

Medical Student Wellness in the United States During the COVID-19 Pandemic: a Nationwide Survey

Louis Nikolis

Loyola University Chicago Stritch School of Medicine

Andrea Wakim

Loyola University Chicago Stritch School of Medicine

William Adams

Loyola University Chicago Health Sciences Division

Premreet Bajaj (✉ pbajaj@lumc.edu)

Loyola University Medical Center

Research Article

Keywords: COVID-19, medical education, medical students, public health crises, wellness

Posted Date: February 19th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-209110/v1>

License:  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Version of Record: A version of this preprint was published at BMC Medical Education on July 26th, 2021. See the published version at <https://doi.org/10.1186/s12909-021-02837-y>.

Abstract

Background: As United States (US) medical students suffer higher rates of depression and anxiety than the general population, medical student wellness has been studied in recent years. One definition describes wellness as having eight dimensions: Intellectual, emotional, physical, social, occupational, financial, environmental, and spiritual. As the coronavirus (COVID-19) pandemic poses unique challenges for medical students, we aimed to compare medical student wellness before and during the COVID-19 pandemic.

Methods: An informal survey was created to assess the eight wellness dimensions and distributed via Survey Monkey to US allopathic and osteopathic medical students via email and social media. The survey was administered from March 29, 2020 to June 23, 2020. Univariable and multivariable linear mixed-effects models were used to estimate the change in students' overall wellness using an 11-point scale ranging from 0 (least well) to 10 (most well). Generalized estimating equations were used to compare students' responses to the eight dimensions before and during the COVID-19 pandemic.

Results: On multivariable analysis, students reported a decline in their overall wellness during COVID-19 ($M_{diff} = -1.04$; $p < .001$), with Asian respondents reporting almost no change in overall wellness ($M = -0.69$) compared to White respondents ($M = -1.18$; $p = .049$) and Black respondents ($M = -1.78$; $p = .03$). Students felt less supported and comfortable with their social ($OR = 0.47$) and daily ($OR = 0.45$) environments and expressed decreased satisfaction with their exercise ($OR = 0.85$), sense of purpose ($OR = 0.33$), and financial status ($OR = 0.75$). Students also expressed lower confidence ($OR = 0.15$) and satisfaction ($OR = 0.11$) with their medical education and increased anxiety ($OR = 3.37$) and depression ($OR = 2.05$).

Conclusions: Medical students reported declines in overall wellness and individual wellness dimensions. These findings can be used to implement changes to improve medical student wellness.

Background

Compared to the general population, United States (US) medical students have significantly higher rates of depression, anxiety, burnout, and suicidal ideation.^{1,2,3} Given these alarming statistics, the relationship between medical education and student wellness has been extensively studied in recent years. One popular and inclusive definition describes wellness as having eight dimensions: Intellectual, emotional, physical, social, occupational, financial, environmental, and spiritual. These eight dimensions intertwine in creating one's overall wellness.⁴

The coronavirus (COVID-19) pandemic has posed new and unique challenges for medical students. As a result of national and institutional mandates, including stay-at-home orders, students are grappling with curricular and lifestyle changes that affect their future careers and current daily lives. On top of their taxing education, these challenges place students at higher risk for reduced wellness.

Few studies have examined the pandemic's effects on medical student wellness. One study found that psychological wellbeing and work performance were decreased in medical students in Saudi Arabia during the pandemic.⁵ Another study found that medical students in India had worse mental health during COVID-19, including higher anxiety and stress levels, which were linked to poor sleep quality.⁶ Though these studies examined some components of wellness, no studies have examined the eight dimensions of wellness, particularly in US medical students. Analyzing medical student wellness during this unique time could highlight ways to improve the structure of medical education and promote wellness in the future. Therefore, the aim of our study was to utilize the eight domains of wellness to assess and compare US medical student wellness before and during the COVID-19 pandemic.

Methods

An informal survey (see Supplementary File 1, .pdf, Medical Student Wellness During the COVID-19 Pandemic, which is a copy of the survey) was created by the authors to measure the eight dimensions of wellness. The survey was sent via Survey Monkey to medical education coordinators, student affairs leaders, and medical student wellness groups from allopathic and osteopathic schools across the US, who were asked to share it with medical students at their institutions. Additionally, the survey was shared on social media sites, including Facebook, Twitter, and Instagram. Responses were collected from March 29, 2020 through June 23, 2020, and participation was completely voluntary. Informed consent was obtained from participants. Respondents were asked to complete the survey only one time, and incomplete survey responses were included in the analysis. The study was submitted to the Institutional Review Board (IRB) for the Protection of Human Subjects at Loyola University Chicago Health Sciences Division before beginning any study procedures and received IRB exemption.

Survey Design

Our survey collected basic demographic information (i.e., year in school, sex, race), information regarding current education status (participation in recorded lectures vs. live-online lectures), and subjective information regarding each of the eight wellness domains. For the items related to wellness, students were asked to indicate their responses before and during the COVID-19 period.

