


# Depressive Symptoms and Burnout Among Medical Students: a Prospective Study



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**BACKGROUND:** Depressive symptoms and burnout are common among medical students. However, few studies have investigated their trajectory over the course of medical school.

**OBJECTIVE:** Evaluate year-by-year changes in depressive and burnout symptoms over the course of medical school training.

**DESIGN:** Prospective study.

**PARTICIPANTS:** Medical students who matriculated at a private medical school in Maryland from 2010 to 2016 ( $n=758$ ).

**MAIN MEASURES:** Clinically significant depressive symptoms were defined as a score of  $\geq 10$  on the 9-item Patient Health Questionnaire (PHQ-9), and burnout was measured using the Maslach Burnout Inventory (MBI). High emotional exhaustion, high depersonalization, and low personal accomplishment were defined as scores of  $\geq 27$ ,  $\geq 10$ , and  $\leq 33$  on the respective MBI subscales.

**KEY RESULTS:** At matriculation, the prevalences of significant depressive symptoms, high emotional exhaustion, high depersonalization, and low personal accomplishment were 4.3%, 9.4%, 8.6%, and 37.7%, respectively. After adjustment for age, sex, race/ethnicity, marital status, and cohort, compared with year 1, the odds of significant depressive symptoms was significantly higher at the beginning of the 2nd, 3rd, and 4th years of study (ORs=2.63, 2.85, and 3.77, respectively; all  $ps<0.001$ ). Compared with the 1st year, the odds of high emotional exhaustion also increased during the 2nd, 3rd, and 4th years of study, (ORs=3.46, 4.79, 8.20, respectively; all  $ps<0.001$ ), as did the odds of high depersonalization (ORs=3.55, 6.14, 12.53, respectively; all  $ps<0.001$ ). The odds of low personal accomplishment did not significantly differ across years of study.

**CONCLUSIONS:** The results of this study suggest that symptoms of depression and burnout may increase during medical school. Because of the high prevalence of

depressive symptoms and burnout in medical students, interventions earlier in the medical career pathway that aim to prevent, detect, and treat these symptoms may be of benefit to the physician community.

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## INTRODUCTION

Students entering medical school expect to devote significant time and commitment to learning and mastering skills in order to become physicians. However, medical school can also be a period of high stress for students, which can manifest as a cluster of symptoms consistent with depression and/or psychological burnout.<sup>1, 2</sup>

Compared to college graduates, medical students have statistically significant lower levels of depressive symptoms (42.4% and 26.2%, respectively) and burnout symptoms (37.3% and 27.3%, respectively) at matriculation, suggesting that medical school may be a risk factor.<sup>3</sup> A meta-analysis that included 167 cross-sectional and 16 longitudinal studies from around the world estimated (i.e., the pooled crude estimate) 27.2% of medical students have depressive symptoms.<sup>4</sup> Meanwhile, the prevalence of burnout, a syndrome characterized by emotional exhaustion, depersonalization, and low personal accomplishment, is 44.2–55.9% among medical students; on the Maslach Burnout Inventory (MBI) subscales, 40.8–44.6% reported high emotional exhaustion and 35.1–37.9% reported high depersonalization.<sup>5–8</sup>

Depression and burnout adversely affect the health and well-being of medical students.<sup>9</sup> The consequences of depression and burnout in this population include suicidal ideation, substance use, relationship issues, and negative physical health outcomes.<sup>7, 10</sup> Depression and burnout may also lead to program dropout, a decrease in empathy, problems identifying and managing conflicts, unprofessional conduct, impairment in performance, and academic dishonesty.<sup>7, 9</sup> In the long-term, depression and burnout have been found to impact the quality of

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care provided to patients, with a negative effect on patient safety and quality.<sup>7, 9</sup> As a result, this issue has found increased recognition and attention among interested parties, including the Association of American Medical Colleges (AAMC).

