

Medical students, mental health and the role of resilience – a cross-sectional study

AUTHOR(S)

Colm Healy, Áine Ryan, Catherine Moran, Denis Harkin, Frank Doyle, Anne Hickey

CITATION

Healy, Colm; Ryan, Áine; Moran, Catherine; Harkin, Denis; Doyle, Frank; Hickey, Anne (2023). Medical students, mental health and the role of resilience – a cross-sectional study. Royal College of Surgeons in Ireland. Journal contribution. <https://hdl.handle.net/10779/rcsi.23618802.v1>

HANDLE

[10779/rcsi.23618802.v1](https://hdl.handle.net/10779/rcsi.23618802.v1)

LICENCE

CC BY-NC-ND 4.0

This work is made available under the above open licence by RCSI and has been printed from <https://repository.rcsi.com>. For more information please contact repository@rcsi.com

URL

https://repository.rcsi.com/articles/journal_contribution/Medical_students_mental_health_and_the_role_of_resilience_a_cross-sectional_study/23618802/1

Abstract

Background: Medical students have reported high prevalence of mental health difficulties and burnout. However, there are limited investigations examining the association between resilience and these difficulties. We investigated: 1) depression, anxiety, personal and professional burnout and comorbidity; 2) demographic and education characteristics associated with these outcomes; 3) the association between resilience and these outcomes; and 4) whether these results were attributable to sampling bias.

Methods: Participants were n=521 medical students from RCSI University of Medicine and Health Sciences. Outcomes were measured using validated scales. We report descriptive statistics, and risk factors for the difficulties were investigated using generalized linear modelling.

Results: One-in-three students reported incidence of depression or anxiety (24.5% co-morbidity). 8.9% of students reported all four difficulties. Difficulties were more common in female students and those in middle years of the programme. Resilience was negatively correlated with all outcomes and stable across demographic and educational variables. Weighting the data for sampling bias did not affect these results.

Conclusions: Our results emphasise the high incidence of depression, anxiety, burnout and comorbidity in students. We advocate for further investigation into the role of resilience as a modifiable factor that may ameliorate the incidence of depression, anxiety and burnout in medical students.

Keywords: Medical Students, Depression, Anxiety, Burnout, Resilience

Practical Points.

- One in three medical students report clinical levels of depression or anxiety with 24% reporting comorbid depression and anxiety.
- 9% report depression, anxiety, personal and professional burnout.
- Difficulties were more common in female students and in those in second and third year of direct entry medicine.
- Resilience was negatively correlated with all other outcomes and stable across demographic and educational characteristics.
- Weighted and unweighted comparisons suggest that sampling bias has a limited effect on these results.

Notes on Contributors.

Dr Colm Healy. Dr Healy is a Lecture in the Department of Health Psychology and a Senior Post-Doctoral Research Fellow in the Department of Psychiatry at the Royal College of Surgeons in Ireland. His interests include Youth Mental Health and the Prediction and Prevention of Severe Psychiatric Disorder. ORCID:0000-0001-7974-1861.
Email:colmhealy@rcsi.com

Dr Áine Ryan. Dr Ryan is a Postdoctoral Fellow in Professionalism in Healthcare and Honorary Lecturer in the RCSI. Áine is a Chartered Physiotherapist and has a PhD in Population Health and Health Services Research. Her research interests are in Professionalism, Health Professions Education and Lifestyle Medicine. ORCID ID:0000-0002-9259-9799. Email:aineryan@rcsi.ie

Dr Catherine N. Moran. Dr. Moran is a postdoctoral researcher in the Department of Health Psychology at RCSI University of Medicine and Health Sciences, Dublin. Her research interests include medical education, stroke quality of care, interventions for complex chronic conditions, and cognitive ageing. ORCID: 0000-0002-7619-859X. Email: catherinenmoran@rcsi.ie

Professor Denis W. Harkin. Professor Harkin is Chair of Medical Professionalism at RCSI and leads the Centre for Professionalism in Medicine and Health Sciences at RCSI. A Consultant Vascular Surgeon, he has a special interest in vascular trauma, complex aortic and venous disease. His research interests include Medical Education, Professionalism and Vascular Surgery. ORCID:0000-0002-4701-8350. Email:denisharkin@rcsi.ie

Professor Frank Doyle. Professor Doyle is Associate Professor in Psychology in RCSI and a Fellow of the European Health Psychology Society. His research interests include health and education and he has led the development of three new research methods, including a novel metric for the assessment of medication adherence and a ‘hybrid’ systematic review approach. ORCID:0000-0002-3785-7433.

Professor Anne Hickey. Professor Hickey is Professor of Health Psychology and Deputy Dean for Positive Education at RCSI University of Medicine and Health Sciences. She is involved in coordinating and teaching health psychology and resilience skills to health professional students. Her research interests include stroke and stroke rehabilitation, development of complex interventions for clinical settings, and medical education. ORCID ID:0000-0003-0008-3195.
Email:ahickey@rcsi.ie

Medical school is challenging and educators have recognised that the stress of medical school can be significant (Adsett 1968; Neufeld and Malin 2021). Medical students appear particularly susceptible to common mental health problems, such as depression, relative to students from other courses (Dyrbye et al. 2006). Prior to medical school, these students are reported to have lower symptoms of depression than their peers, suggesting that the training and environment of medical school may contribute to deterioration in mental health (Brazeau et al. 2014). Meta-analyses have indicated that the prevalence of depression within medical students ranges from 10.3% to 59% (Ibrahim et al. 2013), with 28% of medical students meeting criteria for depression as assessed by a self-reported questionnaire (Puthran et al. 2016). Anxiety among medical students ranges widely (6%-67%, Hope and Henderson 2014) and a third of medical students meet criteria for an anxiety disorder (Tian-Ci Quek et al. 2019). Burnout, a syndrome conceptualized as resulting from unsuccessfully managed chronic workplace stress (World Health Organization 2019), is common in the medical profession (Imo 2016). This extends to medical training where symptoms attributable to college-related burnout have been reported widely in medical student populations (Erschens et al. 2019). Some of the predictors of burnout in medical students include lower levels of physical activity, gender and year of study (Cecil et al. 2014). Moreover, comorbid associations between depression and burnout have also been reported (Fitzpatrick et al. 2019). This mounting evidence suggests that medical students a high risk population and failure to intervene in these difficulties may have a lasting impact on their longer-term mental wellbeing and career trajectory.