The survey contained 28 items pertaining to wellness: Four on intellectual, four on emotional, six on physical, three on social, three on occupational, two on financial, two on environmental, three on spiritual wellness, and one item pertaining to overall wellness. 17 of these items were statements that capitalized on an ordinal (Likert) scale ranging from 'strongly disagree' to 'strongly agree.' Six items were questions regarding frequency of activities (e.g., How many days do you exercise per week?). Two items were 'select all that apply' questions (e.g., What strengthens your sense of purpose? Select all that apply). Two items were multiple choice questions (e.g., Where do you spend the majority of your time during the week?). One item asked students to rate their overall wellness before and during COVID-19 on a scale from 0–10. The final survey question was an optional free response where students could share any comments that were not addressed in the survey.

Statistical Methods

Respondent characteristics were reported as valid counts and proportions stratified by the COVID incidence rate of the state they were living in at the time of the survey based on “Trends in Cumulative Incidence Rate of COVID-19 Cases Reported to CDC.”⁷ The respondent was considered living in a high incidence state if he/she lived in a state with a single day incidence rate per 100,00 of 800 or greater, while moderate incidence rate was between 500–800, and low incidence rate was considered 500 or lower.

Regarding overall wellness, each respondent’s pre-pandemic response was subtracted from his/her current pandemic response to create a delta overall wellness score ranging from – 10 (worsening wellness) to + 10 (improving wellness); a value of zero reflects no change in the respondent’s overall wellness. Subsequently, univariable and multivariable linear mixed effects models were used to compare the delta wellness score by respondents’ sex, year in school, race, their location (i.e., incidence of COVID) at the time of survey, as well as other school-level and student-level characteristics. In these models, confidence limits and significance values for year in school, race, and the COVID incidence rate were adjusted for multiple comparisons using a Sidak correction. Further, responses were considered correlated within medical schools and random intercepts were allowed for each school while specifying a completely general (unstructured) covariance matrix to account for the within-school correlation. For the multivariable model, multicollinearity diagnostics were monitored for tolerance, variance inflation, and shared variance proportions. There were no violations of linearity or homoscedasticity.

Students also answered questions about their medical school training, sleep and nutrition/exercise behaviors, social activities, finances, and mood using ordinal (Likert-type) scales. For these items, generalized estimating equations (GEE models) were used to compare the odds of a higher response on the scale during versus pre-pandemic. Each model specified a multinomial distribution with cumulative logit link for the ordered response categories, and an exchangeable working correlation matrix was used to account for students’ paired responses (i.e., within-subject correlation). While robust standard errors were used to construct 95% confidence limits for the odds ratios, these comparisons were not subjected to null hypothesis tests. A similar approach was used to compare the odds of respondents spending most of their time at home rather than elsewhere during the pandemic, though this model specified a binomial distribution with logit link for the response. Finally, all remaining survey questions were *check-all-that-apply* items. For each question, we used exact McNemar chi-square tests to compare the proportion checked during versus pre-COVID. All analyses were completed using SAS version 9.4 (Cary, NC).

Results

Due to the snowball sampling plan, the response rate is not estimable. However, there were 1,389 respondents from 38 states. Among these individuals, 11 (0.8%) were excluded because they did not list

their academic institution, and one respondent (0.07%) was excluded because he was living outside the United States at the time of the survey (Table 1).

Table 1
Demographic information of medical student respondents

	COVID Incidence Rate			Total (N = 1377)
	Low (n = 476)	Moderate (n = 272)	High (n = 629)	
Year in medical school				
MS1	131 (28%)	79 (29%)	165 (26%)	375 (27%)
MS2	135 (28%)	69 (25%)	150 (24%)	354 (26%)
MS3	141 (30%)	91 (33%)	227 (36%)	459 (33%)
MS4	69 (15%)	33 (12%)	87 (14%)	189 (14%)
Sex				
Female	319 (67%)	187 (69%)	416 (66%)	922 (67%)
Male	156 (33%)	85 (31%)	208 (33%)	449 (33%)
Non-binary	1 (0.2%)	0	4 (0.6%)	5 (0.4%)
Prefer not to say	0	0	1 (0.2%)	1 (0.1%)
Race or ethnicity				
White	335 (70%)	188 (69%)	385 (61%)	908 (66%)
Hispanic or Latino	33 (6.9%)	11 (4.0%)	36 (5.7%)	80 (5.8%)
Black or African American	10 (2.1%)	25 (9.2%)	24 (3.8%)	59 (4.3%)
Asian	72 (15%)	34 (13%)	134 (21%)	240 (17%)
Native American	1 (0.2%)	0	1 (0.2%)	2 (0.2%)
Other	21 (4.4%)	9 (3.3%)	37 (5.9%)	67 (4.9%)