Although numerous studies describe the cross-sectional prevalence of depression and burnout among medical students, only a few longitudinal studies explore the trajectory of these symptoms during medical school. Research found that from matriculation through 4th year symptoms of depression significantly increased from 18% to 31%,<sup>11</sup> and burnout significantly increased from 17% to 38%.<sup>2</sup>

Improving the understanding of the course of depressive symptoms and burnout among medical students may help identify key time points in the appearance of symptoms, and areas for intervention. Therefore, the objective of this study was to prospectively assess year-by-year changes in depressive symptoms and burnout across 4 years of training among medical students. The study hypothesis was that depressive symptoms and burnout would increase during each year of medical school.

## METHODS

We enrolled medical students, who matriculated at a private medical school in Maryland, into a longitudinal study of health and well-being. Incoming medical students completed surveys regarding their general physical and mental health status during their medical school orientation. Subsequently, participants were invited to complete a similar follow-up survey at the beginning of each academic school year. Participants in our study comprised 7 cohorts of medical students who matriculated from 2010 to 2016 (mean number of participants per cohort at baseline: 109, range: 102–116). During this period, 840 students matriculated and were eligible to take part in this study. Of this sample, 758 (90.2%) medical students had complete data on at least one primary outcome at baseline. All participants provided informed consent and participation was voluntary. Approval for the study was obtained from the Johns Hopkins School of Medicine's institutional review board.

## Demographics

Age, gender, race/ethnicity, and marital status were collected at baseline. We re-categorized race as "White," "Black or African American," "Hispanic or Latino(a)," East or Southeast Asian (i.e., "East Asian," "Southeast Asian"), or Other (i.e., "Multiracial," "Middle Eastern," "Other"). Participants in our sample self-reported as "single," "married," "engaged," "partnered," or "other." We re-categorized participants who reported being "engaged," "partnered," or "other" as "Other." We also categorized participants by the year they entered the study (i.e., cohort).

## Depressive Symptoms

Depressive symptoms were measured using the Patient Health Questionnaire (PHQ-9), a 9-item instrument validated to assess depressive symptoms and their severity in the general population.<sup>12</sup> Responses on the PHQ-9 range from 0 to 3, with a total score ranging from 0 to 27. Those with a PHQ-9 score  $\geq 10$  were categorized as having clinically significant depressive symptoms.<sup>12</sup>

## Burnout

Burnout was measured using the Maslach Burnout Inventory-Human Services Survey (MBI-HSS), a validated 22-item measure that evaluates burnout among persons working in human services.<sup>5</sup> Participants rated the frequency of burnout symptoms on a scale ranging from 0 (never) to 6 (every day). Responses on items were summed to determine levels of burnout. The MBI-HSS measures three components of burnout: (1) emotional exhaustion (score range 0 to 54); (2) depersonalization (score range 0 to 30); and (3) personal accomplishment (score range 0 to 48). For each of the MBI-HSS subscales, we used the MBI-HSS cutoffs for medical occupations.<sup>5</sup> High emotional exhaustion, high depersonalization, and low personal accomplishment were defined as scores of  $\geq 27$ ,  $\geq 10$ , and  $\leq 33$  on the respective MBI subscales.

## Statistical Analyses

We described participants' characteristics using proportions and means. The prevalences of depressive and burnout symptoms were calculated for each year separately. We also used a non-parametric test for trend to determine whether changes in the prevalence of burnout symptoms (emotional exhaustion, personal accomplishment, depersonalization) and depressive symptoms were linear across medical school years. Participants' burnout symptoms and depressive symptoms data from each year were tracked longitudinally. We fit generalized estimating equation (GEE) logistic regression models, which allowed us to account for within-person correlation and to evaluate repeated-measures among participants. Additionally, GEE logistic models allowed for the comparison of the odds of each study outcome by medical school years. Medical school year was the primary predictor: first year, second year, third year, and fourth year. The primary outcomes were components of burnout (i.e., emotional exhaustion, low personal accomplishment, depersonalization) and depressive symptoms. Models adjusted for age, race/ethnicity, sex, marital status, and cohort. In exploratory analyses, GEE linear models were also fit to assess burnout and depressive symptoms as continuous variables over time. We also fit logistic regression models to determine whether there existed differences in outcomes (at baseline) between those who had baseline data only ( $n=203$ ; 26.8%) versus those who had any follow-up data ( $n=555$ ; 73.2%). Additionally, we evaluated whether these

