiential avoidance: Concerns over discriminant validity. Journal of Contextual Behavioral Science, 12, 278-284.

Tyndall, I., Waldeck, D., Pancani, L., Whelan, R., Roche, B., & Pereira, A. (2020). Profiles of psychological flexibility: A latent class analysis of the acceptance and commitment therapy model. Behavior modification, 44(3), 365-393.

Ventriglio, A., Watson, C., & Bhugra, D. (2020). Suicide among doctors: a narrative review. Indian journal of psychiatry, 62(2), 114.

Waters, C. S., Frude, N., Flaxman, P. E., & Boyd, J. (2018). Acceptance and commitment therapy (ACT) for clinically distressed health care workers: Waitlist-controlled evaluation of an ACT workshop in a routine practice setting. British Journal of Clinical Psychology, 57(1), 82-98.

Weathers, F. W., Litz, B. T., Keane, T. M., Palmieri, P. A., Marx, B. P., & Schnurr, P. P. (2013). The ptsd checklist for dsm-5 (pcl-5). Scale available from the National Center for PTSD at www. ptsd. va. gov, 10.

West, C. P., Dyrbye, L. N., Erwin, P. J., & Shanafelt, T. D. (2016). Interventions to prevent and reduce physician burnout: a systematic review and meta-analysis. The Lancet, 388(10057), 2272-2281.

West, C. P., Dyrbye, L. N., Sinsky, C., Trockel, M., Tutty, M., Nedelec, L., ... & Shanafelt, T. D. (2020). Resilience and burnout among physicians and the general US working population. JAMA network open, 3(7), e209385-e209385.

White, R. G., Gumley, A. I., McTaggart, J., Rattrie, L., McConville, D., Cleare, S., & Mitchell, G. (2013). Depression and anxiety following psychosis: Associations with mindfulness and psychological flexibility. Behavioural and cognitive psychotherapy, 41(1), 34.

Wood, E. A., Egan, S. C., Ange, B., Garduno, H., Williams, D. R., & Wyatt, T. R. (2020). Association of Self-Reported Burnout and Protective Factors Within Single-Institution Resident Physicians. Journal of graduate medical education, 0.

World Health Organization. (2019). World health statistics 2019: monitoring health for the SDGs, sustainable development goals.

Appendices

Appendix 1. Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
Population: • Medical doctors • No geographical restrictions *Studies assessing the prevalence of:* • Depression symptoms • Anxiety symptoms *Study type:* • Quantitative *Additional criteria:* • During the COVID-19 pandemic timescale • Use of standardised and validated measure • English language • Data pooled for target population • Published in peer reviewed journal • Original research	*Population:* • Non-medical doctors • Non-practicing doctors *Studies assessing the prevalence of:* • Any other outcomes e.g., stress, social phobia, OCD, burnout. *Study type:* • Qualitative • Case reports, commentaries • Sample size <139 *Additional criteria:* • Pre-pandemic prevalence studies • Studies using non standardised or unvalidated measures • Non-English language • Studies that do not give prevalence for target population or do not provide sufficient information to calculate prevalence • Studies that have not separated other professions in data (e.g., veterinary medicine, dental medicine, nurses etc.) • Published articles that are inaccessible for full review • Pre-print or not published in a peer reviewed journal • Not original research (e.g., lit review, article, commentary)

Appendix 2. Example of search terms (PsychInfo, via Ovid)

[mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh]

1. exp coronavirus/
2. covid.mp.
3. covid-19.mp.
4. sars cov 2.mp.
5. sarscov2.mp
6. sars cov2.mp.
7. sarscov 2.mp.
8. corona.mp.
9. virus.mp.
10. 8 and 9
11. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 10
12. exp physicians/
13. doctor*.mp.
14. physician*.mp.
15. medic.mp.
16. medics.mp.
17. 12 or 13 or 14 or 15 or 16
18. 11 and 17
19. exp anxiety/
20. anxiety.mp.
21. anxiety symptoms.mp.
22. anxiety disorder.mp.
23. anxious.mp.
24. generali?ed anxiety.mp
25. panic.mp.
26. worry.mp.
27. exp emotional states/
28. depress*.mp.
29. mental health.mp.
30. mental illness.mp.
31. mental disorder.mp.
32. exp mental disorders/
33. 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32
34. 18 and 33

Appendix 3. JBI Critical Appraisal Checklist for Studies Reporting Prevalence Data

1. Was the sample frame appropriate to address the target population?

JBI guidance: This question relies upon knowledge of the broader characteristics of the population of interest and the geographical area. If the study is of women with breast cancer, knowledge of at least the characteristics, demographics and medical history is needed. The term "target population" should not be taken to infer every individual from everywhere or with similar disease or exposure characteristics. Instead, give consideration to specific population characteristics in the study, including age range, gender, morbidities, medications, and other potentially influential factors. For example, a sample frame may not be appropriate to address the target population if a certain group has been used (such as those working for one organisation, or one profession) and the results then inferred to the target population (i.e. working adults). A sample frame may be appropriate when it includes almost all the members of the target population (i.e. a census, or a complete list of participants or complete registry data).

Additional guidance:

Score yes - if it is clear there was a sample frame and it would include all members of the study's target population - for example, if the study uses a census, registry, national survey or entire database, even if this population only includes a specific group of the overall systematic review population (e.g., a particular medical specialism - as long as this is the target population of the specific paper).

Score no - if there is no specified sample frame; if the study uses snowball sampling/ convenience sample etc. (as these do not have identified sample frames); if sample frame is taken from a single hospital only.

2. Were study participants recruited in an appropriate way?

JBI guidance: Studies may report random sampling from a population, and the methods section should report how sampling was performed. Random probabilistic sampling from a defined subset of the population (sample frame) should be

employed in most cases, however, random probabilistic sampling is not needed when everyone in the sampling frame will be included/ analysed. For example, reporting on all the data from a good census is appropriate as a good census will identify everybody. When using cluster sampling, such as a random sample of villages within a region, the methods need to be clearly stated as the precision of the final prevalence estimate incorporates the clustering effect. Convenience samples, such as a street survey or interviewing lots of people at a public gatherings are not considered to provide a representative sample of the base population.

Additional guidance:

Score yes - if random sampling/ probability sampling method was used and described (may include cluster sampling).

Score no – if random sampling method was used but not described; or if non random sampling/ non-probability sampling method was used (e.g., convenience, snowball, quota).

3. Was the sample size adequate?

JBI guidance: The larger the sample, the narrower will be the confidence interval around the prevalence estimate, making the results more precise. An adequate sample size is important to ensure good precision of the final estimate. Ideally we are looking for evidence that the authors conducted a sample size calculation to determine an adequate sample size. This will estimate how many subjects are needed to produce a reliable estimate of the measure(s) of interest. For conditions with a low prevalence, a larger sample size is needed. Also consider sample sizes for subgroup (or characteristics) analyses, and whether these are appropriate. Sometimes, the study will be large enough (as in large national surveys) whereby a sample size calculation is not required. In these cases, sample size can be considered adequate. When there is no sample size calculation and it is not a large

national survey, the reviewers may consider conducting their own sample size analysis.

Additional guidance:

Score yes - if a sample size calculation was conducted with relevance to the question; or if the sample size (of doctors) is 384 or above; or if an adequate sample size can be calculated via this calculator https://select-statistics.co.uk/calculators/sample-size-calculator-population-proportion

Score no – if sample size is under the recommended size (either from paper or calculator); or if it is not calculatable.

4. Were the study subjects and setting described in detail?

JBI guidance: Certain diseases or conditions vary in prevalence across different geographic regions and populations (e.g., Women vs. Men, sociodemographic variables between countries). The study sample should be described in sufficient detail so that other researchers can determine if it is comparable to the population of interest to them.

Additional guidance:

Score yes - if sample setting (e.g., geographical location, speciality/ specialities, hospital or otherwise) and characteristics of the systematic review target population (i.e., doctors) are sufficiently described (e.g., age, sex, speciality, career grade).

Score no – if there is insufficient description of population characteristics and setting; or if there is no breakdown specifically for doctors.

5. Was data analysis conducted with sufficient coverage of the identified sample?

JBI guidance: Coverage bias can occur when not all subgroups of the identified sample respond at the same rate. For instance, you may have a very high response rate overall for your study, but the response rate for a certain subgroup (i.e., older adults) may be quite low.

Additional guidance:

Score yes - if there is sufficient coverage of all target participants within the analysis; and/or if the issue of sample coverage is appropriately addressed within the paper – for example, a gender or age bias may be considered appropriate if reflective of the underlying population of doctors (e.g., age bias expected if target population is foundation doctors).

Score no - probably for the majority (but not all) of the studies in this review. Sufficient coverage in a non-random / non-probability sampling study (i.e., the majority of these papers) is unlikely unless there is a very high response rate.

6. Were valid methods used for the identification of the condition?

JBI guidance: Here we are looking for measurement or classification bias. Many health problems are not easily diagnosed or defined and some measures may not be capable of including or excluding appropriate levels or stages of the health problem. If the outcomes were assessed based on existing definitions or diagnostic criteria, then the answer to this question is likely to be yes. If the outcomes were assessed using observer reported, or self-reported scales, the risk of over or under-reporting is increased, and objectivity is compromised. Importantly, determine if the measurement tools used were validated instruments as this has a significant impact on outcome assessment validity.

Additional guidance:

Score yes - if an independently validated measure was used (i.e., for depression and/ or anxiety).

Score no – if no independently validated measure was used.

7. Was the condition measured in a standard, reliable way for all participants?

JBI guidance: Considerable judgment is required to determine the presence of some health outcomes. Having established the validity of the outcome measurement instrument (see item 6 of this scale), it is important to establish how the measurement was conducted. Were those involved in collecting data trained or

educated in the use of the instrument/s? If there was more than one data collector, were they similar in terms of level of education, clinical or research experience, or level of responsibility in the piece of research being appraised? When there was more than one observer or collector, was there comparison of results from across the observers? Was the condition measured in the same way for all participants?
Additional guidance:
Score yes - if the condition was measured in the same way for all participants (e.g., same measure, same delivery, same cut-offs used for all).
Score no – if different methods were used (e.g., questionnaire for some, interview for others).

8. Was there appropriate statistical analysis?
JBI guidance: Importantly, the numerator and denominator should be clearly reported, and percentages should be given with confidence intervals. The methods section should be detailed enough for reviewers to identify the analytical technique used and how specific variables were measured. Additionally, it is also important to assess the appropriateness of the analytical strategy in terms of the assumptions associated with the approach as differing methods of analysis are based on differing assumptions about the data and how it will respond.

Additional guidance:
Score yes - if the numerator, denominator and percentage for prevalence data is reported.
Score no - if one of the above is not reported; or if not reported specifically for doctors in studies with multiple professions.

9. Was the response rate adequate, and if not, was the low response rate managed appropriately?

JBI guidance: A large number of dropouts, refusals or “not founds” amongst selected subjects may diminish a study’s validity, as can a low response rates for survey studies. The authors should clearly discuss the response rate and any reasons for non-response and compare persons in the study to those not in the study, particularly with regards to their socio-demographic characteristics. If reasons for non-response appear to be unrelated to the outcome measured and the characteristics of non-responders are comparable to those who do respond in the study (addressed in question 5, coverage bias), the researchers may be able to justify a more modest response rate.

Additional guidance:

Score yes - if response rate is sufficient (e.g., 70% or above); if response rate is not sufficient but the authors: 1) clearly discuss reasons for non-response, and 2) compare and appropriately conclude that the characteristics of non-responders are comparable to those who did respond in the study (particularly with regards to their socio-demographic characteristics).

Score no - if response rate is not sufficient and no further analysis or discussion of the difference between respondents and non-respondents is provided; or if response rate is not calculable (e.g., in studies using snowball/ convenience sampling).