	COVID Incidence Rate			Total (N = 1377)
	Low (n = 476)	Moderate (n = 272)	High (n = 629)	
Prefer not to say	4 (0.8%)	5 (1.8%)	12 (1.9%)	21 (1.5%)
School suspended in-person meetings	474 (99%)	272 (100%)	629 (100%)	1375 (99%)
Taking required class or clerkship (N = 1376)	376 (79%)	186 (69%)	487 (77%)	1049 (76%)
Taking elective class or clerkship (N = 1371)	128 (27%)	83 (31%)	196 (31%)	407 (30%)
Classes or clerkships utilize recorded lectures (N = 1363)	369 (78%)	189 (72%)	446 (72%)	1004 (74%)
Classes or clerkships utilize live online lectures (N = 1365)	392 (83%)	227 (86%)	439 (70%)	1058 (78%)
Classes or clerkships have required exams (N = 1365)	396 (84%)	198 (75%)	535 (86%)	1129 (83%)
Currently assisting with in-person patient care (N = 1376)	16 (3.4%)	18 (6.6%)	16 (2.5%)	50 (3.6%)
Currently providing in-person care of COVID-19 patients (N = 1376)	10 (2.1%)	5 (1.9%)	12 (1.9%)	27 (2.0%)
Currently assisting with COVID-19 relief efforts? (N = 1376)	179 (38%)	103 (38%)	226 (36%)	508 (37%)
<i>Note: Unless otherwise noted, the number of respondents = 1377 from 112 medical schools.</i>				

Most of the remaining 1,377 respondents were living in a state with a high (n = 629 or 46%) COVID-19 incidence rate at the time of survey; only 20% (n = 272) were living in a state with a moderate COVID-19 incidence rate, while another 35% (n = 476) were living in a state with a low COVID-19 incidence rate. Most identified as White (n = 908 or 66%), female (n = 922 or 67%), and were in their first or second year of medical school (n = 729 or 53%); another 33% (n = 459) of respondents were in their third year of medical school, while few (n = 189 or 14%) reported that they were in their fourth year of medical school. Nearly every respondent reported that their school suspended in-person meetings (n = 1,375 or 99%), and the majority reported that they were taking a required class or clerkship (n = 1,049/1,376 or 76%) that capitalized on recorded (n = 1,004/1,363 or 74%) as well as live online lectures (n = 1,058/1,365 or 78%). As expected, the majority reported that their class or clerkship required examinations (n = 1,129/1,365 or 83%). Finally, at the time of the survey, few participants reported they were taking an elective class or clerkship (n = 407/1,371 or 30%) or were actively involved in COVID-19 relief efforts (n = 508/1,376 or

37%). In fact, a sparse number of respondents were providing in-patient care ($n = 50/1,376$ or 3.6%) or caring for COVID-19 patients ($n = 27/1,376$ or 2.0%).

Overall, students rated their wellness during the COVID-19 pandemic about 1 point lower than their pre-pandemic response ($M_{\text{diff}} = -1.04$, 95% CI: -1.23 to -0.85; $p < .001$). This change score nominally depended on the respondents' race (overall $p = .01$) with Asian students reporting almost no change in overall wellness ($M = -0.69$) when compared to White respondents ($M = -1.18$; $p = .049$) and Black respondents ($M = -1.78$; $p = .03$). That is, Asian respondents reported a change score that was about 0.49 (95% CI: 0.001 to 0.97) points higher than White respondents but about 1.09 (95% CI: 0.08 to 2.10) points higher than Black respondents. See Table 2. Similarly, students taking an elective class or clerkship reported a change score ($M = -0.96$) that was nominally higher than those *not* taking an elective class or clerkship ($M = -1.36$; $M_{\text{diff}} = 0.40$, 95% CI: 0.11 to 0.69; $p = .01$). Results were similar for those taking versus *not* taking a class or clerkship that required live online lectures ($M_{\text{diff}} = 0.34$, 95% CI: 0.02 to 0.66; $p = .04$).