**Table 1** Sample Size of Participants by Medical School Year and Cohort

Cohort	Year 1	Year 2	Year 3	Year 4
2010	105	94	76	60
2011	104	90	78	60
2012	101	79	59	29
2013	116	67	52	48
2014	115	75	60	53
2015	108	52	43	—
2016	109	50	—	—
Eligible sample	840	758	649	541
Final sample, <i>n</i>	758	507	368	250
(%) <sup>A</sup>	(90.2%)	(66.9%)	(56.7%)	(46.2%)

<sup>A</sup>Percentage indicates the percentage of eligible participants included in the final sample

groups significantly differed by participant characteristics using chi-squared and independent samples t-tests. An alpha <0.05 indicated statistical significance for all analyses. We performed analyses using Stata version 15.1 (StataCorp, College Station, TX).

## RESULTS

Table 1 reports the sample size of each cohort and study attrition over time. Of the 840 eligible medical students who matriculated, 758 (90.3%) participated in the study at baseline. Among baseline participants, 507 (66.9%) participants had follow-up data on depressive symptoms or burnout at the beginning of their 2nd year (year 2). A total of 109 (14.4%) participants were ineligible to complete the survey at the beginning of their third 3rd year because they had not yet reached their third year at the time of data analysis. Of participants who were eligible (*n* = 649), 56.7% (*n* = 368) had follow-up data during their 3rd year (year 3). A total of 217 (28.6%) participants were not eligible to complete the 4th follow-up data collection at the beginning of their fourth 4th year because they had not yet reached their 4th year at the time of data analysis. Among those participants who were eligible (*n* = 541), 250 (46.2%) had follow-up data that corresponded with their beginning of the 4th year (year 4) of medical school.

**Table 2** Baseline Participant Characteristics

Characteristics	<i>N</i> =758
Age in years, mean ±SD (range)	23.2 ±2.3 (20–38)
Sex, <i>n</i> (%)	
Female	371 (49.1)
Male	385 (50.9)
Race/ethnicity, <i>n</i> (%)	
White	328 (44.3)
East or Southeast Asian	219 (29.6)
Black or African American	58 (7.8)
Hispanic or Latino(a)	27 (3.7)
Other	108 (14.6)
Marital status, <i>n</i> (%)	
Single	684 (90.7)
Married	39 (5.2)
Other	31 (4.1)

\*Missing data (*n*): age = 6; sex = 2; race/ethnicity = 18; marital status = 4. SD = standard deviation

## Participant Characteristics

At baseline (i.e., year 1), the average age of participants was 23.2 years (standard deviation=2.3 years) (Table 2). Additionally, 49.1% of participants were female, 44.3% were White, and 90.7% were single.

## Depressive Symptoms

Among first-year medical students, the prevalence of significant depressive symptoms was 4.3%. This prevalence was 10.5%, 10.9%, and 13.9% for years 2, 3, and 4, respectively (Fig. 1). Significant depressive symptoms increased across medical school years (trend *p*<0.001).

In unadjusted models, significant depressive symptoms were associated with medical school year. After adjustment for age, race/ethnicity, sex, marital status, and cohort, progressive medical school year was still associated with increased depressive symptoms. Compared with the first year, participants had increased odds of significant depressive symptoms during the second year (OR = 2.63, *p*<0.001), third year (OR = 2.85, *p*<0.001), and fourth year (OR = 3.77, *p*<0.001) (Table 3). However, compared with the second year, there was not a significant difference in the odds of significant depressive symptoms during the third and fourth years. Similarly, the odds of significant depressive symptoms were not different between the third and fourth years.

PHQ-9 scores were also assessed as a continuous variable. At baseline, the average PHQ-9 score was 2.8 ± 3.1. After adjustment, compared with year 1, depressive symptoms (i.e., PHQ-9 scores) was significantly higher during years 2, 3, and 4 (Supplemental Table S1).