Appendix 4. Characteristics of high risk of bias studies

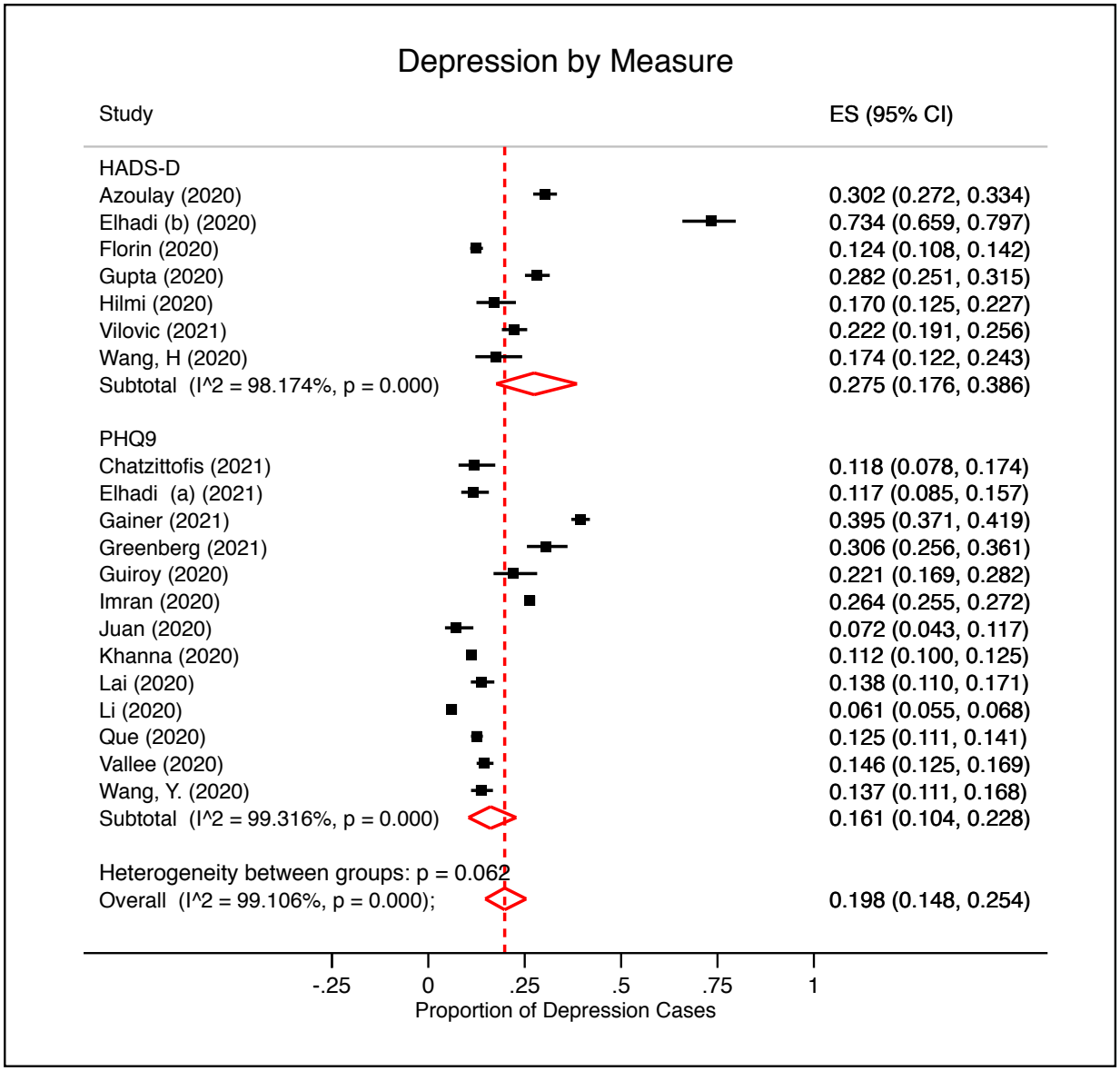
Author, year	Timeframe	Country	Speciality	Age	Sample N	Male, N %	Female, N %
Abdellah, 2021	Jul–Oct 20	Egypt, Saudi Arabia	Various	Md 34	344	98, 28.5%	246, 71.5%
Arafa, 2020	April 20	Egypt, Saudi Arabia	Various	Not reported	206	Not reported	Not reported
Arshad, 2020	March 20	Pakistan	Nephrology	Not reported	431	238, 55.22%	193, 44.78%
Caliskan, 2020	March 20	Turkey	Emergency medicine	31.8 (6.9)	290	179, 61.7%	111,
Campos, 2021	May– June 20	Brazil	Various	Not reported	190	Not reported	Not reported
Chatterjee, 2020	Mar- April 20	India	Various	42.05 (12.19)	152	119, 78.3%	33, 21.7%
Fekih-Romdhane, 2020	April 20	Tunisia	Various	Not reported	210	Not reported	70.5
Gallopeni, 2020	April 20	Kosovo	Various	Not reported	253	Not reported	Not reported
Grover, 2020	May 20	India	Ophthalmology	41.1 (8.6)	144	66, 46%	78, 54%
Gupta, B. 2020	May 20	India	Various	Not reported	192	Not reported	Not reported
Hassan, 2020	May 20	Pakistan	Various	29 (7.28)	151	66, 43.7	85, 56.3%
Linos, 2021	April 20	USA	Physician mothers	Not reported	1809	Not reported	100%
Liu, 2020	February 20	China	Paediatric workers	Not reported	858	Not reported	Not reported
Milgrom, 2020	April 20	Israel	Various	Not reported	337	Not reported	Not reported
Ning, 2020	February 20	China	Various	Not reported	317	160, 50.5%	157, 49.5%
Patel, 2020	7May 20	India	Various	Not reported	258	Not reported	Not reported
Sahin, 2020	Apr-May 20	Turkey	Various	Not reported	580	Not reported	Not reported
Shah, 2020	Not reported	UK	Obstetrics & Gynaecology	Not reported	207	39, 18.9	167, 81.1
Shechter, 2020	April 20	USA	Various	Not reported	282	Not reported	Not reported
Tiete, 2021	Apr-May 20	Belgium	Various	Not reported	179	Not reported	Not reported
Yang, 2020	February 20	China	Otolaryngology	Not reported	285	Not reported	Not reported
Zhang, 2021	March 20	China	Community hospital workers	Not reported	178	Not reported	Not reported

Appendix 5. Point prevalence of depression and anxiety symptoms for high risk of bias studies

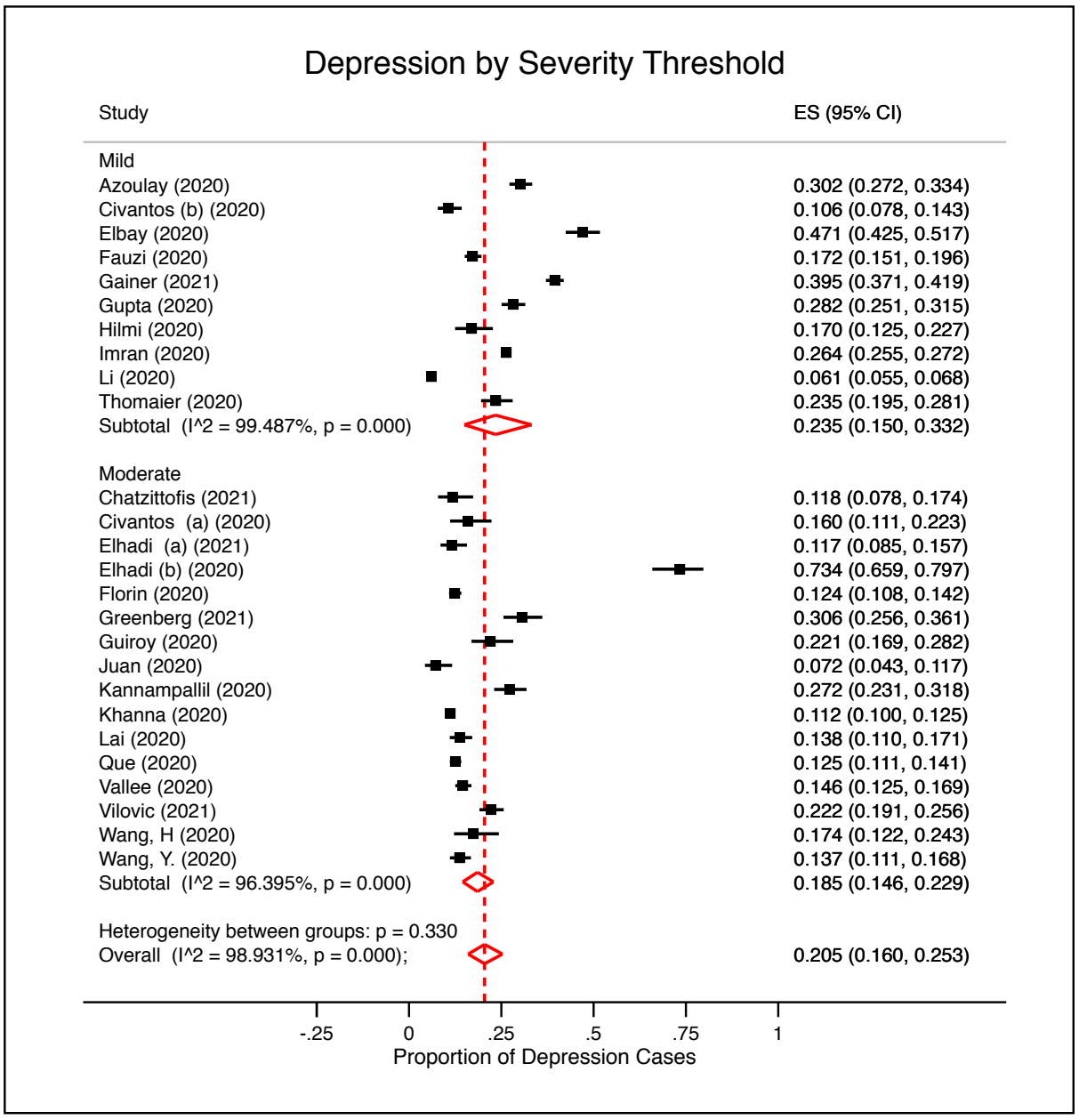
	Total	Depression cases					Anxiety cases				
Study	N	Measure	Cut-off	n	%	(95% CI)	Measure	Cut-off	n	%	(95% CI)
Abdellah, 2021	344	HADS-D	≥8	238	69.2	64.1-73.8	HADS	≥8	263	76.5%	71.7-80.6
Arafa, 2020	206	DASS-21-D	≥10*	152	73.8	67.4-79.3	DASS-21	≥8*	60,	29.1%	23.3-35.7
Arshad, 2020	431	-	-	-	-	-	GAD7	≥10*	145	33.6%	29.3-38.2
Caliskan, 2020	290	HADS-D	≥7	180	62.1	56.4-67.5	HADS	≥10	103	35.5%	30.2-41.2
Campos, 2021	190	DASS-21-D	≥10	73	38.4	31.8-45.5	DASS-21	≥8	49	25.8%	20.1-32.4
Chatterjee, 2020	152	DASS-21-D	Moderate*	37	24.3	18.2-31.7	DASS-21	NS	48	31.6%	24.7-39.3
Fekih-Romdhane, 2020	210	DASS-21-D	Moderate*	64	30.5	24.6-37.0	DASS-21	NS	51	24.3%	19.0-30.5
Gallopeni, 2020	253	HADS-D	≥11 (NS)	113	44.7	38.7-50.8	HADS	≥11	112	44.3%	38.3-50.4
Grover, 2020	144	DASS-21-D	Moderate*	76	52.8	44.7-60.8	DASS-21	NS	74	51.4	43.3-59.4
Gupta. B, 2020	192	-	-	-	-	-	GAD7	≥10	37	19.3%	14.3-25.4
Hassan, 2020	151	-	-	-	-	-	GAD7	≥10	27	17.9%	12.6-24.8
Linos, 2021	1809	-	-	-	-	-	GAD7	≥10*	742	41.0%	38.8-43.3
Liu, 2020	858	DASS-21-D	≥10 (NS)	70	8.2	6.5-10.2	DASS-21	≥10*	97	11.3%	9.4-13.6
Milgrom, 2020	337	-	-	-	-	-	STAIS-S	≥45	109	32.3%	27.6-37.5
Ning, 2020	317	SDS	≥ 53	64	20.2	16.1-25.0	SAS	≥50	40	12.6%	9.4-16.7
Patel, 2020	258	DASS-21-D	Moderate*	46	17.8	13.6-23.0	DASS-21	NS	48	18.6%	14.3-23.8
Sahin, 2020	580	PHQ9	≥10	207	35.7	31.9-39.7	GAD7	≥10*	108	18.6%	15.7-22.0
Shah, 2020	207	PHQ2	≥3	33	15.9	11.6-21.5	GAD2	≥3	51	24.6%	19.3-30.9
Shechter, 2020	282	PHQ2	≥3	107	37.9	32.5-43.7	GAD2	≥3	45	16.0%	12.1-20.7
Tiete, 2021	179	DASS-21-D	≥14*	52	29.1	22.9-43.2	DASS-21	≥10*	33	18.4%	13.4-24.8
Yang, 2020	285	-	-	-	-	-	SAS	Requested	72	25.3%	20.6-30.6
Zhang, 2021	178	SCL-90	≥2	20	11.2		SCL-90	≥2	11	6.2%	3.5-10.7

* Cut-off not specified, moderate and above data extracted.