Table 2
Change in overall wellness of medical student respondents

	Valid N	Unadjusted		Adjusted	
		Mean Difference (95% CI)	p	Mean Difference (95% CI)	p
Male vs female	1274	0.27 (0.004 to 0.54)	.046	0.17 (-0.11 to 0.44)	.23
Year in school	1279		.15 ^a		.24 ^a
MS2 vs MS1		-0.01 (-0.47 to 0.46)	.99	-0.04 (-0.53 to 0.46)	.99
MS3 vs MS1		0.32 (-0.11 to 0.75)	.27	0.28 (-0.21 to 0.78)	.58
MS4 vs MS1		0.16 (-0.40 to 0.72)	.97	-0.06 (-0.72 to 0.60)	.99
MS3 vs MS2		0.33 (-0.12 to 0.77)	.28	0.32 (-0.17 to 0.81)	.42
MS4 vs MS2		0.17 (-0.40 to 0.74)	.97	-0.02 (-0.60 to 0.64)	.99
MS4 vs MS3		-0.16 (-0.70 to 0.38)	.97	-0.34 (-0.94 to 0.25)	.57
Race	1262		.01 ^a		.01 ^a
Asian vs White		0.51 (0.03 to 0.99)	.03	0.49 (0.001 to 0.97)	.049
Black vs White		-0.55 (-1.47 to 0.38)	.64	-0.60 (-1.55 to 0.34)	.54
Hispanic vs White		0.31 (-0.48 to 1.09)	.96	0.26 (-0.54 to 1.06)	.99
Other vs White		-0.08 (-0.91 to 0.74)	.99	-0.05 (-0.90 to 0.79)	.99
Black vs Asian		-1.06 (-2.02 to -0.07)	.03	-1.09 (-2.10 to -0.08)	.03
Hispanic vs Asian		-0.20 (-1.06 to 0.66)	.99	-0.23 (-1.11 to 0.64)	.99
Other vs Asian		-0.59 (-1.49 to 0.30)	.48	-0.54 (-1.46 to 0.38)	.64
Black vs Hispanic		-0.86 (-2.02 to 0.31)	.33	-0.86 (-2.05 to 0.33)	.36

	Valid N	Unadjusted		Adjusted	
		Mean Difference (95% CI)	p	Mean Difference (95% CI)	p
Black vs Other		-0.47 (-1.65 to 0.72)	.96	-0.55 (-1.76 to 0.67)	.90
Hispanic vs Other		0.39 (-0.69 to 1.47)	.98	0.31 (-0.80 to 1.42)	.99
COVID incidence rate	1279		.98 ^a		.91 ^a
Moderate vs low		0.01 (-0.60 to 0.63)	.99	0.09 (-0.54 to 0.71)	.98
High vs low		0.04 (-0.53 to 0.61)	.99	0.08 (-0.49 to 0.66)	.97
High vs moderate		0.03 (-0.60 to 0.66)	.99	-0.0003 (-0.64 to 0.64)	.99
Taking required class or clerkship: Yes vs No	1278	-0.01 (-0.31 to 0.29)	.95	0.003 (-0.35 to 0.36)	.99
Taking elective class or clerkship: Yes vs No	1275	0.46 (0.19 to 0.74)	.001	0.40 (0.11 to 0.69)	.01
Classes or clerkships utilize recorded lectures: Yes vs No	1270	-0.14 (-0.43 to 0.15)	.34	-0.03 (-0.36 to 0.30)	.86
Classes or clerkships utilize live online lectures: Yes vs No	1273	0.35 (0.05 to 0.66)	.02	0.34 (0.02 to 0.66)	.04
Classes or clerkships have required exams: Yes vs No	1272	-0.10 (-0.45 to 0.24)	.55	-0.10 (-0.53 to 0.33)	.64
Currently assisting with in-person patient care: Yes vs No	1279	0.12 (-0.61 to 0.85)	.75	-0.02 (-0.92 to 0.87)	.96
Currently providing in-person care of COVID-19 patients: Yes vs No	1279	-0.26 (-1.38 to 0.86)	.65	-0.10 (-1.42 to 1.23)	.89
Currently assisting in COVID-19 relief efforts: Yes vs No	1279	-0.08 (-0.35 to 0.18)	.53	-0.21 (-0.48 to 0.07)	.14
<p><i>Note:</i> Valid N = Number of respondents used to compute the unadjusted estimates. The valid number of respondents used for the adjusted estimates = 1241. ^aOverall Type-3 test for the fixed effect. Confidence limits and significance values for year in school, race, and the COVID incidence rate are adjusted for multiple comparisons using a Sidak correction.</p>					

Compared to their pre-COVID response, students reported sleeping more during the pandemic ($OR = 3.25$, 95% CI: 2.80–3.77) and that their sleep was more satisfactory ($OR = 1.26$, 95% CI: 1.12–1.43). Despite their increased sleep and quality of sleep, however, students also reported lower levels of energy during the pandemic ($OR = 0.28$, 95% CI: 0.24–0.32). Regarding students' nutrition and exercise behaviors, they reported exercising more frequently during COVID-19 ($OR = 1.25$, 95% CI: 1.11–1.41) but also reported lower satisfaction with their exercise regimen ($OR = 0.85$, 95% CI: 0.74–0.98) and lower overall satisfaction with their nutritional intake ($OR = 0.73$, 95% CI: 0.65–0.83). Further, students reported less satisfaction with their social environment during COVID-19. For example, even though students spent more time (days) engaging with their family each week ($OR = 2.10$, 95% CI: 1.89–2.34), they also reported low levels of support from their social environment ($OR = 0.47$, 95% CI: 0.42–0.53) and low overall comfort with their daily environment ($OR = 0.45$, 95% CI: 0.39–0.52). Similarly, students reported low satisfaction with their sense of purpose ($OR = 0.33$, 95% CI: 0.29–0.36) despite spending substantially more time reflecting on their sense of purpose ($OR = 3.28$, 95% CI: 2.96–3.63). Also, compared to their pre-COVID response, students spent more time (days) worrying about their finances ($OR = 1.71$, 95% CI: 1.59–1.85) and less satisfaction with their finances ($OR = 0.75$, 95% CI: 0.70–0.79). See Table 3 (see Supplementary File 2, .docx, Summary frequencies for Table 3, which indicates summary frequencies for ordinal scale questions).