A factor of relatively recent interest in medical education is resilience, the ability to overcome adversity from negative experiences (Rutter 1999). Given the stresses of the medical profession, it has been suggested that resilience should be fostered and developed as part of a modern

medical curriculum (Howe et al. 2012). Resilience training interventions could provide students with an opportunity to learn the necessary tools to manage a stressful situation but in the safe environment of a medical school. Some studies, using proxy measures of resilience, have indicated that resilient medical students are less likely to experience depression, burnout and have a higher quality of life (Dyrbye et al. 2010; Thompson et al. 2016). However, direct subjective measures of resilience have been less frequently utilised (Drybye et al. 2017). Furthermore, it is unclear if demographic and educational characteristics interact with resilience in medical students, altering the risk of mental health difficulties and burnout.

One major challenge with investigating mental health difficulties in university student populations is sampling bias. While normally cited as a limitation, the extent to which the sample is representative of the target population is rarely investigated. As a result, very little is known about the correlates of self-selection, but there is a suggestion that those who are male, of younger age and from a lower socio-economic background are less likely to partake in such studies (Henderson and Page 2007). Younger age and lower socio-economic background have also been associated with attrition in longitudinal studies (Fraser et al. 2013).

This study explored the prevalence of anxiety, depression, burnout and resilience in a cohort of medical students in a large medical school in the Republic of Ireland. The aims of this study were to: 1) examine depression, anxiety, burnout and their co-morbid occurrence in medical students; 2) examine demographic and educational correlates of depression, anxiety, burnout and comorbidity; 3) examine the relationship between resilience and these outcome variables; and 4) examine discrepancies due to sampling bias.

Methods

Participants. As a compulsory part of the curriculum, medical students from RCSI University of Medicine and Health Sciences, Dublin (Ireland) were invited to complete a quantitative assessment of Professional Identify formation, professionalLism, Leadership And Resilience (PILLAR; Ryan et al. preprint, 2022) – known as PILLAR Part A . The recruitment sample consisted of all students (n= 1245) in years 1-3 of direct-entry (from high school/secondary school) undergraduate medicine (DEM1, DEM2, DEM3) and years 1 and 2 of graduate-entry medicine (GEM1 and GEM2). The assessment was completed between September 2020 and February 2021 and n=1,153 (93%) students completed the PILLAR Part A and consented to their data being used for research (for full description see Ryan et al. preprint, 2022). All data in this survey was collected anonymously.

In addition to Part A of the PILLAR assessment, students were also invited to complete an optional section, Part B, which examined depression, anxiety and burnout. For this part of the study, students were also made aware of available services, including professional mental health services at RCSI, if needed. Of the sample who completed Part A and consented to research, n=521 (45%) completed Part B and consented to research.

Research ethics Committee (REC) approval:

Ethical approval for the study was obtained from the Research Ethics Committee of the RCSI (REC202005016).

Measurement

Demographic and Educational Variables.

We report the overall age, gender, geographical region of origin and the percentage contribution of each year of medical training within the total sample. Additionally we report age, gender and

geographical region of origin when stratified by year of medical training, as well as the percentage completion rate of Part B.

Outcome variables.

For a full description of the outcome variables, see supplementary materials.

Depression. The Patient Health Questionnaire-9 (PHQ-9) screening tool was used to estimate the incidence of depression (Kroenke et al. 2001). Within the study, depression is reported as a categorical measure using a clinically validated cut-off of ≥ 10 . In addition, based on the additional 10th item from the PHQ-9, we report the difficulties these symptoms have posed for home, work or relationships using a conservative threshold (“very or extremely difficult”).

Anxiety: The Generalised Anxiety Disorder-7 (GAD-7) screening tool was used to estimate the incidence of anxiety (Spitzer et al. 2006). Anxiety was reported as a categorical measure using a clinically validated cut-off score of ≥ 10 . Using the additional 8th item from the GAD-7, we report the difficulties these symptoms have posed for home, work or relationships using a conservative threshold (“very or extremely difficult”).

Burnout: Burnout was measured using two sub-scales of the Copenhagen Burnout Inventory: Personal Burnout and Work-Related/Professional Burnout (Kristensen et al. 2005). These scales were measured using a 6-item and 7-item 5-response Likert scale with scores ranging from “Always” (scored as 4) to “Never” (scored as 0). The work-related/professional burnout scale was modified so that the content related to college work rather than employment (for example, “are you exhausted in the morning at the thought of another day at work?” was replaced with “are you exhausted in the morning at the thought of another day at college?”). In line with Kristensen et al. (2005), “High” burnout was defined as a score within the top quartile.

Resilience. Resilience was measured using the Brief Resilience Scale (Smith et al., 2008), a 6-item 5-response Likert scale with responses ranging from “Strongly Disagree” to “Strongly Agree”. This measure examined the student’s ability to positively respond to difficult circumstances.

Sampling bias weighting.

Given the difference in response rates between PILLAR Parts A (93%) and B (45%), 13 variables (relating to demographics, education, professionalism and leadership) from the required component of the PILLAR assessment were used to weight the sample to account for sampling bias using inverse probability weighting. For a full description of this procedure, see supplementary materials methods section. All subsequent analyses have been assigned this weight to account for sampling bias.

Statistical Analysis

We report descriptive statistics for the overall sample and when stratified by medical training year. We examined the mean score and incidence of depression, anxiety, personal burnout, college-related burnout, co-morbidity and resilience. We examined the relationship between the demographic and educational variables with each outcome using univariable logistic regression and with comorbidity using negative binomial regression. Odds ratios (OR) and incidence risk ratios (IRR) with their corresponding 95th percentile confidence intervals (%CIs) are reported respectively. A supplementary analysis was conducted treating the outcomes as continuous variables using linear modelling. We examined the correlation between resilience with each of the outcome variables using Pearson’s linear correlation (depression, anxiety and burnout) and Kendall’s rank correlation (comorbidity). Finally, we descriptively examined any differences in

findings between the weighted analyses and unweighted analyses. We report the discrepancy between these analyses in mean scores and incidence on the outcome variables. All analyses were conducted in Stata 15.