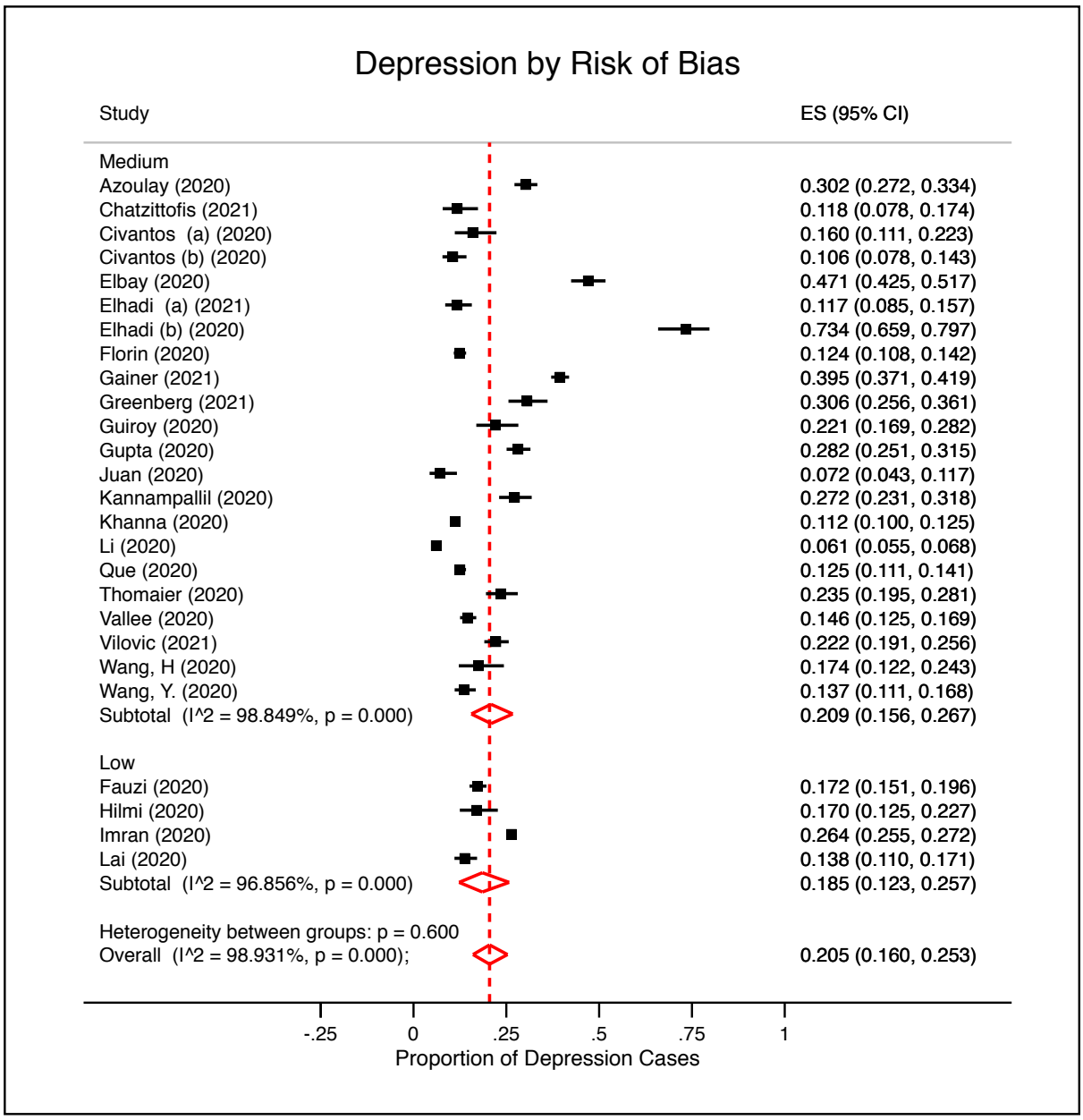
Appendix 6. Forest plot showing depression studies analysed by measure



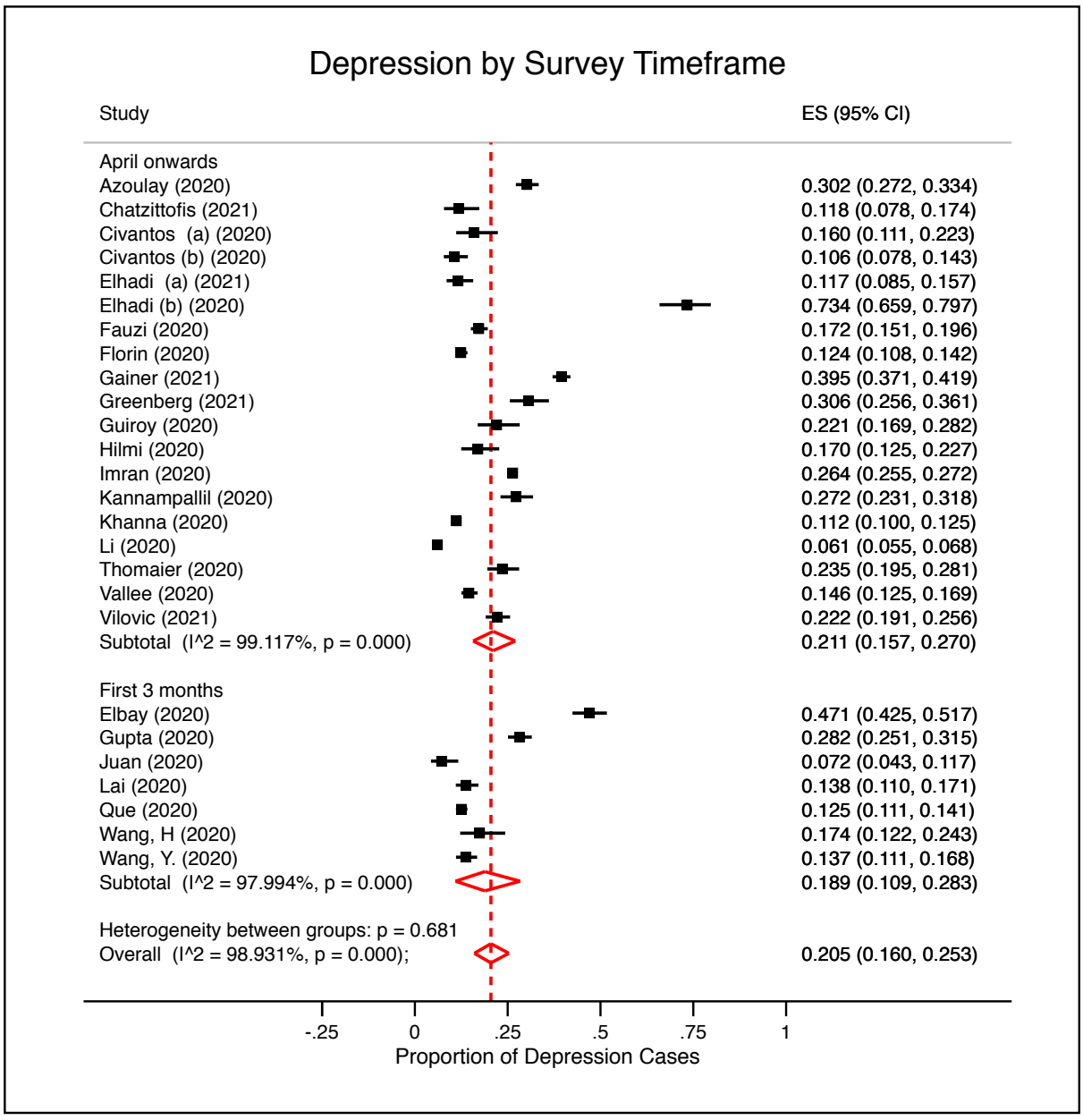
Appendix 7. Forest plot showing depression studies analysed by moderate and mild reporting thresholds



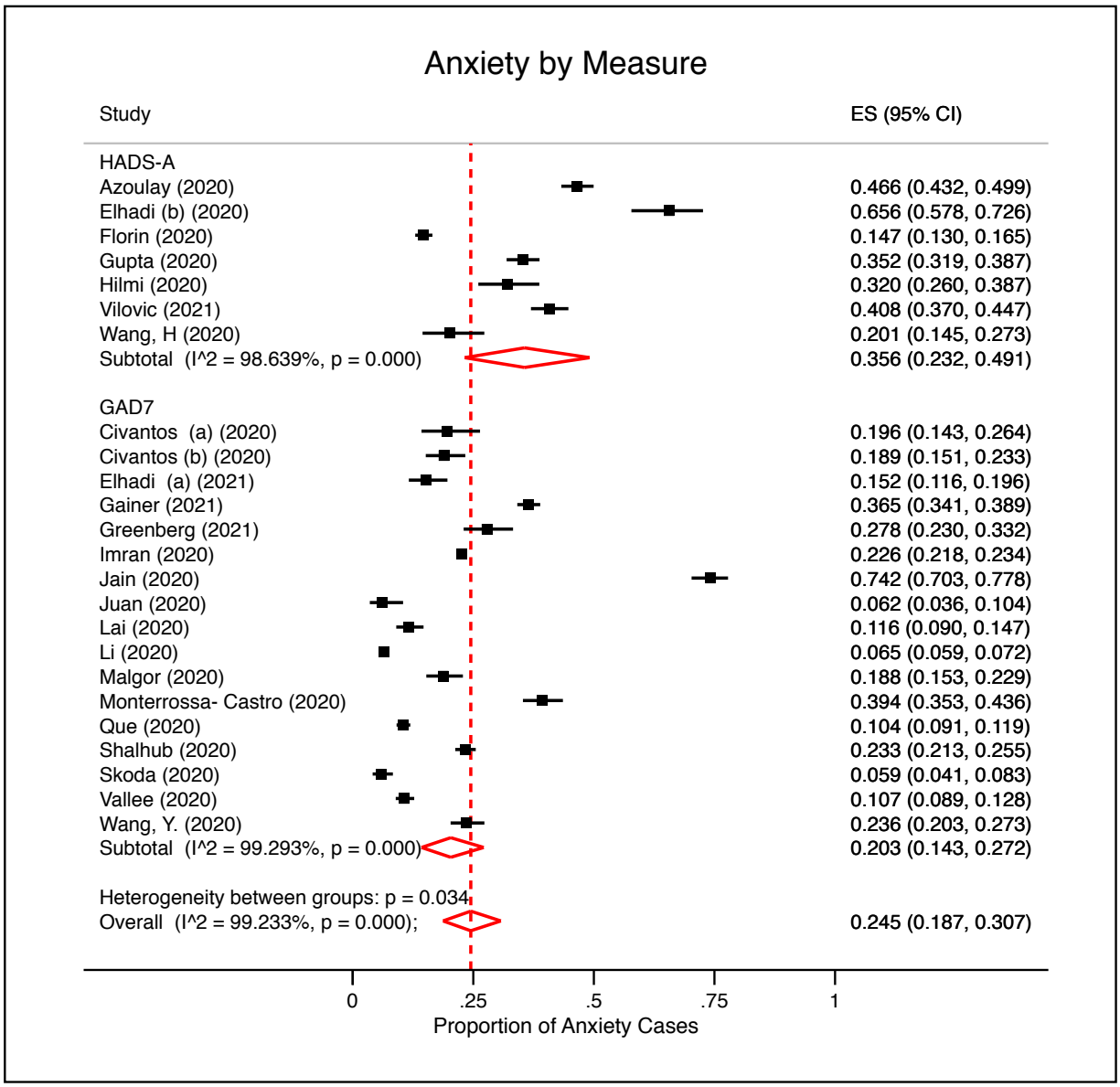
Appendix 8. Forest plot showing depression studies analysed by medium or low risk of bias



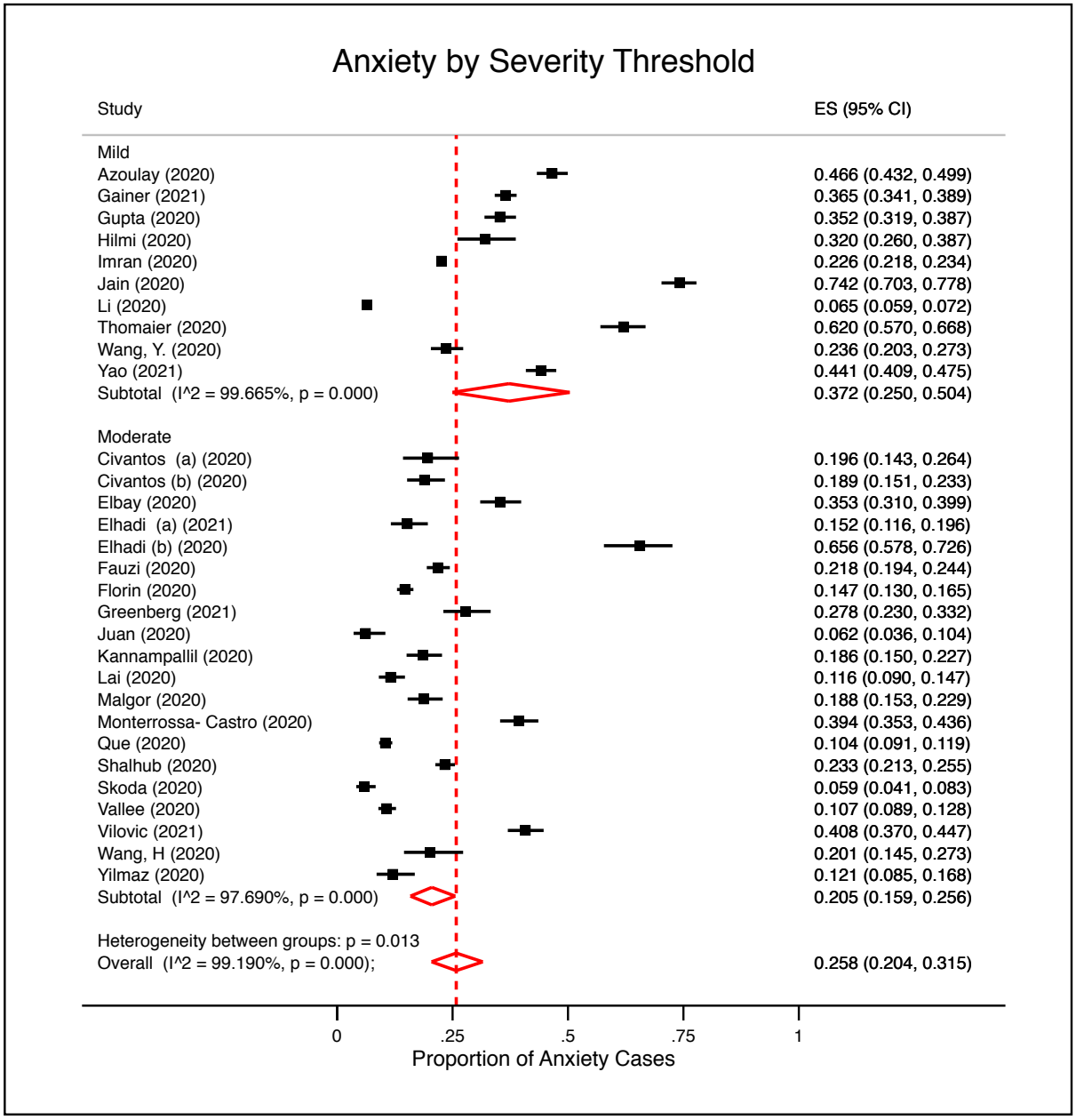
Appendix 9. Forest plot showing depression studies analysed by timeframe of survey