Table 3
Odds of a higher survey response during vs. pre-COVID from medical student respondents

	Valid N	Odds Ratio	95% CI	
			Lower	Upper
Physical				
Hours sleeping per night	1321	3.25	2.80	3.77
Satisfaction with sleep	1288	1.26	1.12	1.43
High energy levels	1288	0.28	0.24	0.32
Satisfaction with nutritional intake	1288	0.73	0.65	0.83
Days exercising per week	1321	1.25	1.11	1.41
Satisfaction with exercise	1288	0.85	0.74	0.98
Social				
Days speaking with family per week	1321	2.10	1.89	2.34
Supported by social environment	1288	0.47	0.42	0.53
Spiritual				
Days reflecting on sense of purpose	1321	3.28	2.96	3.63
Satisfaction with sense of purpose	1288	0.33	0.29	0.36
Environmental				
Comfort with daily environment	1288	0.45	0.39	0.52
Financial				
Days worrying about finances	1321	1.71	1.59	1.85
Satisfaction with financial status	1288	0.75	0.70	0.79
Intellectual				
More hours studying per day	1321	0.99	0.90	1.10
Enough time to study	1288	3.96	3.43	4.56
Worry about grades	1288	1.12	1.03	1.22
Confidence in medical education	1288	0.15	0.13	0.17
Occupational				
Comfort in providing patient care	1286	0.30	0.27	0.33

	Valid N	Odds Ratio	95% CI	
			Lower	Upper
Satisfaction with work/school	1288	0.11	0.09	0.13
Enjoyment of work/schoolwork	1288	0.25	0.22	0.28
Emotional				
Higher stress	1288	2.98	2.59	3.42
Higher anxiousness	1288	3.37	2.99	3.81
Higher depression	1288	2.05	1.88	2.23
Higher burn out	1288	1.60	1.43	1.80

Table 3 also shows that students spend more time studying each week during COVID-19 ($OR = 3.96$, 95% CI: 3.43–4.56) but are increasingly concerned about their grades ($OR = 1.12$, 95% CI: 1.03–1.22) and lack confidence in their medical education ($OR = 0.15$, 95% CI: 0.13–0.17), satisfaction with their training ($OR = 0.11$, 95% CI: 0.09–0.13), and enjoyment of their schoolwork ($OR = 0.25$, 95% CI: 0.22–0.28). Students also expressed higher levels of stress ($OR = 2.89$, 95% CI: 2.59–3.42), anxiety ($OR = 3.37$, 95% CI: 2.99–3.81), depression ($OR = 2.05$, 95% CI: 1.88–2.23), and burn out ($OR = 1.60$, 95% CI: 1.43–1.80) compared to their pre-COVID response.

Additionally, students were less likely to endorse schoolwork (58% vs 84%), friends or family (80% vs 82%), hobbies (51% vs 55%), or community service (32% vs 51%) as activities that strengthen their sense of purpose during COVID. Instead, they were more likely to endorse reflection (45% vs 38%) or other activities (4.1% vs 2.1%) as strengthening their sense of purpose. See Table 4.

Table 4
Summary of responses to tertiary survey questions by medical student respondents

	Before COVID	During COVID
Spend majority of time (Q13)		
At a friend or significant other's home	10 (0.8%)	58 (4.4%)
At home	194 (15%)	1221 (92%)
At school or work	1083 (82%)	26 (2.0%)
Other	15 (1.1%)	4 (0.3%)
Outdoors	19 (1.4%)	12 (0.9%)
Total	1321 (100%)	1320 (100%)
Method of interaction with friends/family		
In person ^a	1119 (81%)	544 (40%)
Text ^a	1235 (90%)	1193 (87%)
Facetime application ^a	645 (47%)	1104 (80%)
Phone-call ^a	1048 (76%)	1074 (78%)
Email ^a	248 (18%)	274 (20%)
Strengthens sense of purpose		
School/work ^a	1155 (84%)	797 (58%)
Friends/family ^a	1133 (82%)	1097 (80%)
Hobbies ^a	762 (55%)	696 (51%)
Community service ^a	709 (51%)	443 (32%)
Religion ^a	398 (29%)	379 (28%)
Reflection ^a	518 (38%)	615 (45%)
Other ^a	36 (2.1%)	56 (4.1%)
<i>Note:</i> ^a Item requested a check-all-that-apply response. These items treat missing responses as unchecked. Therefore, the valid N = 1377 for each item		