Results

Sample Characteristics.

The demographic characteristics of the total sample and when stratified by year are reported in Table 1. 45.1% (n=521) of the medical students completed Part B. The majority of the sample were direct entry students (Year 1: n=165, 32%; Year 2: n=146, 28%; Year 3: n=131, 25%) with graduate entry making up 15% of the sample (Year 1: n=36, 7%; Year 2: n=43, 8%). There were no statistically significant differences between the completion percentage of Part B in direct entry and graduate entry years (direct entry and graduate entry comparison: $X^2 = 1.05$, $p = 0.31$). In total, 58% (n=302) of medical students were female and this was relatively stable across years (range: 53%-63%). Region of origin varied by type of entry into the medical school - graduate entry students were mostly from Ireland or North America while direct entry students were from a variety of regions ($X^2 = 56.0$ $p < .001$). The range of Part B completion across medical training years was 35.5-65.4%, with the lowest reports in direct entry year 2.

Depression, Anxiety and Burnout.

For a histogram break down of the depression, anxiety and burnout scores, see Figure 1. Table 2 displays a descriptive breakdown of the demographic and educational variables when stratified by the outcomes.

Depression: The mean depression score was 7.9 (SD: 6.0). Over a third of students in the sample reported moderate to severe depression (n=179, 35.3%). 50.3% (n=90) of those who met the

criteria for moderate to severe depression reported that these experiences have made work, home or relationships very to extremely difficult. 20.4% (n=105) of the overall sample reported that, on at least several days of the past two weeks, that they thought they would be better off dead or that they wanted to hurt themselves in some way.

There was no significant difference between males and females in the proportion who reported moderate to severe depression (OR:1.2, 95% CI: 0.8-1.9). There was variability in the proportion reporting depression across the years of study, ranging from 10.9% in first year graduate entry medicine to 50.7% in direct entry medicine year 2. Relative to year 1 direct entry, those in years 2 and 3 direct entry had significantly higher odds of depression (DEM 2: OR: 5.42, 95% CI: 3.1-9.4; DEM 3: OR:2.7, 95% CI: 1.5-4.6), while those in GEM 1 had significantly lower odds of depression (OR:0.3, 95% CI: 0.1-0.9). There was no significant relationship between the age of the student or region of origin and moderately severe to severe depression.

Anxiety: The mean anxiety scores was 7.7 (SD:5.7). A third of students reported moderate to severe anxiety (n= 172, 33.6%). 51.7% (n=89) of those who met these criteria reported that these symptoms have made work, home or relationships very to extremely difficult.

Over 1-in-5 males and just under 2-in-5 females met criteria for moderate to severe anxiety, demonstrating a significantly increased odds of anxiety in females (OR:1.65, 95%CI: 1.07-2.54). Similar to depression, there was variability in anxiety across the years of medical training. Relative to year 1 direct entry, those in years 2 and 3 direct entry had significantly higher rates of anxiety (DEM-2: OR: 3.65, 95% CI: 2.13-6.23; DEM-3: OR:2.13, 95% CI: 1.24-3.63). There was no significant relationship between the age of the student or the region of origin and severe anxiety.

Personal Burnout: The mean personal burnout score was 12.5 (SD: 4.6). There was a higher proportion of females within the top quartile of personal burnout scores (OR:1.8, 95% CI: 1.0-3.1). Relative to year 1 direct entry, those in years 2 and 3 direct entry had a significantly higher proportion of students in the top quartile of personal burnout scores (DEM-2: OR: 5.1, 95% CI:2.6-9.9; DEM-3: OR: 2.5, 95% CI:1.2-5.1). There was no significant relationship between the age of the student or region of origin and personal burnout.

College-related Burnout: The mean college-related burnout score was 14.2 (SD: 5.5). Relative to year 1 direct entry, those in years 2 and 3 direct entry had a significantly higher proportion of students in the top quartile of college-related burnout scores (Year 2: OR: 4.3, 95% CI:2.4-7.7; Year 3: OR:3.3, 95% CI:1.8-5.9). A higher proportion of Malaysian and Middle Eastern students were in the top quartile of college-related burnout scores relative to their Irish counter-parts (Malaysian: OR: 2.1, 95% CI:1.1-4.1; Middle Eastern: OR:2.6, 95% CI:1.4-4.8). There was no significant relationship between the age or gender of the student and college burnout.

Comorbid difficulties

There were medium to strong linear correlations between the depression, anxiety, personal burnout and college-related burnout scores (range: 0.57-0.77, all $p < .001$, see supplementary Table 1). Based on categorical thresholds, over half the sample met criteria for at least one difficulty ($n=258$, 51.29%). One in three students had two or more difficulties, 24.5% ($n=123$) reporting both depression and anxiety. Almost one in ten students ($n=45$, 8.89%) had all four difficulties. A visual diagram of the comorbid overlap between depression, anxiety, personal burnout and college-related burnout is presented in Figure 2. Examination of the demographic and education factors associated with comorbidity revealed that female students were significantly more likely to have a greater number of difficulties relative to male students (IRR:

1.3, 95% CI:1.1-1.7). Similar results were observed for non-binary or self-described gender, however these results should be interpreted with caution given there were so few individuals in this group (IRR: 1.6, 95% CI:1.2-2.3, respectively). Second and third year direct entry students were significantly more likely to have more co-morbid difficulties than first year students (Year 2: IRR: 2.8, 95% CI:2.1-3.7; and Year 3: IRR: 2.0, 95% CI:1.5-2.7).

Characteristics and outcomes associated with resilience.

Resilience. The mean resilience score was 3.3 (SD: 0.7). Female students had significantly lower resilience scores ($\beta = -0.2$, 95% CI -0.3 to -0.1) than their male peers. Relative to year 1 direct entry medical students, those in years 2 and 3 direct entry had significantly lower resilience score (DEM 2: $\beta = -0.1$, 95%CI -0.2 to -0.04; and DEM 3: $\beta = -0.2$, 95%CI -0.3 to -0.1) while GEM 1 had significantly higher resilience scores ($\beta = 0.2$, 95%CI 0.02 - 0.3). Malaysian, Middle-Eastern and students from other countries had significantly lower resilience scores than Irish students (Malaysian: $\beta = -0.2$, 95%CI -0.3 to -0.1; Middle-Eastern $\beta = -0.3$, 95%CI -0.4 to -0.1; and Other countries: $\beta = -0.2$, 95%CI -0.3 to -0.1). There was no correlation between age and resilience ($r = 0.01$, $p = 0.59$).