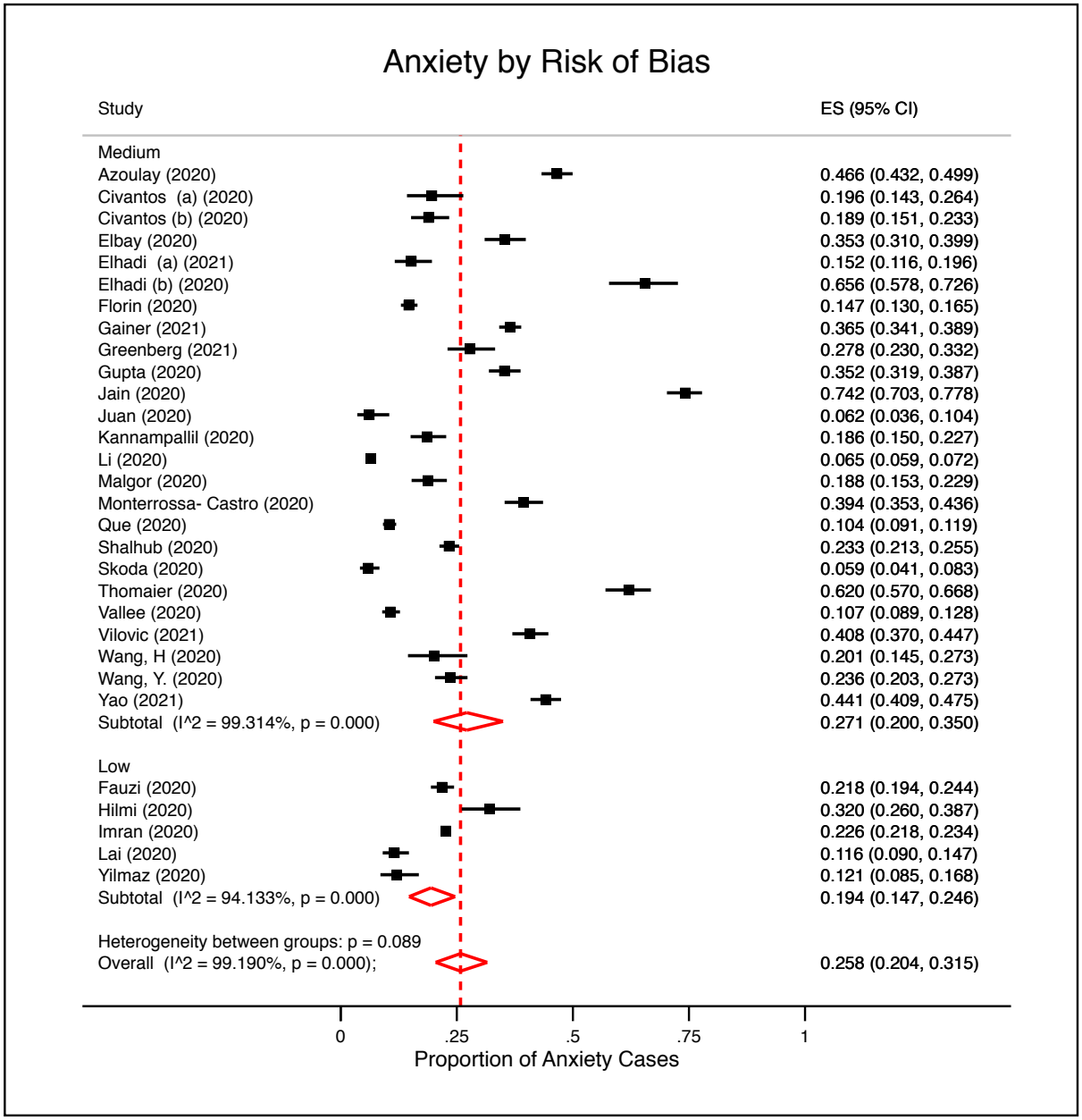
Appendix 10. Forest plot showing anxiety studies analysed by measure



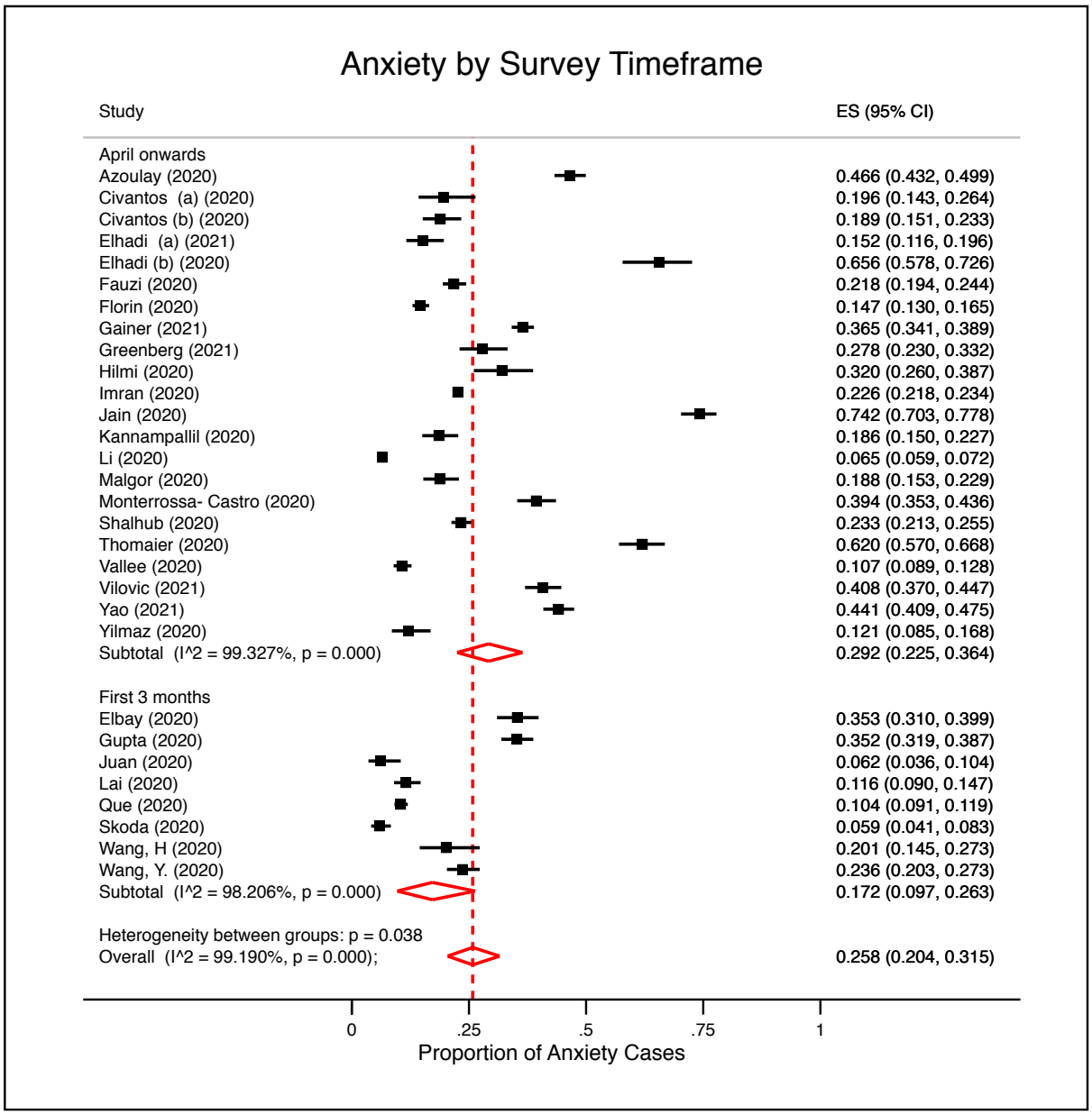
Appendix 11. Forest plot showing anxiety studies analysed by moderate and mild reporting thresholds



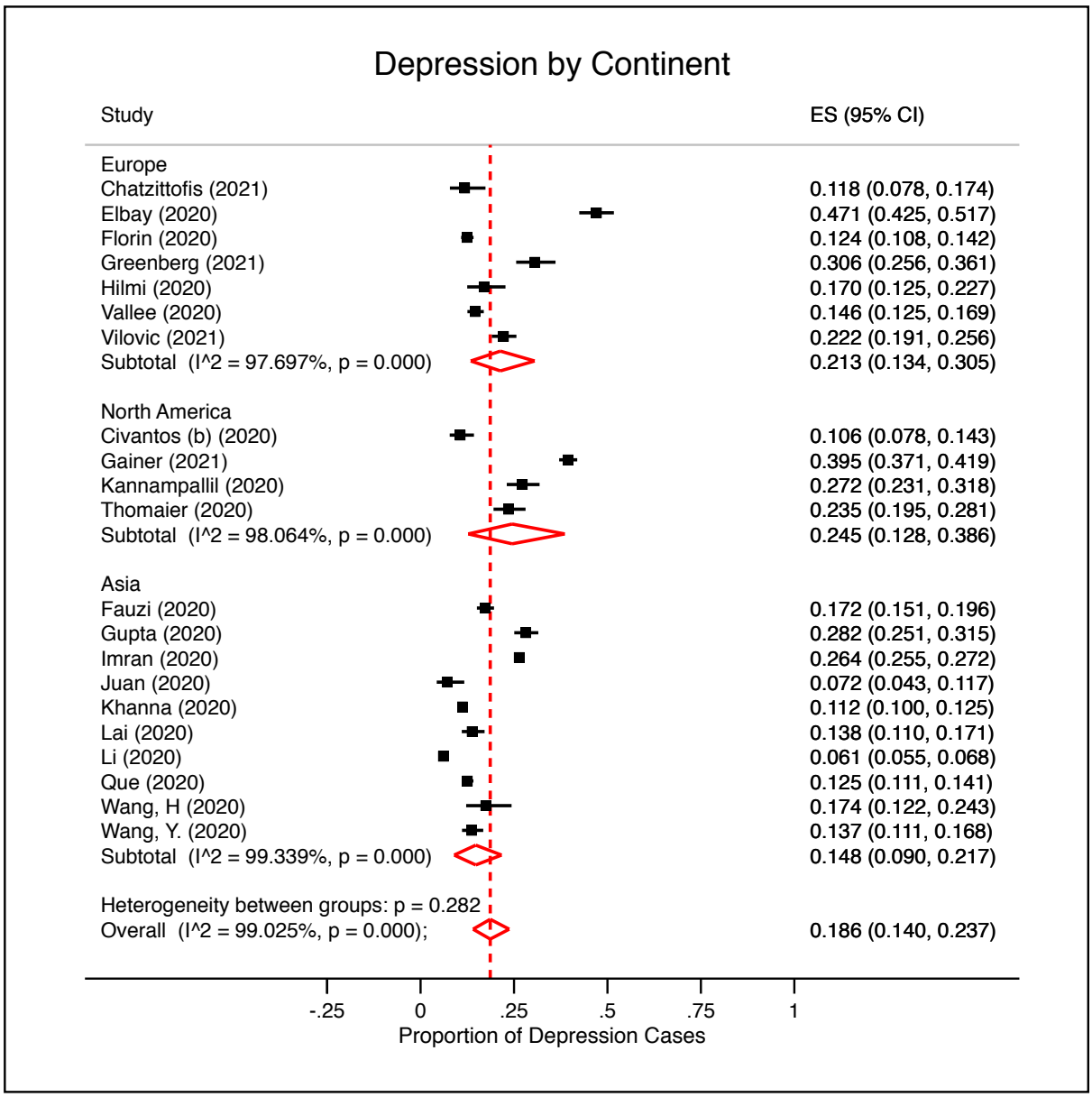
Appendix 12. Forest plot showing anxiety studies analysed by medium or low risk of bias