Discussion

The unique and unprecedented circumstances of the pandemic are potential driving forces for detrimental changes in student wellness. Upon evaluating demographic variables, such as gender, medical school year, and location, significant changes in overall wellness were not observed. However, there were significant differences depending on respondents' race, specifically when comparing Asian respondents to Black and White respondents respectively. Studies have shown that Black students are particularly susceptible to the effects of discrimination as race is strongly linked to their self-identity.⁸ This may explain Black respondents reporting lower overall wellness. Interestingly, other studies have shown that burnout is more common amongst nonminority students than minority students.⁹ Therefore, additional studies are required to further investigate the relationship between race and wellness in medical students.

During the time of survey administration, nearly all medical students were removed from in-classroom and clinical settings, per AAMC Guidelines.¹⁰ As a result, many schools transitioned to virtual learning in an attempt to replace traditional medical training. However, studies have shown that there are many barriers to virtual medical education, including inadequate implementation of technical skills, insufficient resources, and lack of institutional guidance and peer support.^{11,12} Despite these known challenges with virtual learning, most medical schools did not provide adjustments to tuition, which costs an average of \$50,201 annually.¹³ Therefore, the transition to online learning may contribute to the statistically significant reductions in intellectual, occupational, and financial wellness found in this study, including: less confidence in medical education, less comfort in providing patient care, less satisfaction with work/schoolwork, less financial satisfaction, and worrying about finances more frequently.

Further, removing students from clinical rotations and labeling students as "non-essential" could hinder academic and personal growth. In previous emergency crises, students assisted on the frontlines and learned valuable lessons regarding critical decision-making and emergency care.¹⁴ However during the first few months of the pandemic, students could not participate in similar, irreplaceable learning opportunities, which many have been disappointing and contrary to their personal missions in medicine.¹⁵ Likewise, students could not interact with or "carry their own" patients, a valuable responsibility and learning opportunity.¹⁶ This could explain the noted reductions in intellectual and occupational wellness. Moreover, a medical student's personal identity is strongly tied to their professional identity in medicine and service, and studies have shown that identity roles contribute to one's sense of purpose.^{16,17,18} Therefore, the removal of students from the clinical environment, labeling students as "non-essential," and restricting students from assisting on the frontlines offers an explanation for their reduced spiritual wellness, including decreased satisfaction with their sense of purpose.

Other dramatic changes that occurred during the COVID-19 period include changes regarding the scheduling of national licensing exams, such as United States Medical Licensing Examination (USMLE) Step 1 and 2 and Comprehensive Osteopathic Medical Licensing Exam of the United States (COMLEX-USA) Level 1 and 2. Students across the country had these exams rescheduled, canceled, or postponed.¹⁹

These exams are already a significant source of stress and anxiety, and these changes could have led to reductions in emotional wellness, including increased stress, anxiety, depression, and burnout.^{20,21}

The residency application process also changed due to COVID-19, as visiting student rotations were cancelled (unless meeting an AAMC Exception) and residency interviews occurred virtually as opposed to in-person.²² This step is crucial for career planning and is a source of anxiety. Some students may excel during in-person interviews where they can interact with the program director, faculty, current residents, and other candidates. However, with a virtual platform, these interactions may be less organic or not be possible. This new platform could also explain increased stress and anxiety. Moreover, for fourth year students, cancellation of celebratory events like Match Day and graduation may have played a role in their worsened emotional wellness.

Societal changes induced by COVID-19 have affected medical students as well. With quarantine and social distancing orders in place, students spent more time at home with less in-person interactions. Although studies suggest that reduced contact hours and increased free time to explore one's interest could in fact increase levels of wellness, the quality of free time during COVID-19 was drastically different.²³ Stay-at-home orders and closures of local businesses may limit one's physical activity and foster a sedentary lifestyle.²⁴ Sedentary lifestyles are associated with numerous adverse health outcomes, including obesity, depression, and anxiety.^{25,26,27} This may help explain the reduced physical and emotional wellness found in this study, including lower energy, less satisfaction with nutrition and exercise, and increased feelings of depression and anxiety.

To minimize COVID-19 exposures, on-campus meetings and courses were limited or nonexistent, removing medical students from their classmates, usual study groups, and social environment. Studies have shown that study groups, social interaction, and student communities are important for medical students from both social and educational perspectives.^{28,29} This may explain the observed reductions in social and environmental wellness, including students feeling less supported by their social environment and less comfortable in their daily environments.