## Burnout Symptoms

High emotional exhaustion increased across medical school years (trend *p*<0.001). The prevalence of emotional exhaustion was 9.4% among first-year students, compared to 46.2% among fourth-year students (Fig. 1). Similarly, the prevalence of high depersonalization increased across medical school years (trend *p*<0.001); the prevalence was 8.6% among first-year students and 52.5% among fourth-year students. Although the prevalence of low personal accomplishment was higher during year 1 compared to year 4 (37.7% vs. 31.9%), there was not a significant trend in the prevalence of low personal accomplishment across medical school years (trend *p* = 0.12).

In unadjusted and adjusted models, high emotional exhaustion and high depersonalization, but not low personal accomplishment, were significantly associated with medical school year. After adjustment for covariates, emotional exhaustion was associated with medical school year. Compared with the first year, participants had increased odds of emotional exhaustion during the second year (OR = 3.46, *p*<0.001), third year (OR = 4.79, *p*<0.001), and fourth year (OR = 8.20, *p*<0.001) (Table 4). Compared with the second year, students

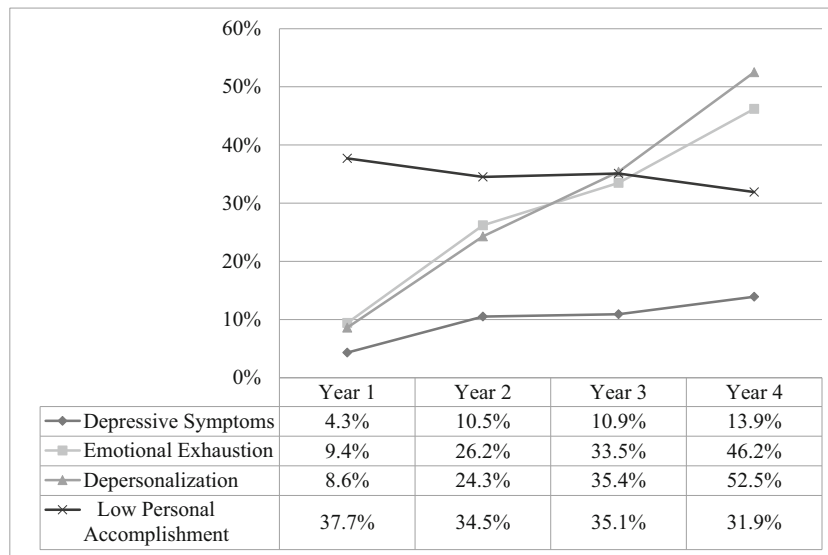


Figure 1 Prevalence of significant depressive symptoms and domains of MBI-measured burnout scale by year.

also had increased odds of emotional exhaustion during the third year (OR = 1.39,  $p=0.04$ ) and fourth year (OR = 2.37,  $p<0.001$ ). Compared with the 3rd year, students also had increased odds of emotional exhaustion during the fourth year (OR = 1.71,  $p=0.003$ ).

High depersonalization was also associated with medical school year after adjustment. Compared with the first year, students had increased odds of high depersonalization during the second year (OR = 3.55,  $p<0.001$ ), third year (OR = 6.14,  $p<0.001$ ), and fourth year (OR = 12.53,  $p<0.001$ ). Compared with the second year, students had increased odds of depersonalization during the third year (OR = 1.73,  $p=0.001$ ) and fourth year (OR = 3.54,  $p<0.001$ ). Finally, compared with the third year, students had increased odds of depersonalization during the fourth year (OR = 2.04,  $p<0.001$ ).

In adjusted models, low personal accomplishment was not associated with medical school year.

Burnout symptoms were also assessed as continuous variables. At baseline, the average MBI emotional exhaustion subscale score was  $14.2 \pm 8.8$ , the average MBI depersonalization subscale score was  $3.5 \pm 4.1$ , and the average personal accomplishment score was  $34.1 \pm 9.6$ . After adjustment, emotional exhaustion and depersonalization scores significantly increased across medical school years. After adjustment, compared with year 1, personal accomplishment was significantly higher during years 3 and 4. However, personal accomplishment did not significantly differ across other years of medical school (Supplemental Table S2).