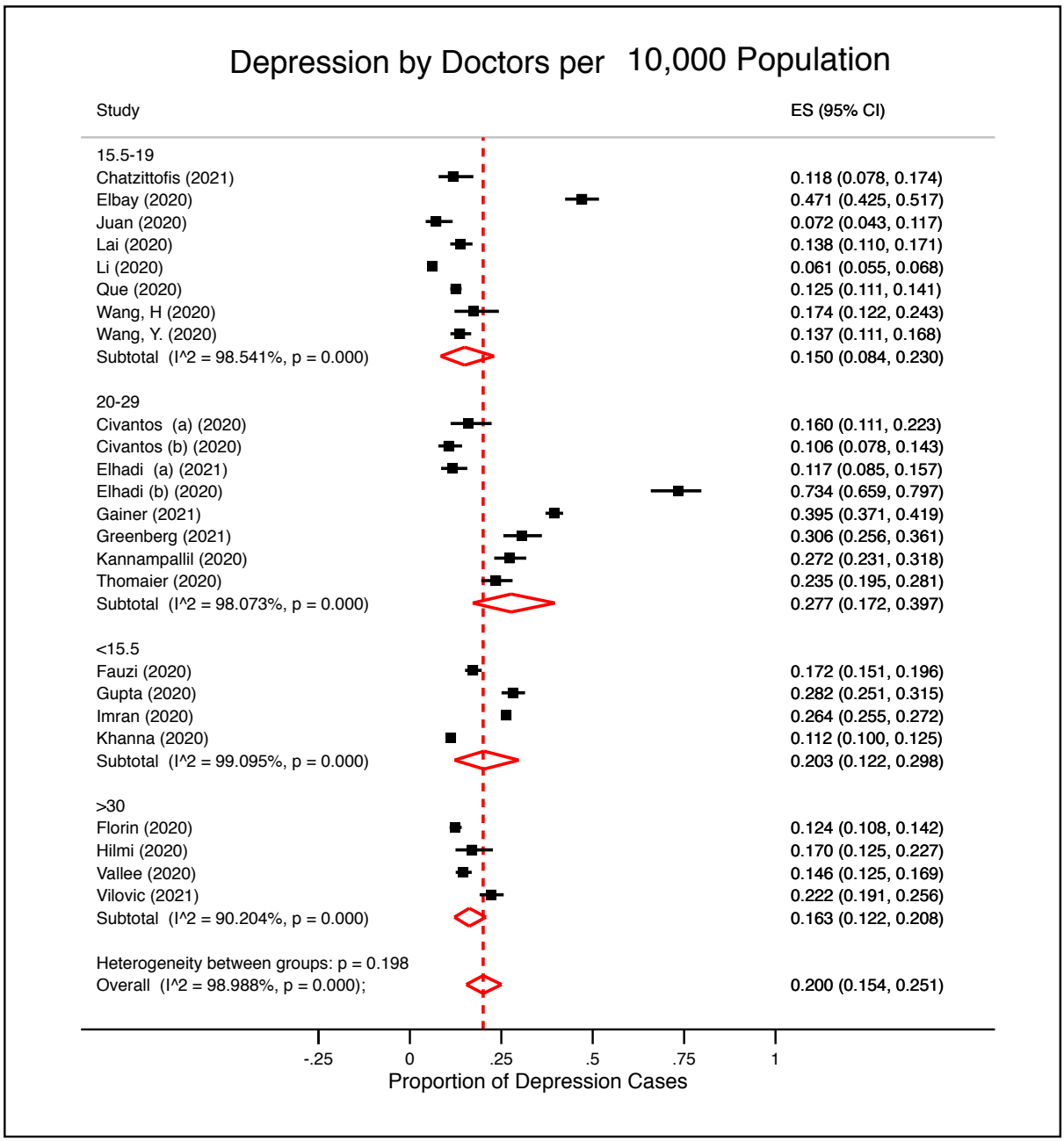
Appendix 13. Forest plot showing anxiety studies analysed by timeframe of survey



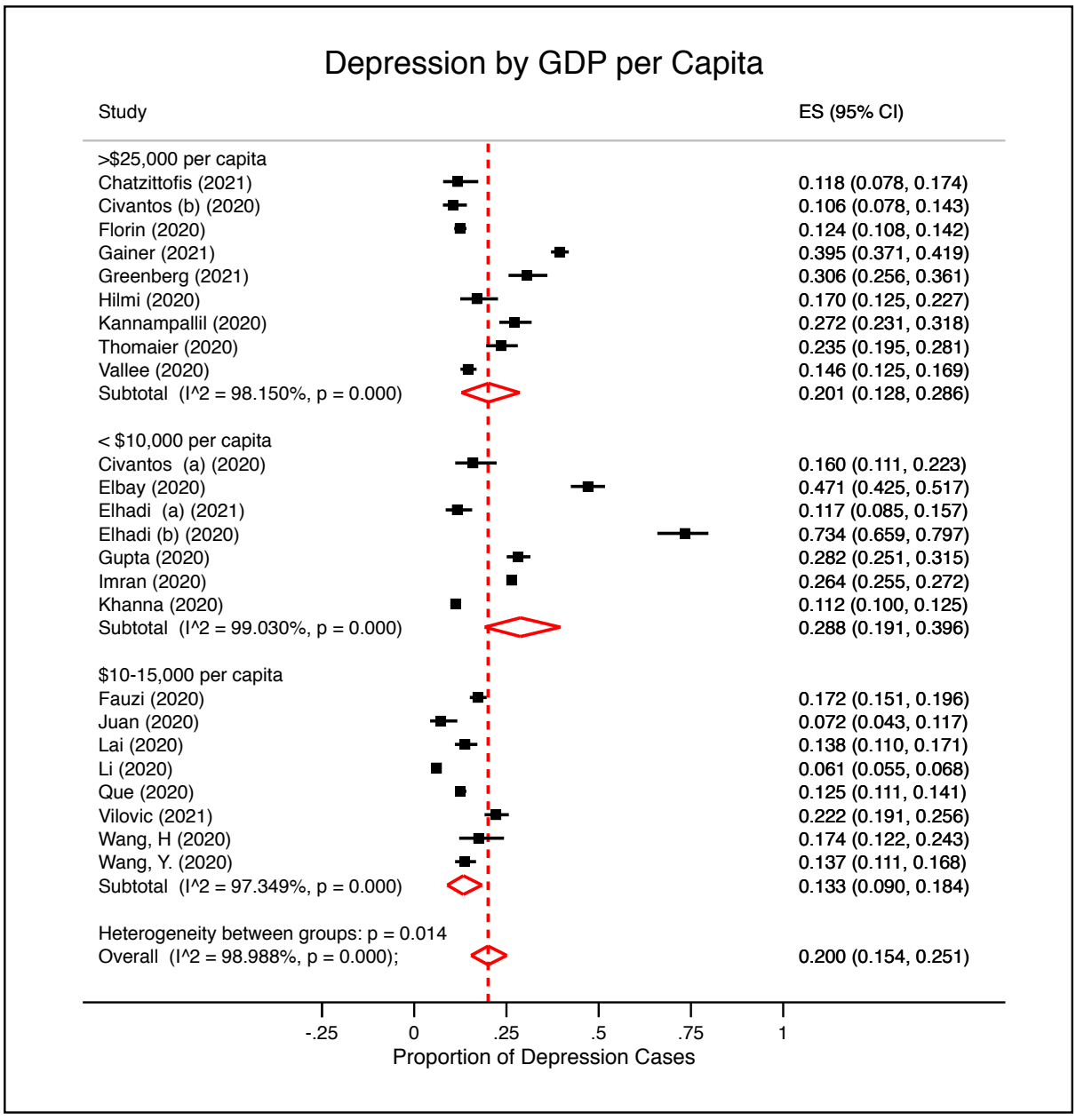
Appendix 14. Forest plot showing subgroup analysis of depression symptoms by geographical region



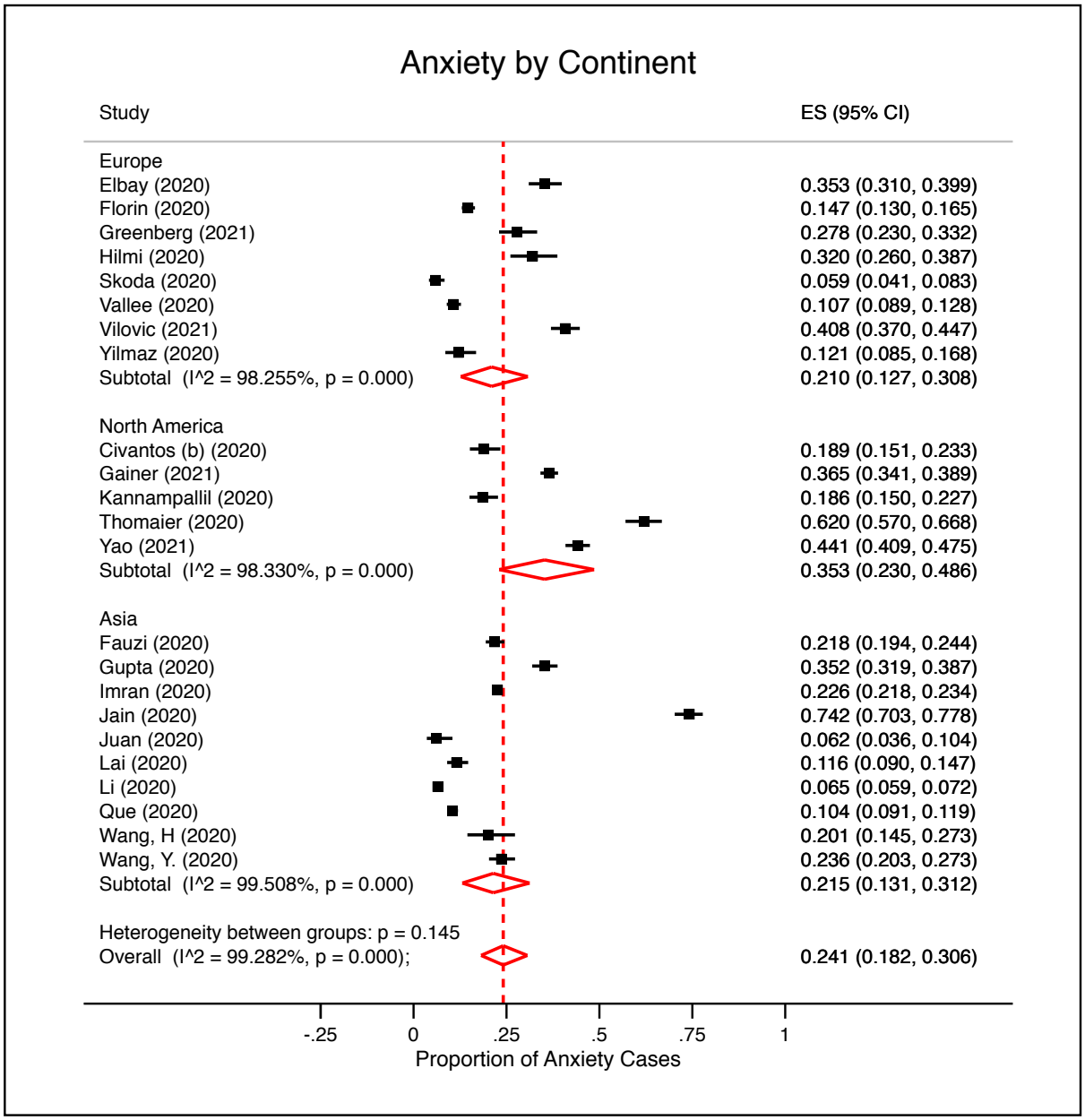
Appendix 15. Forest plot showing subgroup analysis of depression symptoms by doctors per 10,000 population



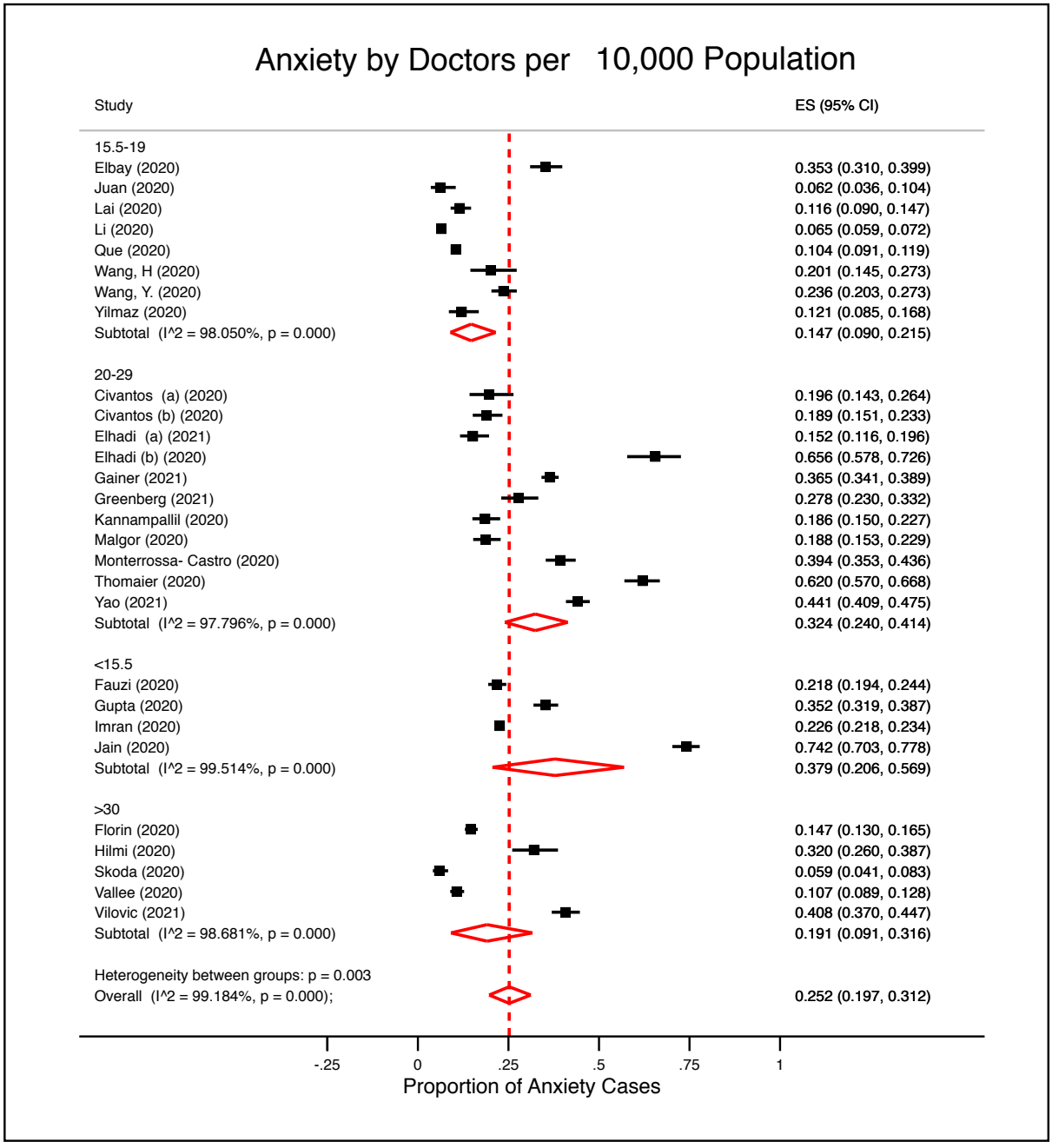
Appendix 16. Forest plot showing subgroup analysis of depression symptoms by gross domestic product per capita