Limitations

Our study is not without limitations. While we aimed to minimize sampling bias by contacting administrators from all US allopathic and osteopathic schools, the survey distribution was largely dependent on each individual medical school's survey policy. Additionally, distribution via social media was limited to those who use social media and saw the postings and was thus another component of sampling bias. As a result, the number of respondents from each school varied. Another limitation of our study included non-response bias. It is not improbable that those who completed the survey have different opinions than those who did not. For this reason, the response rate was not calculable. Furthermore, our informal survey was not validated prior to its use. Ultimately, these limitations may have been mitigated due to the large sample size of the study and diversity of student demographics, permitting a degree of generalizability.

Conclusion

This is the first study examining wellness amongst US medical students during the COVID-19 pandemic. Our study demonstrates that during the COVID-19 time period, medical students reported lower levels of wellness overall and in all eight dimensions: Intellectual, emotional, physical, social, occupational, financial, environmental, and spiritual. Our findings shed light on the vulnerability of medical student wellness. Further research is needed to evaluate targeted strategies to improve and promote medical student wellness during times of crises.

Declarations

Ethics approval and consent to participate

The authors declare that this study did not require human ethics approval and did not include experiments on animal or human subjects. This study was submitted to the Institutional Review Board (IRB) for the Protection of Human Subjects at Loyola University Chicago Health Sciences Division. This project was determined to be exempt from IRB review. All methods were carried out in accordance with relevant guidelines and regulations. Respondents were informed that their participation in the survey was completely voluntary and there were no risks associated with their participation.

Consent for publication

Informed consent was obtained, and the authors attest that the respondents were aware of the study purpose, risks, and benefits.

Availability of data and materials

The Collector Investigators will make the dataset generated and analyzed during this study available to Recipient Investigators upon reasonable request and under a signed data use agreement.

Competing interests

The authors declare that they have no competing interests.

Funding

Not applicable.

Authors' contributions

LN and AW created the study concept and survey design. LN, AW, and PB analyzed and interpreted preliminary data regarding medical student wellness pre-COVID-19 versus during COVID-19. LN and AW drafted the manuscript. PB and WA critically revised the manuscript. WA performed statistical analysis of

the data. PB supervised the entirety of the study. All authors contributed to and approved the final manuscript.

Acknowledgements

Not applicable.

References

1. Goebert D, Thompson D, Takeshita J, et al. Depressive symptoms in medical students and residents: a multischool study. *Acad Med J Assoc Am Med Coll.* 2009;84(2):236-241. doi:10.1097/ACM.0b013e31819391bb.
2. Lloyd C, Gartrell NK. Psychiatric symptoms in medical students. *Compr Psychiatry.* 1984;25(6):552-565. doi:10.1016/0010-440x(84)90036-1.
3. Dyrbye LN, Thomas MR, Massie FS, et al. Burnout and suicidal ideation among U.S. medical students. *Ann Intern Med.* 2008;149(5):334-341. doi:10.7326/0003-4819-149-5-200809020-00008.
4. 8 Dimensions of Wellness. Live Well @ UMD. <https://umwellness.wordpress.com/8-dimensions-of-wellness/> (2015). Accessed 13 April 2020.
5. Meo SA, Abukhalaf AA, Alomar AA, Sattar K, Klonoff DC. COVID-19 Pandemic: Impact of Quarantine on Medical Students' Mental Wellbeing and Learning Behaviors. *Pak J Med Sci.* 2020;36(COVID19-S4):S43-S48. doi:10.12669/pjms.36.COVID19-S4.2809.
6. Saraswathi I, Saikarthik J, Senthil Kumar K, Madhan Srinivasan K, Ardhanaari M, Gunapriya R. Impact of COVID-19 outbreak on the mental health status of undergraduate medical students in a COVID-19 treating medical college: a prospective longitudinal study. *PeerJ.* 2020;8:e10164. doi:10.7717/peerj.10164.
7. COVID-19 Cases, Deaths, and Trends in the US | CDC COVID Data Tracker. Centers for Disease Control and Prevention. 28 March 2020. <https://covid.cdc.gov/covid-data-tracker>. Accessed 20 January 2021.
8. Perry SP, Hardeman R, Burke SE, Cunningham B, Burgess DJ, van Ryn M. The Impact of Everyday Discrimination and Racial Identity Centrality on African American Medical Student Well-Being: a Report from the Medical Student CHANGE Study. *J Racial Ethn Health Disparities.* 2016;3(3):519-26. doi:10.1007/s40615-015-0170-3.
9. Dyrbye LN, Thomas MR, Eacker A, Harper W, Massie FS Jr, Power DV, Huschka M, Novotny PJ, Sloan JA, Shanafelt TD. Race, ethnicity, and medical student well-being in the United States. *Arch Intern Med.* 2007;167(19):2103-9. doi:10.1001/archinte.167.19.2103.
10. Whelan A, Prescott J, Young G, Cantanese VM, McKinney R. Guidance on Medical Students' Participation in Direct Patient Contact Activities. Association of American Medical Colleges. 2020. <https://lcme.org/wp-content/uploads/filebase/March-17-2020-Guidance-on-Mediical-Students-Clinical-Participation.pdf>. Accessed 18 May 2020.