There were significant moderate negative correlations between the Brief Resilience Scale scores and the outcome measures (range: -0.48 to -0.40; see Supplementary Table 2). There were stronger correlations between resilience and the outcome variables in DEM 2 and 3, and GEM 2 relative to GEM 1 and DEM 1. There were little differences in the strength or direction of the correlation between resilience and the outcome variables when stratified by region of origin with the exception of the lower strength relationships between resilience and anxiety and college burnout in Malaysian students.

Assessment of Sampling Bias

Several variables were associated with completion of Part B of the PILLAR assessment (Supplementary Table 3). A comparison of the weighted and unweighted data revealed that there was little difference in the scores/incidence of depression, anxiety and burnout with the application of the s bias weighting (Supplementary Table 4) suggesting limited effect of sampling bias.

Supplementary analysis

The supplementary investigation, examining the relationship between demographic and educational risk factors when the outcomes were measured as continuous variables, indicated little difference in the interpretation of the results (see supplementary analysis and Supplementary Table 6).

Discussion.

This study reports baseline cross-sectional data for a prospective study of professionalism, resilience, leadership and mental well-being in the School of Medicine of the RCSI University of Medicine and Health Sciences. We observed that a high proportion of medical students were experiencing depression, anxiety, burnout and co-morbid difficulties. One in three students met criteria for depression and a similar percentage met criteria for anxiety. Of those who met these criteria, over 50% reported that these difficulties made social and work functioning very to extremely difficult. Experiencing high personal and college-related burnout was also common within the sample.

Female students had higher incidence of personal burnout and comorbid difficulties and lower resilience relative to male students. Non-binary or those who self-described their gender in the

survey reported higher incidence of comorbid difficulties relative to their male peers but this result should be interpreted cautiously given the number of students in this group. The age of the student was unrelated to all outcomes, as was the region of origin, with the exception of college related burnout which was higher in students from Malaysia and the Middle-East, who also had lower resilience scores.

Year of medical training was associated with all individual outcomes and comorbid difficulties. Relative to first year students, a greater proportion of those in direct entry years 2 and 3 reported above threshold scores on all outcomes and had comorbid difficulties. This was particularly the case for direct entry year 2, with 18% reporting all four difficulties we investigated.

Resilience was inversely associated with all outcome variables. While there were some differences in the strengths of the association when stratified by demographic characteristics, there was an overall strong pattern of agreement. Notably, the strongest correlation between resilience and college burnout was in DEM 2, which had the highest incidence of depression, anxiety, burnout and comorbidity of any year. This indicates the potential importance of resilience as a modifiable factor that could offset a proportion of mental health difficulties such as depression, anxiety and burnout (Dunn et al. 2008). A review of 30 randomised controlled trials indicated that health care students receiving resilience training had higher post-intervention resilience, lower anxiety and lower stress (Kunzler et al., 2020). We propose that providing medical students with key skills to manage adversity and/or high stress situation may have downstream effects on their well-being as students and as they advance through their careers in the medical profession.

This study comprised a required component as part of the medical curriculum (Part A) and an optional component (Part B). Given the novelty of this design and the known relationship

between some of our auxiliary variables (for weighting) with the outcome variables, we were able to assess the degree of confounding sampling bias may pose in self-select and self-report questionnaires with medical students. Our findings suggest that, while there were significant differences between those who took part in the optional part of the PILLAR assessment and those who did not, adjustment for this had little effect on the incidence of any outcome. This suggests that our findings are broadly representative of the vast majority of the student cohorts from the measured years (93% of the overall student population).

Overall, our findings are broadly comparable with the prevalence of depression and anxiety reported in meta-analytic studies with medical student populations (Puthran et al. 2016; Tian-Ci Quek et al. 2019). Our findings are also consistent with the incidence of mental health problems in third level student populations both in Ireland (Dooley et al. 2019) and internationally (Ibrahim et al. 2013; Healthy Minds Network 2020). However, while the overall incidence of depression, anxiety and burnout was comparable with other studies, the characteristics of those reporting these difficulties differed. We did not observe significantly higher rates of depression in female students as has been indicated previously (Pacheco et al. 2019), nor did we observe higher incidence of anxiety based on region of geographical origin as has previously been reported for Asian and Middle Eastern students (Tian-Ci Quek et al. 2019). We did observe that female students had higher rates of burnout which is in line with previous investigations (Muzafar et al. 2015).

This paper reports findings from the first wave of data collection of the PILLAR assessment, the rationale for which was to establish baseline measurement prior to introduction of a major transformation of the curriculum of the medical school. A major confounder is the coincident experience of the COVID-19 pandemic, which profoundly impacted students' experience of

university life, both locally and internationally. Students within years 2 and 3, who had experienced at least one year of pre-Covid medical training, reported the highest rates of difficulties. Thus, the increasing complexity of years 2 and 3 of the medical programme and the experience of blended learning initiatives core to curriculum delivery during the pandemic may have played a role in the incidence of difficulties for these students, it is difficult to quantify the extent of this effect. It is important to note that the findings of mental health difficulties and burnout in this study are similar to pre-Covid findings from meta-analytic reports in medical student populations, and similar to findings across university settings internationally. To date the effect of the pandemic and public health restrictions on the mental health of students is unclear (Fried et al. 2021).

Strengths and Limitations

Our investigation included a large international sample of medical students from a variety of years across both direct entry and graduate entry medical training programs. We used clinically validated measures of mental well-being, and a subjective measure of resilience. While the response rate to the optional mental well-being measures was 45% compared to a 93% response rate for the resilience measure, the novelty of the study design allowed us to examine and statistically account for sampling bias. The results were encouraging from a reliability perspective as there were little differences between weighted and unweighted investigations in the incidence and scoring of all outcomes. However, it should be noted that we were unable to account for the remaining students who either did not complete PILLAR Part A or who did not consent for their data to be used for research purposes (7%).