**Additional Analyses**

We also examined whether there were any differences between students who participated in the baseline survey only compared to students who participated in follow-up surveys. Participants with baseline data only did not significantly differ from those

with follow-up data with regard to age or marital status. However, there were significant differences in sex and race/ethnicity between those with and without follow-up data. After adjustment for age, sex, race/ethnicity, marital status, and cohort, those with baseline data did not differ from those with follow-up data in regard to odds of baseline depressive symptoms (OR = 0.63, 95% CI 0.23, 1.70,  $p = 0.36$ ), emotional exhaustion (OR = 0.93, 95% CI 0.45, 1.90,  $p = 0.84$ ), depersonalization (OR = 1.01, 95% CI 0.49, 2.11,  $p = 0.97$ ), or low personal accomplishment (OR = 1.05, 95% CI 0.68, 1.65,  $p = 0.82$ ).

**DISCUSSION**

This study investigated temporal trends in symptoms of depression and burnout across medical school years in a large sample of medical students. In both unadjusted and adjusted models, we found a statistically significant increase in the odds of depressive symptoms, burnout, and its domains: emotional exhaustion and depersonalization, during each year in medical

Table 3 Adjusted Association of Significant Depressive Symptoms with Medical School Year, (OR, 95% CI)

Primary Predictor	OR (95% CI) <sup>A</sup>	p-value
Medical school year		
Year 1	1.00	
Year 2	2.63 (1.65, 4.19)	<0.001
Year 3	2.85 (1.72, 4.73)	<0.001
Year 4	3.77 (2.20, 6.47)	<0.001
Medical school year		
Year 2	1.00	
Year 3	1.09 (0.69, 1.71)	0.72
Year 4	1.44 (0.88, 2.35)	0.15
Medical school year		
Year 3	1.00	
Year 4	1.32 (0.79, 2.20)	0.28

Notes. Significant depressive symptoms (PHQ-9  $\geq 10$ ) versus PHQ-9 <10(reference category)  
<sup>A</sup>Adjusted for age, sex, race/ethnicity, marital status, and cohort

Table 4 Adjusted Associations of MBI-Assessed Burnout Symptoms with Medical School Year, (OR, 95% CI)

Primary predictor	Outcomes (odds ratio, 95% confidence interval)					
	High Emotional exhaustion		High Depersonalization		Low personal accomplishment	
		<i>p</i> -value		<i>p</i> -value		<i>p</i> -value
Medical school year						
Year 1	1.00		1.00		1.00	
Year 2	3.46 (2.45, 4.88)	<0.001	3.55 (2.46, 5.11)	<0.001	0.91 (0.70, 1.19)	0.49
Year 3	4.79 (3.35, 6.86)	<0.001	6.14 (4.20, 8.99)	<0.001	0.88 (0.66, 1.18)	0.40
Year 4	8.20 (5.54, 12.14)	<0.001	12.53 (8.29, 18.96)	<0.001	0.75 (0.53, 1.06)	0.10
Medical school year						
Year 2	1.00		1.00		1.00	
Year 3	1.39 (1.01, 1.90)	0.04	1.73 (1.26, 2.38)	0.001	0.97 (0.71, 1.32)	0.84
Year 4	2.37 (1.67, 3.37)	<0.001	3.54 (2.48, 5.04)	<0.001	0.82 (0.57, 1.18)	0.28
Medical school year						
Year 3	1.00		1.00		1.00	
Year 4	1.71 (1.20, 2.44)	0.003	2.04 (1.43, 2.91)	<0.001	0.85 (0.58, 1.23)	0.39

Notes. High (subscale score  $\geq 27$ ) versus low emotional exhaustion (subscale score  $< 27$ ; reference category). High (subscale score  $\geq 10$ ) versus low depersonalization (subscale score  $< 10$ ; reference category). Low (subscale score  $\leq 33$ ) versus high personal accomplishment (subscale score  $> 33$ ; reference category). Models adjusted for age, sex, race/ethnicity, marital status, and cohort

school compared to matriculation (i.e., Year 1). There was no evidence of a temporal trend in the odds of low personal accomplishment in adjusted models.