11. O'Doherty D, Dromey M, Loughheed J, Hannigan A, Last J, McGrath D. Barriers and solutions to online learning in medical education - an integrative review. *BMC Med Educ.* 2018;18(1):130. doi:10.1186/s12909-018-1240-0.
12. Muilenburg LY, Berge ZL. Student barriers to online learning: A factor analytic study. *Distance Educ.* 2005;26(1):29-48. doi:10.1080/01587910500081269.
13. Tuition and Student Fees Reports. In: *Medical Education. Association of American Medical Colleges.* 2020. <https://www.aamc.org/data-reports/reporting-tools/report/tuition-and-student-fees-reports>. Accessed 11 June 2020.
14. Rose S. Medical Student Education in the Time of COVID-19. *JAMA.* 2020;323(21):2131-2132. doi:10.1001/jama.2020.5227.
15. Krieger P, Goodnough A. Medical Students, Sidelined for Now, Find New Ways to Fight Coronavirus. *The New York Times.* 2020. <https://www.nytimes.com/2020/03/23/health/medical-students-coronavirus.html>. Accessed 10 June 2020.
16. Miller DG, Pierson L, Doernberg S. The Role of Medical Students During the COVID-19 Pandemic. *Ann Intern Med.* 2020. doi:10.7326/M20-1281.
17. Thoits PA. Role-Identity Salience, Purpose and Meaning in Life, and Well-Being among Volunteers. *Soc Psychol Q.* 2012;75(4):360-384. doi:10.1177/0190272512459662.
18. Vignoles VL, Regalia C, Manzi C, Golledge J, Scabini E. Beyond self-esteem: influence of multiple motives on identity construction. *J Pers Soc Psychol.* 2006;90(2):308-333. doi:10.1037/0022-3514.90.2.308.
19. Murphy B. Delays, miscommunications add even more stress to USMLE Step exams. *American Medical Association.* 2020. <https://www.ama-assn.org/residents-students/usmle/delays-miscommunications-add-even-more-stress-usmle-step-exams>. Accessed 10 June 2020.
20. Murphy B. COVID-19 and USMLE testing: 4 key questions for students, residents. *American Medical Association.* 2020. <https://www.ama-assn.org/residents-students/usmle/covid-19-and-usmle-testing-4-key-questions-students-residents>. Accessed 10 June 2020.
21. Strowd RE, Lambros A. Impacting student anxiety for the USMLE Step 1 through process-oriented preparation. *Med Educ Online.* 2010;15. doi:10.3402/meo.v15i0.4880.
22. Final Report and Recommendations for Medical Education Institutions of LCME-Accredited, U.S. Osteopathic, and Non-U.S. Medical School Applicants. *Association of American Medical Colleges.* 2020. https://www.aamc.org/system/files/2020-05/covid19_Final_Recommendations_Executive%20Summary_Final_05112020.pdf. Accessed 17 May 2020.
23. Slavin SJ, Schindler DL, Chibnall JT. Medical Student Mental Health 3.0: Improving Student Wellness Through Curricular Changes. *Acad Med.* 2014;89(4):573-577. doi:10.1097/ACM.000000000000166.
24. Chen P, Mao L, Nassis GP, Harmer P, Ainsworth BE, Li F. Coronavirus disease (COVID-19): The need to maintain regular physical activity while taking precautions. *J Sport Health Sci.* 2020;9(2):103-104. doi:10.1016/j.jshs.2020.02.001.

25. Hu FB, Li TY, Colditz GA, Willett WC, Manson JE. Television watching and other sedentary behaviors in relation to risk of obesity and type 2 diabetes mellitus in women. *JAMA*. 2003;289(14):1785-1791. doi:10.1001/jama.289.14.1785.
26. Liu M, Wu L, Yao S. Dose–response association of screen time-based sedentary behaviour in children and adolescents and depression: a meta-analysis of observational studies. *Br J Sports Med*. 2016;50(20):1252-1258. doi:10.1136/bjsports-2015-095084.
27. Teychenne M, Costigan SA, Parker K. The association between sedentary behaviour and risk of anxiety: a systematic review. *BMC Public Health*. 2015;15(1):513. doi:10.1186/s12889-015-1843-x.
28. Keren D, Lockyer J, Ellaway RH. Social studying and learning among medical students: a scoping review. *Perspect Med Educ*. 2017;6(5):311-318. doi:10.1007/s40037-017-0358-9.
29. Champaloux EP, Keeley MG. The impact of learning communities on interpersonal relationships among medical students. *Med Educ Online*. 2016;21. doi:10.3402/meo.v21.32958.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [SupplementaryFile1BMCMedicalEducation.pdf](#)
- [SupplementaryFile2BMCMedicalEducation.docx](#)