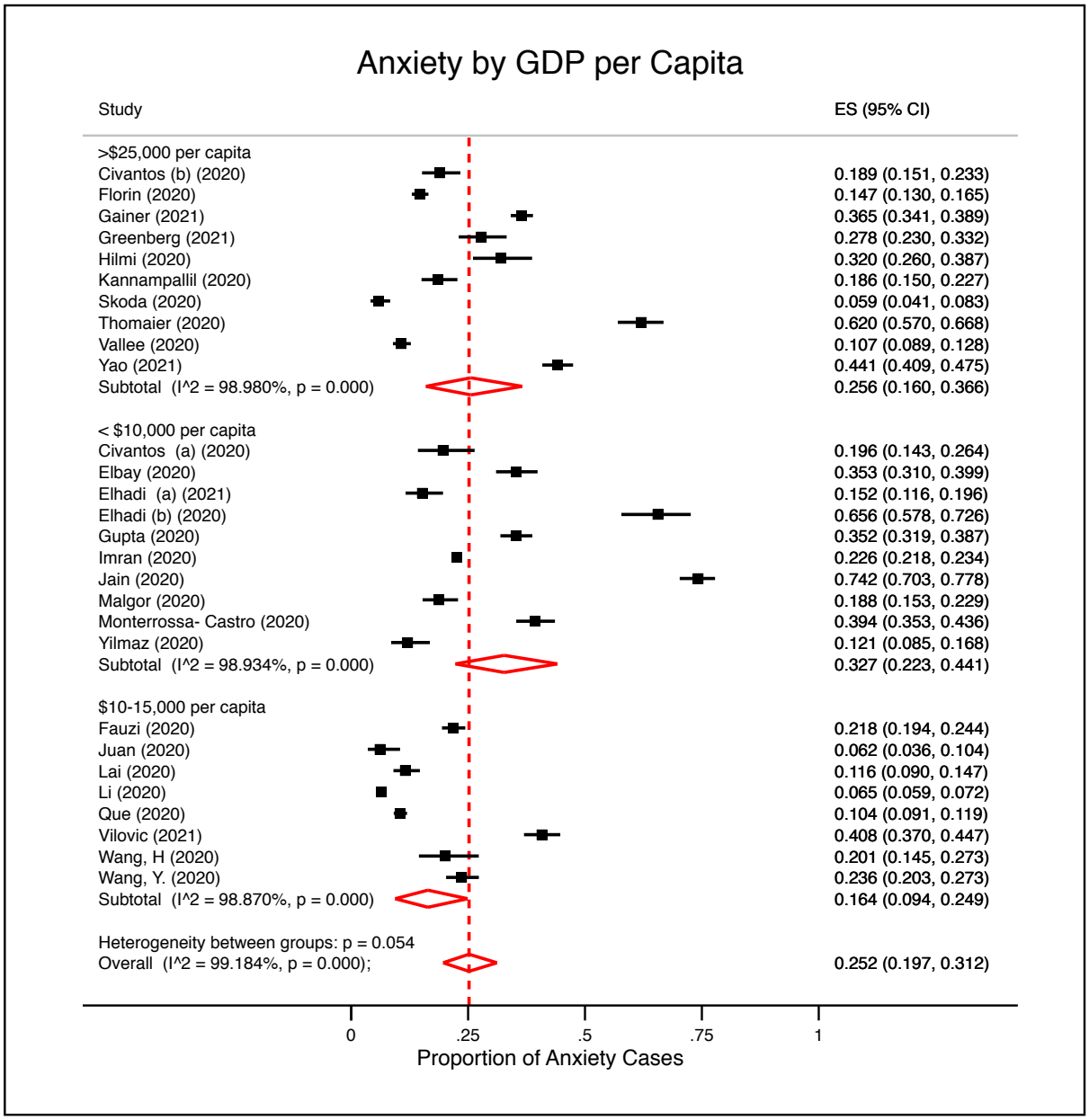
Appendix 17. Forest plot showing subgroup analysis of anxiety symptoms by geographical region



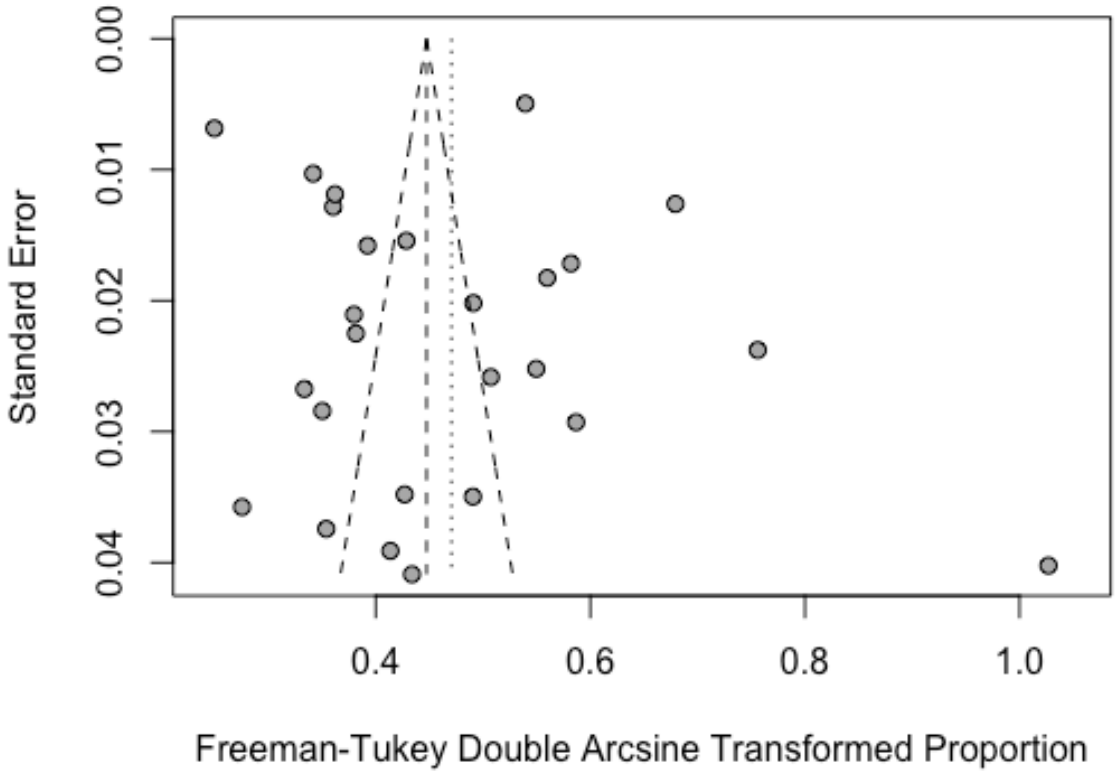
Appendix 18. Forest plot showing subgroup analysis of anxiety symptoms by doctors per 10,000 population



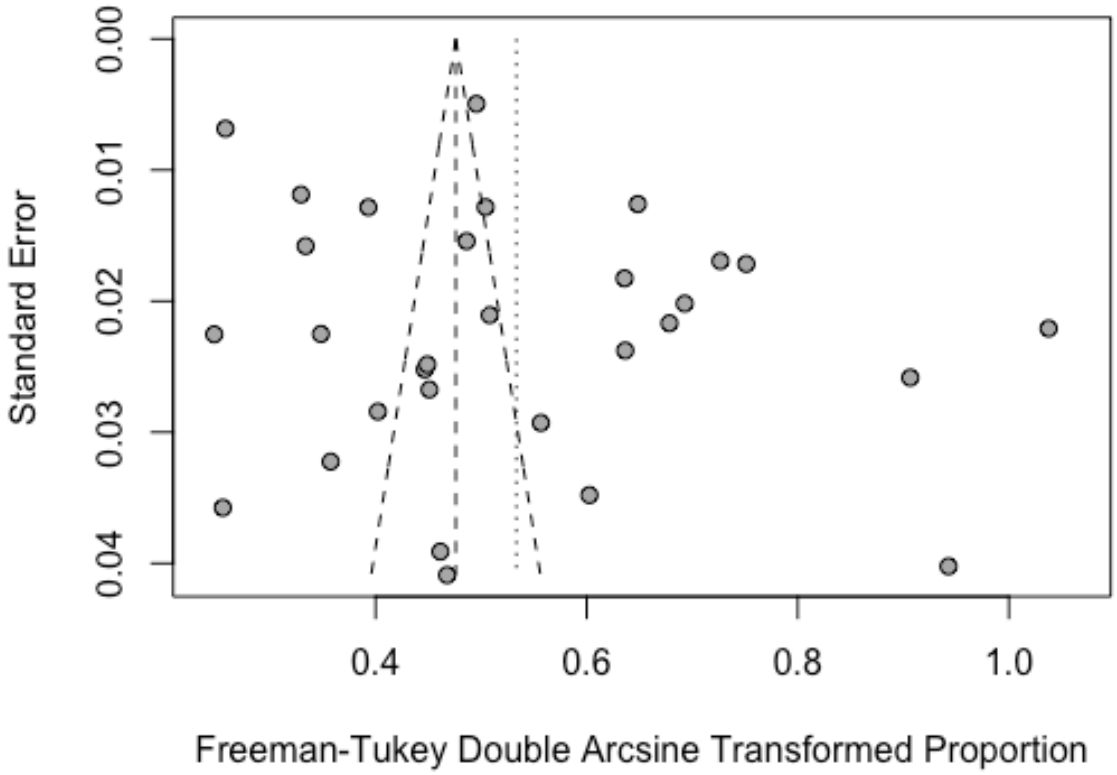
Appendix 19. Forest plot showing subgroup analysis of anxiety symptoms by gross domestic product per capita



Appendix 20. Funnel plot studies assessing depression symptoms



Appendix 21. Funnel plot studies assessing anxiety symptoms



Appendix 22. Survey landing page

Mental Health and Coping Styles of Doctors and Final Year Medical Students

Thank you for your interest in this study.

The aim of the study is to develop a better understanding of the mental health, coping styles and work experiences of UK doctors and final year medial students, within the context of the current global pandemic.

The survey should take around 10 minutes. On completion, you will have the option to enter into a free prize draw for the chance to win a £100 voucher, redeemable in-store or online at a wide range of shops.

On the next page, you will find further information about the study. Please read this information carefully and indicate, using the tick box, whether or not you would like to participate.

Please note: If you get interrupted, you can stop and return to the survey at any point during the next 7 days, without losing your progress.

→

Appendix 23. Survey consent page

Consent to Participate

I have read and understand the **participant information** (please click to download) for the study. I have had the opportunity to consider the information and ask any questions.

I understand that:

- My participation in this project will involve completing a selection of questionnaires about my current psychological wellbeing and my recent experiences at work.
- The survey should take around 10 minutes of my time.
- Participation in this study is entirely voluntary and I can stop or withdraw from the study at any time without giving a reason.
- I am free to ask any questions, discuss my concerns or request withdrawal from participation by contacting the researcher, Gemma Johns, or the supervisor, Dr Louise Waddington.
- At the end of the study I will be provided with additional information and feedback about the purpose of the study.
- The information provided by me will be held anonymously and stored in a secure database.
- My anonymised data will be used as the basis for a dissertation to meet the requirements of the doctoral qualification in Clinical Psychology at Cardiff University and may be published in an academic journal.