It is important to note that our results should be interpreted as descriptive and associative in nature as the data is cross-sectional and the investigation of these associations should not be

interpreted as causative. It was assumed that the impact on work item for the PHQ-9 and the GAD-7 would be interpreted as relating to college work rather than employment. Moreover it can be challenging to tease apart the specific contributions of depression, anxiety or burnout to studying and this is not possible with the current data.

Conclusion

Our results provide further evidence of the high incidence of depression, anxiety, burnout and comorbid difficulties in medical students. We advocate for further investigations into the role of resilience and resilience training as an approach to ameliorate the incidence of depression, anxiety and burnout in these student groups.

References

- Adsett CA. 1968. Psychological health of medical students in relation to the medical education process. *Journal of Medical Education*. 43(6): 728–734.
- Brazeau CM, Shanafelt T, Durning SJ, Massie FS, Eacker A, Moutier C, Satele DV, Sloan JA, Dyrbye LN. 2014. Distress among matriculating medical students relative to the general population. *Academic Medicine*. 89(11):1520-1525.
- Cecil J, McHale C, Hart J, Laidlaw A. 2014. Behaviour and burnout in medical students. *Medical education online*. 19(1): 25209.
- Dooley B, O'Connor C, Fitzgerald A, O'Reilly, A. 2019. My world survey 2: National study of youth mental health in Ireland. Jigsaw and UCD School of Psychology.
- Dooley B, Fitzgerald A. 2012. My world survey: National study of youth mental health in Ireland. Headstrong and UCD School of Psychology.
- Dunn LB, Iglewicz A, Moutier C. 2008. A conceptual model of medical student well-being: promoting resilience and preventing burnout. *Academic Psychiatry*, 32(1):44-53.
- Dyrbye LN, Power DV, Massie FS, Eacker A, Harper W, Thomas MR, Szydlo DW, Sloan JA, Shanafelt TD. 2010. Factors associated with resilience to and recovery from burnout: a prospective, multi-institutional study of US medical students. *Medical education*. 44(10):1016-26.
- Dyrbye LN, Shanafelt TD, Werner L, Sood A, Satele D, Wolanskyj AP. 2017. The impact of a required longitudinal stress management and resilience training course for first-year medical students. *Journal of general internal medicine*. 32(12):1309-14.

- Dyrbye LN, Thomas MR, Shanafelt TD. 2006. Systematic review of depression, anxiety, and other indicators of psychological distress among U.S. and Canadian medical students. *Acad Med.* 81(4):354–373.
- Erschens R, Keifenheim KE, Herrmann-Werner A, Loda T, Schwille-Kiuntke J, Bugaj TJ, Nikedei C, Huhn D, Zipfel S, Junne, F. 2019. Professional burnout among medical students: systematic literature review and meta-analysis. *Medical teacher.* 41(2):172-183.
- Fitzpatrick O, Biesma R, Conroy RM, McGarvey A. 2019. Prevalence and relationship between burnout and depression in our future doctors: a cross-sectional study in a cohort of preclinical and clinical medical students in Ireland. *BMJ open.* 9(4): e023297.
- Fraser A, Macdonald-Wallis C, Tilling K, Boyd A, Golding J, Davey Smith G, Henderson J, Macleod J, Molloy L, Ness A, Ring S. 2013. Cohort profile: the Avon Longitudinal Study of Parents and Children: ALSPAC mothers cohort. *International journal of epidemiology.* 42(1):97-110.
- Fried, EI, Papanikolaou F, and Epskamp S. 2022. Mental health and social contact during the COVID-19 pandemic: an ecological momentary assessment study. *Clinical Psychological Science.* 10(2): 340-354.
- Healthy Minds Study among Colleges and Universities, 2020. Healthy Minds Network, University of Michigan, University of California Los Angeles, Boston University, and Wayne State University.
- Henderson M, Page L. 2007. Appraising the evidence: what is selection bias? *Evidence-based mental health.* 10(3):67-68.
- Hope V, Henderson, M. 2014. Medical student depression, anxiety and distress outside North America: a systematic review. *Medical education.* 48(10):963-979.

- Howe A, Smajdor A, Stöckl A. 2012. Towards an understanding of resilience and its relevance to medical training. *Medical education*. 46(4):349-356.
- Ibrahim AK, Kelly SJ, Adams CE, Glazebrook, C. 2013. A systematic review of studies of depression prevalence in university students. *Journal of psychiatric research*. 47(3):391-400.
- Imo UO. (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.
- Kopera M, Suszek H, Bonar E, Myszkka M, Gmaj B, Ilgen M, Wojnar M. 2015. Evaluating explicit and implicit stigma of mental illness in mental health professionals and medical students. *Community mental health journal*. 51(5):628-634.
- Kristensen TS, Borritz M, Villadsen E, Christensen KB. 2005. The Copenhagen Burnout Inventory: A new tool for the assessment of burnout. *Work & Stress*. 19(3):192-207.
- Kroenke K, Spitzer RL, Williams JB. 2001. The PHQ-9: validity of a brief depression severity measure. *Journal of general internal medicine*. 16(9):606-613.
- Kunzler AM, Helmreich I, Chmitorz A, Koenig J, Binder H, Wessa M, Lieb K. 2020. Psychological interventions to foster resilience in healthcare professionals. *Cochrane Database of Systematic Reviews*. (7). doi: 10.1002/14651858.CD013684
- Muzafar Y, Khan HH, Ashraf H, Hussain W, Sajid H, Tahir M, Rehman A, Sohail A, Waqas A, Ahmad W. 2015. Burnout and its associated factors in medical students of Lahore, Pakistan. *Cureus*. 7(11): e390
- Neufeld A, Malin G. 2021. How medical students cope with stress: a cross-sectional look at strategies and their sociodemographic antecedents. *BMC Medical Education*, 21(1):1-12.