Our results support prior studies that reported increases in the prevalence of depression and burnout over the course of medical school. Previous studies reported that the prevalence of depressive symptoms was 10–18% at matriculation, 25–43% at year 2, 34–40% at year 3, and 18–31% at year 4.<sup>2, 11, 13</sup> Similarly, studies have found the prevalence of burnout increased from 17–21% at matriculation, to 35–41% at year 2, 42–59% at year 3, and to 31% at year 4 and 38% after the residency match.<sup>2, 14</sup> Levels of depressive symptoms were lower in our study compared to previously reported longitudinal studies of medical students. The potential reasons could be that previous studies were done in smaller cohorts and the tools used to measure depressive symptoms were different. Together, previous studies suggest that burnout and depressive symptoms increase during medical school years and may decrease around graduation, however rates may not return to baseline levels. In our analysis, it is possible we did not observe a decline in symptoms because year 4 data collection was performed at the beginning of fourth year, instead of after the matching process. Potential factors that may contribute to burnout and depressive symptoms among medical students include difficulty adjusting to the medical school environment, lack of sleep and exercise, ethical conflicts, the demands of clinical training, exposure to death and suffering as a part of clinical training, workload, and student debt.<sup>9, 15–17</sup>

Studies have reported that residents and early-career physicians have high prevalences of depression and burnout. The prevalence of depressive symptoms among residents is 28.8% and the prevalence of burnout among surgery residents is 69%.<sup>18, 19</sup> Moreover, an estimated 51% of early-career physicians have burnout and 40% have depressive symptoms; however, the odds of burnout decline among experienced physicians (i.e.,  $> 30$  years of practice).<sup>6, 20</sup> Taken together,

this evidence suggests that depressive and burnout symptoms may increase after matriculation to medical school and persists during residency and into early to mid-practice.<sup>6</sup>

Therefore, medical school may be a critical period to provide timely and system-level interventions that promote awareness and equip students with the skills to improve well-being and resiliency prior to entering training and clinical practice. Potential interventions that are supported by evidence include mind-body training and practices including mindfulness, introduction of well-being curriculum, changing course grading to a pass/fail system, exercise education, and a coaching program for students.<sup>21–25</sup> However, additional prospective research is needed to investigate the progression of psychological distress from medical school to residency, associated critical triggers, and the effectiveness of interventions in the medium and long-term.

This study had several limitations. First, this study was conducted at a single institution and we were unable to exclude those students who may have taken a break or took more than 4 years to complete medical school. Additionally, although we had data on 90.2% of eligible participants during their first year, only 46.2% of eligible participants completed the survey during the 4th year. This high level of attrition could be due to multiple factors. For one, the first survey was conducted in-person and follow-up surveys were completed online; additionally, follow-up surveys may have interfered with coursework. Moreover, students may have taken a year or more off for further, non-medical school studies. However, our findings are consistent with previously reported data in this population.

A major strength of our study was that it was longitudinal and followed several cohorts of medical students over time using validated measures of both depressive symptoms and burnout. Also, to our knowledge, there was no major curriculum change during the study period that may have confounded our results. Additionally, our sample size was large, and we were able to adjust for multiple important confounders. Data collection was performed consistently at the beginning of each

academic year. Importantly, our study adds to the literature by prospectively investigating these associations across multiple cohorts of medical students during medical school using standardized tools.

In conclusion, our study provides evidence that depressive symptoms and burnout are prevalent among medical students and that medical school year is a strong predictor of both. This study highlights the psychological impact of medical school and the need for early interventions aimed at improving well-being among students. Future studies should examine how multidisciplinary interventions provided early in medical school may improve student well-being both during medical school and beyond. Focusing on medical student well-being may result in healthier medical students which may lead to a healthier physician workforce.

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**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s11606-021-06765-x>.

**Compliance with Ethical Standards:**

**Conflicts of Interest:** The authors report no relevant conflicts of interest.

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