I understand all of the above and would like to take part in this study:

◯ **Yes, I consent**

◯ **No, I do not consent**

← →

Appendix 24. Participant information document

Participant Information

We would like to invite you to take part in a research study to develop a better understanding of the current mental health of medical students and doctors, in the context of the global pandemic. The following information explains why we are conducting this research and what taking part will involve. Please take the time to read this information carefully and consider your decision to take part. Please get in touch if you have any questions or need further information, via the contact details provided below.

Why have I been asked to take part in this study?
You have been asked to take part in this study because you are a final year medical student or medical doctor.

What is this study about?
The study aims to provide a better understanding of the mental health, coping styles, and work experiences of medical students and doctors, within the context of the global pandemic.

Why are you doing this study?
We hope that findings from this study may help to shape future support systems for medical students and doctors, in addition to informing how support is provided for healthcare professionals at other times of global or national crises.

What will I have to do?
You will be invited to complete a series of questionnaires relating to your current mental health and your experiences at work. The survey should take around ten minutes to complete.

What are the benefits of taking part?
You have the option of submitting you name to a prize draw for the chance to win a £100 high street voucher.

Are there any disadvantages or risks of participating in this research study?
Being asked about difficult experiences can be hard; however, research suggests that most people find participating in this type of research to be of value (Jaffe et al., 2015). Your participation is entirely voluntary, and you have the right to stop at any time. On completion of the survey, you will be provided with some useful self-help resources and details regarding how to access further psychological support, if needed. If you choose not to participate but would still like access to these materials, then please get in touch via the contact details below.

Do I have to take part?
Your participation is entirely voluntary.

If I agree to participate in the study, can I change my mind later on?
If you wish to withdraw from the study, you can do this at any time. However, if the data provided has already been anonymised, analysed or published it may not be possible to retrieve and destroy it.

Will I be paid for this study?
There is no payment for taking part in this study, however you have the option to submit your email to a prize draw for the chance to win a £100 voucher.

Will my participation in the study be confidential?
The data we collect will be stored anonymously on a database using an identification code. You will not be identified in any report or publication that follows this study. If you provide contact details for the prize drawer, or consent to be contacted for a future study, your contact information will be stored separately to your survey data.

Our team have a duty of care to protect people from harm. In the unlikely event that we find there is a risk of harm to you or anyone else, we will follow legal and ethical guidelines which may require us to over-ride our duty of confidentiality. The sponsor's GDPR statement is detailed below:

Research sponsor's general data protection regulation (GDPR) statement:
Cardiff University is the sponsor for this study based in the United Kingdom. We will be using information from you in order to undertake this study and will act as the data controller for this study. This means that we are responsible for looking after your information and using it properly. Cardiff University will keep identifiable information about you for 15 years after the study has finished. Your rights to access, change or move your information are limited, as we need to manage your information in specific ways in order for the research to be reliable and accurate. If you withdraw from the study, we will keep the information about you that we have already obtained. To safeguard your rights, we will use the minimum personally identifiable information possible. You can find out more about how we use your information at
https://www.cardiff.ac.uk/public-information/policies-and-procedures/data-protection.
The University's Data Protection Officer can be contacted at: inforequest@cardiff.ac.uk

What if I have a concern about the treatment I have received while participating?
We hope you will enjoy taking part in the research. However, if you are dissatisfied with the treatment you have received you have a right to raise a concern or make a complaint. In the first instance, if you feel able to do so, please raise your concern with the primary researcher, Gemma Johns, who will attempt to resolve any problems in the first instance. If for any reason you do not feel able to do this, then please contact Dr Louise Waddington, who is the primary supervisor overseeing this study, via the contact details below. You can also seek advice relating to concerns and complaints by contacting Cardiff University's Research Governance Team by e-mailing resgov@cardiff.ac.uk.

Who has reviewed the study?
All research conducted by Cardiff University is reviewed by the University's ethics committee in order to protect your safety, rights, dignity and wellbeing. This study has been reviewed and approved by the University ethics committee. The University Ethics Committee can be contacted by emailing psycethics@cardiff.ac.uk.

What will happen with the findings?
The findings will be written in a report and will be sent to a journal for publication. The findings will be written up and submitted to Cardiff University in order to fulfil the requirements for a Doctorate in Clinical Psychology. You will not be identified in any report or publication that follows this study.

What do I do if I want to take part?
If you would like to take part, please read all participant information and indicate that you consent to the conditions of the research. If you would like further information to inform your decision, please email johnsg3@cardiff.ac.uk.

Researcher contact details
If you would like more information about the project, please feel free to contact us via the details below.

Researcher / Main Contact
Gemma Johns
Trainee Clinical Psychologist
Doctoral Programme in Clinical Psychology
11th Floor, Tower Building
School of Psychology
70 Park Place
Cardiff
CF10 3AT
Johnsg3@cardiff.ac.uk

Academic Supervisor & Chief Investigator
Dr Louise Waddington
Therapies Director
Doctoral Programme in Clinical Psychology
11th Floor, Tower Building
School of Psychology
70 Park Place
Cardiff
CF10 3AT
Waddingtonl1@cardiff.ac.uk

Secondary Academic Supervisor
Dr Victoria Samuel
Senior Research Tutor
Doctoral Programme in Clinical Psychology
11th Floor, Tower Building
School of Psychology
70 Park Place
Cardiff
CF10 3AT
samuelv3@cardiff.ac.uk

Appendix 25. Example questionnaire page (GAD7)

Over the last *2 weeks*, how often have you been bothered by any of the following problems?

	Not at all	Several days	More than half the days	Nearly every day
Feeling nervous, anxious or on edge	○	○	○	○
Not being able to stop or control worrying	○	○	○	○
Worrying too much about different things	○	○	○	○
Trouble relaxing	○	○	○	○
Being so restless that it is hard to sit still	○	○	○	○
Becoming easily annoyed or irritable	○	○	○	○
Feeling afraid as if something awful might happen	○	○	○	○

← →

Appendix 26. Example additional information questions

"During the pandemic, I have been in close clinical contact with COVID-19 patients"

Please select the option which best applies:

Not at all	Rarely	Sometimes	Often	All the time
○	○	○	○	○

Do you have a condition that places you in a clinically vulnerable group (according to NHS / government criteria)?

- ○ Yes
- ○ No
- ○ Prefer not to say

Do you have a close relative, or live with someone, with a condition that places them in a clinically vulnerable group (according to NHS / government criteria)?

- ○ Yes
- ○ No
- ○ Prefer not to say

Please rate your agreement with the following statement:

"I have experienced a significant adverse life event related to COVID-19"

(e.g. bereavement or serious health complications for self, family or friends due to COVID)

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Prefer not to say
○	○	○	○	○	○

Please rate your agreement with the following statement:

"In the past 12 months, I have experienced a significant adverse life event *unrelated* to COVID-19"

(e.g. non-COVID-related bereavement or health problems; relationship breakdown)

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Prefer not to say
○	○	○	○	○	○

Appendix 27. Survey debrief

School of Psychology

Mental Health and Coping Styles of Doctors and Final Year Medical Students

Thank you for taking the time to participate in this study. We really value your input.
Your contribution will help us to develop a better understanding of the mental health, coping styles and work experiences of doctors and final year medical students, within the context of the current global pandemic. It may also help to shape future support systems for medical students and doctors and inform how support is provided for healthcare professionals at other times of global or national crisis.

Being asked about adverse experiences can sometimes bring up difficult thoughts and feelings; however, research suggests that most people find participating in this type of study to be of value. We hope that you have found contributing to this study to be a positive experience, but we also understand that the global context may be causing you, and many others, to experience greater levels of stress and anxiety than usual.

Information about helpful resources can be found on the next page.

If you have any concerns or complaints about the research, you can contact the School of Psychology Research Ethics Committee:

Secretary to the Research Ethics Committee
School of Psychology, Tower Building
70 Park Place, Cardiff, CF10 3AT
psychethics@cardiff.ac.uk

Many thanks again for taking the time to participate.

To submit your details for the prize draw, please follow the link at the very end of the survey.

Appendix 28. Support resources

School of Psychology

Support and Resources

Silver Cloud is a multi-award-winning digital mental health platform with online programmes including: Space from COVID-19; Space for Resilience; Space from Stress; Space for Sleep. Access to these programmes is now free for all NHS staff and their family members. Simply follow the link and enter the access code NHS2020 https://www.silvercloudhealth.com/uk/mental-health-nhs-staff

If Silvercloud don't feel like enough support for you, then you may find it helpful to contact some of the services listed on the next page and/or your GP, who will be able to discuss how to access further psychological support. If taking part in this survey has caused you any distress, or if you are worried about how you are feeling, then please contact us so that we can discuss avenues for you to access further support.

Support Services

- **GP** - If you are worried about how you are feeling then your GP will be best placed to support you to access psychological support
- **Papyrus / Hopeline** - confidential support and advice service for people under the age of 35 who are experiencing thoughts of suicide 0800 068 41 41 / papyrus-uk.org
- **Samaritans** – confidential support for people experiencing feelings of distress or despair. Call free on116 123

Websites

- **NHS Employers** - a selection of useful resources, apps, and information about mental and physical health and wellbeing. https://www.nhsemployers.org/covid19/health-safety-and-wellbeing/support-available-for-nhs-staff
- **Every Mind Matters -** expert advice and guidance on how to improve your mental health and wellbeing if you are worried or anxious about the coronavirus outbreak https://www.nhs.uk/oneyou/every-mind-matters
- **Psychology Tools -** A guide to living with worry and anxiety amidst global uncertainty https://www.psychologytools.com/assets/covid-19/guide_to_living_with_worry_and_anxiety_amidst_global_uncertainty_en-us.pdf

Apps

- **Headspace** is a science-backed mindfulness and meditation app, free access for NHS staff until 31st December 2020 https://www.headspace.com/nhs
- **Sleepio** is a clinically evidenced sleep improvement programme that is fully automated and highly personalised, using cognitive behavioural techniques to help improve poor sleep. Free access to Sleepio until 31st December 2020 for NHS staff, including staff who do not currently have an NHS email address, such as medical students. http://sleepio.com/nhs-staff
- **Daylight** is a smartphone-based app that provides help to people experiencing symptoms of worry and anxiety, using evidence-based cognitive behavioural techniques. Free access to Daylight until 31st December 2020 for NHS staff, including staff who do not currently have an NHS email address, such as medical students. http://trydaylight.com/nhs-staff

If you would like this information emailed to you, you can request a copy via the contact details below.

Thank you.

Researcher/ Main Contact:
Gemma Johns
Trainee Clinical Psychologist
Doctoral Programme in Clinical Psychology
11th Floor, Tower Building, School of Psychology
70 Park Place, Cardiff, CF10 3AT
Johnsg3@cardiff.ac.uk

Academic Supervisor/ Chief Investigator:
Dr Louise Waddington
Therapies Director
Doctoral Programme in Clinical Psychology
11th Floor, Tower Building, School of Psychology
70 Park Place, Cardiff, CF10 3AT
Waddingtonl1@cardiff.ac.uk

Academic Supervisor:
Dr Victoria Samuel
Senior Research Tutor
Doctoral Programme in Clinical Psychology
11th Floor, Tower Building, School of Psychology
70 Park Place, Cardiff, CF10 3AT
Samuelv3@cardiff.ac.uk

Appendix 29. Anxiety, depression, PTSD prevalence - full sample for each measure

Anxiety (GAD7)	Total (435) N, %	Career grade (431) N, %					Early Reg (431) N, %	
		Student (106)	F1 (104)	F2 (88)	Middle (98)	Senior (35)	No (344)	Yes (87)
None	174, 40.0	35, 33.0	38, 36.5	30, 34.1	55, 56.2	15, 42.9	146, 42.4	27, 21.0
Mild	151, 34.7	36, 34.0	36, 34.6	38,43.2	29, 29.6	10, 28.6	113, 32.8	36, 41.4
Moderate	73, 16.8	27, 25.5	18, 17.3	10,11.4	10,10.2	8, 22.9	57,16.5	16, 18.4
Severe	37, 8.5	8, 7.5	12, 11.5	10, 11.4	4, 4.0	2, 5.7	28, 8.1	8, 9.2
<10	325, 74.7	71, 67.0	74, 71.2	68, 77.3	84, 85.7	25, 71.4	259, 75.3	63, 72.4
≥ 10	110, 25.3	35, 33.0	30, 28.8	20, 22.7	14, 14.3	10, 28.6	85, 24.7	24, 27.6
Depression (PHQ9)	Total (419) N, %	Career grade (416)					Early Reg (416)	
		Student (104)	F1 (100)	F2 (87)	Middle (91)	Senior (34)	No (330)	Yes (86)
None	196, 46.8	46, 44.2	51, 51.0	35, 40.2	46, 50.5	17, 50.0	154, 46.6	41, 47.7
Mild	129, 30.8	31, 29.8	23, 23.0	31, 35.6	34, 37.4	9, 26.5	104, 31.5	24, 27.9
Moderate	66, 15.8	23, 22.1	15, 15.0	12, 13.8	9, 9.9	6, 17.6	52, 15.7	13, 15.1
Moderately severe	18, 4.3	4, 3.8	6, 6.0	5, 5.7	2, 2.2	1, 2.9	14, 4.2	4, 4.7
Severe	10, 2.4	0, 0.0	5, 5.0	4, 4.6	0, 0	1, 2.9	6, 1.8	4, 4.7
<10	325, 77.6	77, 74.0	74, 74.0	66, 75.9	82, 90.1	26, 76.5	258, 78.1	65, 75.6
≥ 10	94, 22.4	27, 26.0	26, 26.0	21, 24.1	11, 12.1	8, 23.5	72, 21.8	21, 24.4

PTSD (PCL-5)	Total (387) N, %	Career grade (384)					Early Reg (384)	
		Student (99)	F1 (190)	F2 (79)	Middle (82)	Senior (34)	No (307)	Yes (77)
<31	342, 88.4	88, 88.9	78, 86.7	70, 88.6	75,	30, 88.2	274, 89.2	67, 87.0
≥ 31	45, 11.6	11, 11.1	12, 13.3	9, 11.4	7,	4, 11.8	33, 10.7	10, 13.0

Student = final year medical student; F1 = foundation year 1 doctor; F2 = foundation year 2 doctor; Middle = junior and senior middle grade doctors; Senior = consultant or GP grade; Early reg = early registration granted.