- Pacheco JPG, Silveira JB, Ferreira RPC, Lo K, Schineider JR, Giacomini HTA, San Tam WW. 2019. Gender inequality and depression among medical students: a global meta-regression analysis. *Journal of psychiatric research*. 111:36-43.
- Puthran R, Zhang MW, Tam WW, Ho RC. 2016. Prevalence of depression amongst medical students: A meta-analysis. *Medical education*. 50(4):456-468.
- Rosenzweig S, Reibel DK, Greeson JM, Brainard GC, Hojat M. 2003. Mindfulness-based stress reduction lowers psychological distress in medical students. *Teaching and learning in medicine*. 15(2):88-92.
- Rutter M. 1999. Resilience concepts and findings: implications for family therapy. *J Fam Ther*. 21:119-44.
- Ryan A, Hickey DW, Boland F, Collins, Doyle F. 2022. Professional Identity Formation, Professionalism, Leadership And Resilience (PILLAR) in Medical Students: methodology and early results. *Research Square*. (Preprint) [accessed 22 August 2022]. doi: <https://doi.org/10.21203/rs.3.rs-1527305/v1>
- Smith BW, Dalen J, Wiggins K, Tooley E, Christopher P, Bernard J. 2008. The brief resilience scale: assessing the ability to bounce back. *International journal of behavioral medicine*. 15(3):194-200.
- Spitzer RL, Kroenke K, Williams JB, Löwe, B. 2006. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Archives of internal medicine*. 166(10):1092-1097.
- Thompson G, McBride RB, Hosford CC, Halaas G. 2016. Resilience among medical students: the role of coping style and social support. *Teaching and learning in medicine*. 28(2):174-82.

Tian-Ci Quek T, Tam WWS, Tran BX, 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

World Health Organization. 2019. ICD-11:International classification of diseases (11th revision).

Retrieved from <https://icd.who.int/en>

Table 1. Demographic characteristics of the sample overall and stratified by year of medical training who completed part B.

	Overall	Year of Medical Training				
		Year1	Year2	Year3	GEM1	GEM2
Part B n (%) Complete	521 (45.4)	165 (51.7)	146 (35.5)	131 (42.5)	36 (65.4)	43 (48.3)
Age \bar{x} (SD)	21.5 (2.9)	20.1 (2.7)	21.0 (1.4)	22.1 (2.5)	24.3 (2.3)	25.2 (3.4)
Gender n (%)						
Female	302 (57.9)	87 (52.9)	92 (63.0)	79 (60.3)	21 (58.6)	23 (52.6)
Male	213 (40.9)	78 (47.2)	53 (36.1)	48 (36.7)	15 (41.4)	19 (45.6)
N-B/O	6 (1.2)	-	<5 (<3.4)	<5 (<3.1)	-	<5 (<11.6)
Ethnicity n (%)						
Irish	88 (16.9)	23 (14.2)	20 (13.8)	23 (17.4)	14 (37.2)	8 (19.2)
Malaysian	75 (14.4)	25 (15.3)	31 (21.5)	19 (14.2)	-	-
Middle Eastern	136 (26.2)	56 (34.0)	31 (21.3)	47 (36.3)	-	<5 (<11.6)
North American	108 (20.6)	17 (10.4)	24 (16.3)	21 (15.8)	19 (53.0)	27 (61.2)
Other	114 (21.9)	43 (26.0)	39 (27.1)	21 (16.2)	<5 (<13.9)	7 (15.6)

*Note: All results were analytically weighted. This will differ from the raw number of individuals in the data. N-B/O: Non-binary or other specified gender. Cells with less than 5 individuals were censored to preserve anonymity.

Table 2. Descriptive statistics for demographic and educational characteristics stratified by the outcomes variables.

	Difficulty Outcomes								Resilience ^a (n=521)
	Depression (n=507)		Anxiety (n=512)		Personal Burnout (n=521)		College-related Burnout (n=521)		
	No	Yes	No	Yes	No	Yes	No	Yes	̄ (SD)
Age Med (IQR)	21 (20-23)	21 (20-22)	21 (20-23)	21 (20-22)	21 (20-23)	21 (20-22)	21 (20-23)	21 (20-22)	-
Gender %									
Female	186 (62.9)	110 (37.1)	186 (61.9)	114 (38.1)	238 (78.7)	64 (21.3)	211 (70.0)	91 (30.0)	3.19 (0.65)
Male (ref)	139 (67.7)	66 (32.3)	150 (72.8)	56 (27.2)	185 (86.7)	28 (13.3)	165 (77.3)	48 (22.7)	3.36 (0.65)
N-B/O	<5 (<100)	<5 (<100)	<5 (<100)	<5 (<100)	<5 (<100)	<5 (<100)	<5 (<100)	<5 (<100)	3.25 (0.62)
Medical Training Year %									
DEM1 (ref)	130 (79.8)	33 (20.2)	127 (78.0)	36 (22.0)	151 (91.5)	14 (8.5)	141 (85.4)	24 (14.6)	3.34 (0.61)
DEM2	60 (42.2)	82 (57.8)	71 (49.3)	73 (50.7)	99 (68.2)	46 (31.8)	84 (57.7)	62 (42.3)	3.20 (0.65)
DEM3	74 (59.7)	50 (40.3)	79 (62.5)	47 (37.5)	106 (81.2)	25 (18.8)	84 (64.1)	47 (35.9)	3.10 (0.68)
GEM1	34 (92.8)	<5 (<13.5)	32 (89.1)	<5 (13.8)	34 (93.1)	<5 (13.5)	35 (94.5)	<5 (13.5)	3.52 (0.59)
GEM2	31 (73.3)	11 (26.7)	30 (72.5)	11 (27.5)	36 (82.9)	7 (17.1)	36 (84.1)	7 (15.9)	3.47 (0.65)
Region %									
Irish (ref)	57 (65.7)	30 (34.3)	60 (70.7)	25 (29.3)	72 (81.0)	17 (19.0)	71 (80.7)	17 (19.3)	3.41 (0.67)
Malaysian	49 (66.6)	24 (33.5)	56 (74.5)	19 (25.5)	65 (86.6)	10 (13.4)	50 (67.0)	25 (33.0)	3.22 (0.63)
Middle Eastern	80 (60.6)	52 (39.4)	78 (58.2)	56 (41.8)	108 (79.5)	28 (20.5)	85 (62.1)	52 (38.0)	3.15 (0.61)
North American	67 (64.8)	36 (35.2)	68 (66.3)	35 (33.7)	92 (85.2)	16 (14.8)	84 (77.9)	24 (22.1)	3.37 (0.67)
Other	76 (67.6)	37 (32.4)	77 (67.5)	37 (32.5)	90 (78.7)	24 (21.3)	90 (78.8)	24 (21.2)	3.21 (0.68)

Note: Emboldened statistics denote a significant difference from the reference category (ref). The corresponding effect size metrics and confidence intervals are reported in text. ^a :Resilience was measured as a continuous variable thus means and standard deviations are reported. All results were analytically weighted. This will differ from the raw number of individuals in the data. N-B/O: Non-binary or other specified gender. Cells with less than 5 individuals were censored to preserve anonymity.

Table 3. Descriptive statistics for demographic and educational characteristics stratified by number of outcomes above threshold endorsed.

	Number of Difficult Outcomes				
	None	One	Two	Three	Four
Age Med (IQR)	21 (20-23)	21 (20-22)	21 (20-23)	21 (20-22)	21 (20-22)
Gender %					
Female	148 (48.9)	38 (12.7)	42 (13.9)	13 (13.4)	34 (11.1)
Male (ref)	105 (49.2)	56 (26.1)	27 (12.5)	15 (7.0)	11 (5.2)
N-B/O	-	<5 (<100)	<5 (<100)	-	-
Medical Training Year %					
DEM1 (ref)	105 (63.6)	30 (18.2)	17 (10.3)	10 (6.0)	<5 (<3.0)
DEM2	43 (29.3)	26 (18.1)	20 (13.4)	31 (21.4)	26 (17.9)
DEM3	51 (39.3)	22 (21.9)	26 (20.2)	10 (7.8)	14 (10.8)
GEM1	31 (84.0)	<5 (13.5)	<5 (13.5)	<5 (13.5)	-
GEM2	23 (52.6)	9 (21.9)	7 (16.9)	<5 (<11.9)	<5 (<11.9)
Region %					
Irish (ref)	49 (55.4)	15 (16.8)	8 (9.4)	8 (9.5)	8 (9.0)
Malaysian	36 (48.0)	17 (22.5)	9 (11.7)	10 (13.0)	<5 (<6.6)
Middle Eastern	55 (40.3)	27 (19.6)	21 (15.2)	17 (12.3)	17 (12.6)
North American	55 (51.0)	19 (18.1)	15 (13.7)	13 (12.1)	6 (5.1)
Other	58 (50.7)	19 (16.7)	19 (16.8)	7 (6.6)	11 (9.2)

Note: The effect size metrics and confidence intervals for the analyses are reported in text. Above threshold outcomes include Depression, Anxiety, Personal Burnout (top quartile) or College-related Burnout (top quartile). All results were analytically weighted. This will differ from the raw number of individuals in the data. N-B/O: Non-binary or other specified gender. Cells with less than 5 individuals were censored to preserve anonymity.

Figure 1. Histogram plot of depression, anxiety and burnout.