Appendix 30. Brain Behavior and Immunity: Guide for Authors

Retrieved from: https://www-elsevier-com.abc.cardiff.ac.uk/journals/brain-behavior-and-immunity/0889-1591/guide-for-authors

Types of Article

Full-length research reports: There is no word limit on full length research reports, but papers should be concisely written and most should be able to articulate their findings within approximately 6,000 words.

Reviews: Reviews consist of approximately 6,000 words of text and no more than 100 scientific references. Reviews must contain at least one figure highlighting the key aspects of the article, complete with explanatory figure legends. If appropriate a color version of the figure can be published in the online publication, with a black-and-white figure in the print version. If the author chooses this option, the figure legend must be self-explanatory in the absence of color-coding.

Format

Manuscripts should be prepared using a 12-point font, double-spaced throughout (including tables, footnotes, references, and figure captions) with 1-in. margins on all sides. Unusual typeface is acceptable only if it is clear and legible. For initial submission, all manuscripts must be prepared and submitted in one of the following formats: Microsoft Word (.doc), WordPerfect (.wps), or Rich Text Format (.rtf). All figures and tables should be clearly labeled at the top.

PREPARATION

Article Structure

Subdivision - numbered sections: Divide your article into clearly defined and numbered sections. Subsections should be numbered 1.1 (then 1.1.1, 1.1.2, ...), 1.2, etc. (the abstract is not included in section numbering). Use this numbering also for internal cross-referencing: do not just refer to 'the text'. Any subsection may be given a brief heading. Each heading should appear on its own separate line.

Introduction: State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Material and methods: Provide sufficient details to allow the work to be reproduced by an independent researcher. Methods that are already published should be summarized, and indicated by a reference. If quoting directly from a previously published method, use quotation marks and also cite the source. Any modifications to existing methods should also be described.

Results: Results should be clear and concise.

Discussion: This should explore the significance of the results of the work, not repeat them. Avoid extensive citations and discussion of published literature.

Conclusions: The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion.

Appendices: If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

Essential Title Page Information

Title: Concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible.

Author names and affiliations. Please clearly indicate the given name(s) and family name(s) of each author and check that all names are accurately spelled. You can add your name between parentheses in your own script behind the English transliteration. Present the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lower-case superscript letter immediately after the author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name and, if available, the e-mail address of each author.

Corresponding author: Clearly indicate who will handle correspondence at all stages of refereeing and publication, also post-publication. This responsibility includes answering any future queries about Methodology and Materials. Ensure that the e-mail address is given and that contact details are kept up to date by the

corresponding author. Present/permanent address. If an author has moved since the work described in the article was done, or was visiting at the time, a 'Present address' (or 'Permanent address') may be indicated as a footnote to that author's name. The address at which the author actually did the work must be retained as the main, affiliation address. Superscript Arabic numerals are used for such footnotes.

Word count: Please include a word count, excluding references and tables.

Highlights

Highlights are mandatory for this journal as they help increase the discoverability of your article via search engines. They consist of a short collection of bullet points that capture the novel results of your research as well as new methods that were used during the study (if any). Highlights should be submitted in a separate editable file in the online submission system. Please use 'Highlights' in the file name and include 3 to 5 bullet points (maximum 85 characters, including spaces, per bullet point).

Abstract

A concise and factual abstract is required. The abstract should state briefly the purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so it must be able to stand alone. For this reason, References should be avoided, but if essential, then cite the author(s) and year(s). Also, non-standard or uncommon abbreviations should be avoided, but if essential they must be defined at their first mention in the abstract itself.

Keywords

A list of up to 10 keywords or phrases suitable for indexing should be provided.

Abbreviations

Do not use periods after abbreviations of measure (cm, s, kg, mA, etc.) in text or tables, except for "in." (inch). The American Chemical Society Style Guide should be used as a reference for proper abbreviations.

Acknowledgements

Collate acknowledgements in a separate section at the end of the article before the references and do not, therefore, include them on the title page, as a footnote to the title or otherwise. List here those individuals who provided help during the research (e.g., providing language help, writing assistance or proof reading the article, etc.).

Formatting of funding sources

List funding sources in this standard way to facilitate compliance to funder's requirements. If no funding has been provided for the research, please include the following sentence: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Units

Follow internationally accepted rules and conventions: use the international system of units (SI). If other units are mentioned, please give their equivalent in SI.

Math formulae

Please submit math equations as editable text and not as images. Present simple formulae in line with normal text where possible and use the solidus (/) instead of a horizontal line for small fractional terms, e.g., X/Y. In principle, variables are to be presented in italics. Powers of e are often more conveniently denoted by exp. Number consecutively any equations that have to be displayed separately from the text (if referred to explicitly in the text).

Footnotes

Footnotes should be used sparingly. Number them consecutively throughout the article. Many word processors build footnotes into the text, and this feature may be used. Should this not be the case, indicate the position of footnotes in the text and present the footnotes themselves separately at the end of the article.

Electronic artwork

General points:

- Make sure you use uniform lettering and sizing of your original artwork.
- Preferred fonts: Arial (or Helvetica), Times New Roman (or Times), Symbol, Courier. Number the illustrations according to their sequence in the text.

- Use a logical naming convention for your artwork files.
- Indicate per figure if it is a single, 1.5 or 2-column fitting image.
- For Word submissions only, you may still provide figures and their captions, and tables within a single file at the revision stage.
- Please note that individual figure files larger than 10 MB must be provided in separate source files.

A detailed guide on electronic artwork is available. You are urged to visit this site; some excerpts from the detailed information are given here.

Formats:

Regardless of the application used, when your electronic artwork is finalized, please 'save as' or convert the images to one of the following formats (note the resolution requirements for line drawings, halftones, and line/halftone combinations given below):

EPS (or PDF): Vector drawings. Embed the font or save the text as 'graphics'.

TIFF (or JPG): Color or grayscale photographs (halftones): always use a minimum of 300 dpi.

TIFF (or JPG): Bitmapped line drawings: use a minimum of 1000 dpi.

TIFF (or JPG): Combinations bitmapped line/half-tone (color or grayscale): a minimum of 500 dpi is required.

Please do not:

- Supply files that are optimized for screen use (e.g., GIF, BMP, PICT, WPG); the resolution is too low.
- Supply files that are too low in resolution.
- Submit graphics that are disproportionately large for the content.

Color artwork: Please make sure that artwork files are in an acceptable format (TIFF (or JPEG), EPS (or PDF), or MS Office files) and with the correct resolution. If, together with your accepted article, you submit usable color figures then Elsevier

will ensure, at no additional charge, that these figures will appear in color online (e.g., ScienceDirect and other sites) regardless of whether or not these illustrations are reproduced in color in the printed version. For color reproduction in print, you will receive information regarding the costs from Elsevier after receipt of your accepted article. Please indicate your preference for color: in print or online only. Further information on the preparation of electronic artwork.

Figure captions: Ensure that each illustration has a caption. A caption should comprise a brief title (not on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum but explain all symbols and abbreviations used.

Tables

Please submit tables as editable text and not as images. Tables can be placed either next to the relevant text in the article, or on separate page(s) at the end. Number tables consecutively in accordance with their appearance in the text and place any table notes below the table body. Be sparing in the use of tables and ensure that the data presented in them do not duplicate results described elsewhere in the article. Please avoid using vertical rules and shading in table cells.

References

Citation in text: Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Unpublished results and personal communications are not recommended in the reference list, but may be mentioned in the text. If these references are included in the reference list they should follow the standard reference style of the journal and should include a substitution of the publication date with either 'Unpublished results' or 'Personal communication'. Citation of a reference as 'in press' implies that the item has been accepted for publication.

Web references: As a minimum, the full URL should be given and the date when the reference was last accessed. Any further information, if known (DOI, author names, dates, reference to a source publication, etc.), should also be given. Web

references can be listed separately (e.g., after the reference list) under a different heading if desired, or can be included in the reference list.

Data references: This journal encourages you to cite underlying or relevant datasets in your manuscript by citing them in your text and including a data reference in your Reference List. Data references should include the following elements: author name(s), dataset title, data repository, version (where available), year, and global persistent identifier. Add [dataset] immediately before the reference so we can properly identify it as a data reference. The [dataset] identifier will not appear in your published article.

References in a special issue: Please ensure that the words 'this issue' are added to any references in the list (and any citations in the text) to other articles in the same Special Issue.

Reference management software: Most Elsevier journals have their reference template available in many of the most popular reference management software products. These include all products that support Citation Style Language styles, such as Mendeley. Using citation plug-ins from these products, authors only need to select the appropriate journal template when preparing their article, after which citations and bibliographies will be automatically formatted in the journal's style. If no template is yet available for this journal, please follow the format of the sample references and citations as shown in this Guide. If you use reference management software, please ensure that you remove all field codes before submitting the electronic manuscript. More information on how to remove field codes from different reference management software. Users of Mendeley Desktop can easily install the reference style for this journal by clicking the following link: http://open.mendeley.com/use-citation-style/brain-behavior-and-immunity When preparing your manuscript, you will then be able to select this style using the Mendeley plugins for Microsoft Word or LibreOffice.

Reference formatting: There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is

consistent. Where applicable, author(s) name(s), journal title/ book title, chapter title/article title, year of publication, volume number/book chapter and the article number or pagination must be present. Use of DOI is highly encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for the author to correct. If you do wish to format the references yourself they should be arranged according to the following examples:

Text: All citations in the text should refer to: 1. Single author: the author's name (without initials, unless there is ambiguity) and the year of publication; 2. Two authors: both authors' names and the year of publication; 3. Three or more authors: first author's name followed by 'et al.' and the year of publication. Citations may be made directly (or parenthetically). Groups of references can be listed either first alphabetically, then chronologically, or vice versa.

Examples: 'as demonstrated (Allan, 2000a, 2000b, 1999; Allan and Jones, 1999)…. Or, as demonstrated (Jones, 1999; Allan, 2000)… Kramer et al. (2010) have recently shown …'

List: References should be arranged first alphabetically and then further sorted chronologically if necessary. More than one reference from the same author(s) in the same year must be identified by the letters 'a', 'b', 'c', etc., placed after the year of publication.

Examples:

Reference to a journal publication: Van der Geer, J., Hanraads, J.A.J., Lupton, R.A., 2010. The art of writing a scientific article. J. Sci. Commun. 163, 51–59. https://doi.org/10.1016/j.Sc.2010.00372.

Reference to a journal publication with an article number: Van der Geer, J., Hanraads, J.A.J., Lupton, R.A., 2018. The art of writing a scientific article. Heliyon. 19, e00205. https://doi.org/10.1016/j.heliyon.2018.e00205.

Reference to a book: Strunk Jr., W., White, E.B., 2000. The Elements of Style, fourth ed. Longman, New York.

Reference to a chapter in an edited book: Mettam, G.R., Adams, L.B., 2009. How to prepare an electronic version of your article, in: Jones, B.S., Smith , R.Z. (Eds.), Introduction to the Electronic Age. E-Publishing Inc., New York, pp. 281–304.
Reference to a website: Cancer Research UK, 1975. Cancer statistics reports for the UK. http://www.cancerresearchuk.org/ aboutcancer/statistics/cancerstatsreport/ (accessed 13 March 2003).
Reference to a dataset: [dataset] Oguro, M., Imahiro, S., Saito, S., Nakashizuka, T., 2015. Mortality data for Japanese oak wilt disease and surrounding forest compositions. Mendeley Data, v1. https://doi.org/10.17632/ xwj98nb39r.1.
Reference to software: Coon, E., Berndt, M., Jan, A., Svyatsky, D., Atchley, A., Kikinzon, E., Harp, D., Manzini, G., Shelef, E., Lipnikov, K., Garimella, R., Xu, C., Moulton, D., Karra, S., Painter, S., Jafarov, E., & Molins, S., 2020. Advanced Terrestrial Simulator (ATS) v0.88 (Version 0.88). Zenodo. https://doi.org/10.5281/ zenodo.3727209. Journal abbreviations source Journal names should be abbreviated according to the List of Title Word Abbreviations.

Data statement

To foster transparency, we encourage you to state the availability of your data in your submission. This may be a requirement of your funding body or institution. If your data is unavailable to access or unsuitable to post, you will have the opportunity to indicate why during the submission process, for example by stating that the research data is confidential. The statement will appear with your published article on ScienceDirect. For more information, visit the Data Stateme