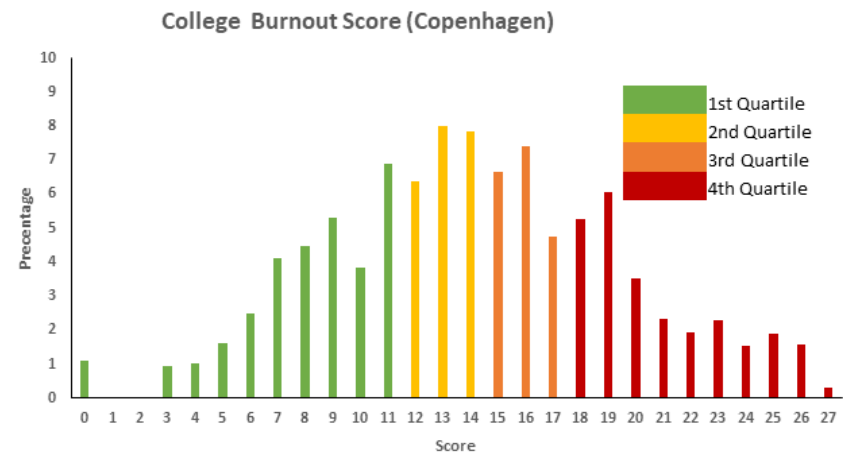
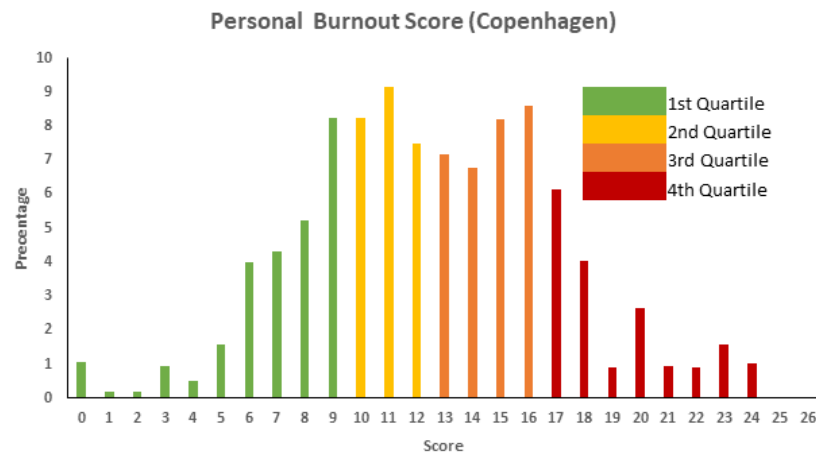
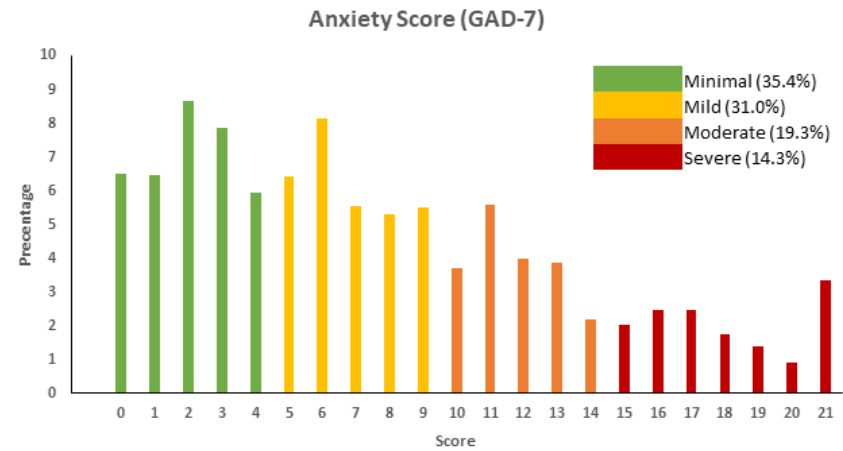
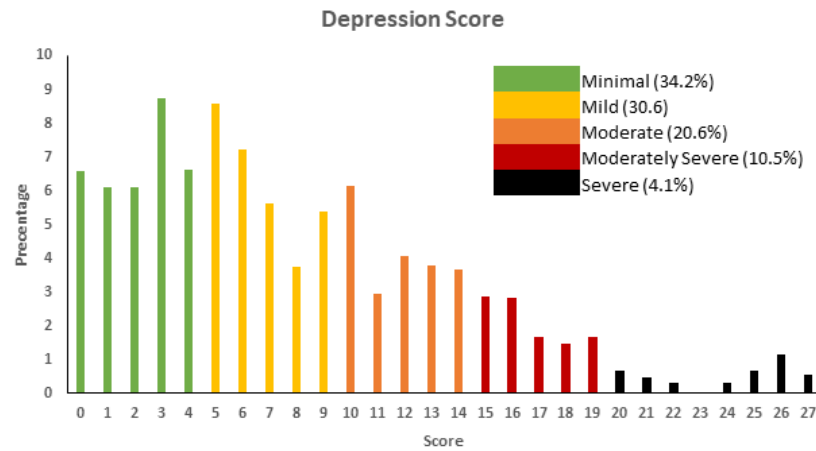
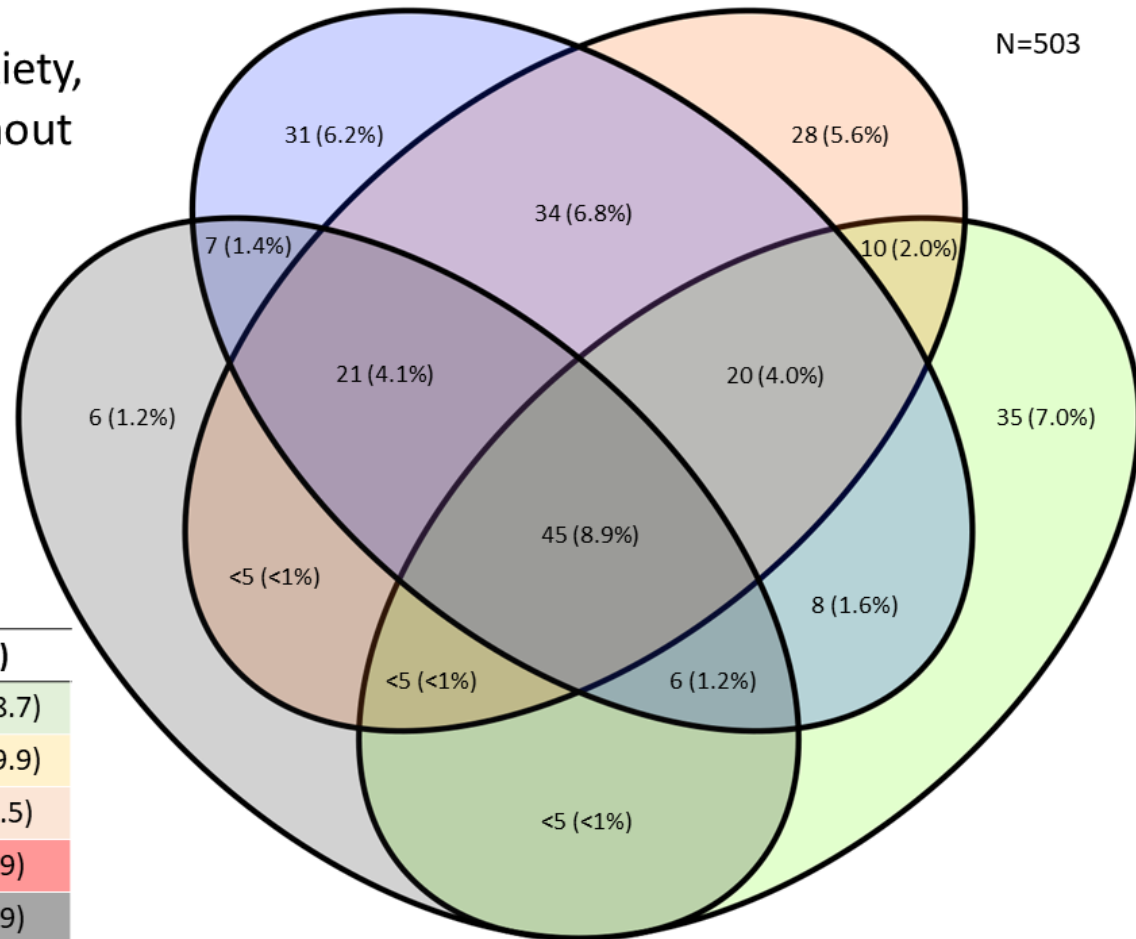


Figure 2. Venn diagram of the comorbid difficulties.

Comorbidity between Anxiety, Depression, Personal Burnout and College Burnout.

	Anxiety
	Depression
	Personal Burnout
	College Burnout

Number of Comorbidities	n (%)
None difficulties	245 (48.7)
One difficulty	100 (19.9)
Two difficulties	63 (12.5)
Three difficulties	50 (9.9)
Four difficulties	45 (8.9)



Note: Difficult outcomes include above threshold scores for Depression, Anxiety, Personal Burnout (top quartile) or College-related Burnout (top quartile). To be included in this figure all students had to complete all four outcome questionnaires (n=503). Cells with less than 5 individuals were censored to preserve anonymity.