

Research Article

Pandemic-Related Concern Domains Associated With PTSD-Like Symptoms Among U.S. Medical Students: An Exploratory Secondary Analysis

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Article History	Abstract
Received: September 25, 2026 Accepted: October 15, 2026 Published: October 21, 2026	Background: Earlier reports from a six-school survey described the prevalence of anxiety and PTSD-like symptoms among U.S. medical students and their individual pandemic concerns but did not model related concern domains together. Methods: We conducted an exploratory secondary analysis of de-identified cross-sectional survey data collected from April 20 to May 25, 2020. Multivariable logistic regression estimated associations of institutional preparedness, ethical/equity, and transmission-to-others concerns with a positive pandemic-anchored PC-PTSD-5 screen (score ≥ 3), adjusting for clinical exposure, gender, burnout change, perceived social support, and GAD-7 score. Results: Among 662 students, 170 (25.7%) screened positive. Ethical/equity concern was associated with higher adjusted odds of a positive screen (adjusted odds ratio [aOR] 1.53, 95% CI 1.24–1.88; $p < .001$). The transmission-to-others estimate was smaller (aOR 1.13, 95% CI 1.02–1.26; $p = .025$), whereas the institutional-preparedness confidence interval included 1.00 (aOR 1.09, 95% CI 0.90–1.31; $p = .371$). The ethical/equity estimate was stable across sensitivity analyses; the transmission estimate's confidence interval included 1.00 at the stricter score ≥ 4 threshold. Conclusions: After simultaneous adjustment, ethical/equity concern had the largest and most consistent association with a positive screen. The transmission estimate was smaller and less precise, whereas the institutional-preparedness estimate was compatible with little or no association. The cross-sectional self-report design does not support causal or diagnostic conclusions. Keywords: Medical Students, COVID-19, PTSD-Like Symptoms, Ethical Concern, Health Equity, Secondary Analysis.

Introduction

The first U.S. COVID-19 surge disrupted clinical education while exposing medical students to uncertainty about personal protective equipment, testing capacity, viral transmission, equitable care, and their roles in strained health systems. In the six-school survey used for the present analysis, 84.1% of respondents reported at least somewhat increased stress or anxiety, and approximately one quarter screened positive for pandemic-related PTSD-like symptoms (Harries *et al.*, 2021; Lee *et al.*, 2021). The same reports showed that inadequate testing, asymptomatic spread, and racial or other disparities were among students' most highly rated concerns. Those reports established prevalence and described concerns, but their primary quantitative analyses did not estimate the unique associations of conceptually different concern domains in one adjusted model. Concerns about institutional readiness, ethically difficult or inequitable care, and transmitting infection to other people refer to different aspects of the pandemic. Cognitive models of posttraumatic stress emphasize persistent perceptions of current threat and negative appraisals of an event's consequences (Ehlers and Clark, 2000), and meta-analytic work suggests peritraumatic psychological processes can relate more strongly to posttraumatic symptoms than many pre-event characteristics (Ozer *et al.*, 2003). These frameworks do not establish causation here, but they support examining the concern domains separately.

Links between ethical concern and trauma-related symptoms require careful interpretation. Medical students can experience moral distress when clinical realities conflict with professional values or perceived obligations (Lomis *et al.*, 2009; Wiggleton *et al.*, 2010). Among frontline healthcare workers during COVID-19, moral distress dimensions were associated with PTSD symptoms and functional difficulties (Norman *et al.*, 2021), and a follow-up study linked moral distress with later moral injury-related guilt (Fischer *et al.*, 2022). The present survey, however, did not measure moral distress, potentially morally injurious events, or moral injury. Its two-item ethical/equity score should therefore be treated as a concern domain rather than a moral-injury construct.

We therefore modeled institutional preparedness, ethical/equity, and transmission-to-others concerns simultaneously to estimate each domain's adjusted association with a positive pandemic-anchored PC-PTSD-5 screen. Because the analysis was exploratory, interpretation focused on effect estimates, confidence intervals, missing-data rules, and sensitivity analyses.

Materials and Methods

Study Design and Data Source

This was an exploratory secondary analysis of a de-identified, publicly available cross-sectional survey. The original investigators emailed the survey to 2,511 medical students in clinical training years at six U.S. medical schools between April 20 and May 25, 2020; 741 students responded (29.5%).

Participating schools were selected to represent multiple U.S. regions and pandemic contexts. The original study was deemed exempt by the participating institutional review boards, and responses were anonymous (Lee *et al.*, 2021). The present analysis involved no new participant contact and used only the released de-identified data.

Outcome

The survey presented the five symptom items of the Primary Care PTSD Screen for DSM-5 (PC-PTSD-5) with the prompt, "Since the start of the COVID-19 pandemic, have you ..." Items assessed intrusion/nightmares, avoidance, hypervigilance/startle, numbness/detachment, and guilt/blame. Yes, responses were summed from 0 to 5. The primary binary outcome was a score of 3 or greater, consistent with the threshold used by the original investigators and initial PC-PTSD-5 validation work (Prins *et al.*, 2016).

A score of 4 or greater was tested in sensitivity analysis. Because the survey did not include the standard trauma-exposure gate or a diagnostic interview, we use "positive screen" and "PTSD-like symptoms," not "PTSD." Primary scoring required responses to all five items.

Concern Domains

All concern items used a 1 ("not at all") to 7 ("extremely") response scale. Institutional preparedness concern was the mean of concern that the hospital or clinic was not sufficiently prepared, that available PPE was inadequate, and that COVID-19 testing was inadequate. Ethical/equity concern was the mean of concern about ethical decisions required during the pandemic and racial or other disparities in testing, treatment, and outcomes. Transmission-to-others concern was a single item assessing worry that, as a healthcare worker, the respondent might secondarily expose family members or others. Higher values represented greater concern. These labels were chosen to match item content and avoid implying validated latent constructs.

Covariates

The adjusted model included clinical exposure (any direct patient contact since February 15, 2020, or participation on a team caring for a patient suspected of COVID-19), a binary indicator for Female versus Male gender responses, change in burnout (pandemic score minus pre-pandemic score), perceived social support, and total GAD-7 score. Perceived social support was the mean of three 1-to-7 items on connection with peers, support from faculty/staff/advisors, and confidence that the school was helping students adjust. GAD-7 items were summed from 0 to 21 and required all seven responses (Spitzer *et al.*, 2006). Because this adjustment set accounts for clinical exposure, concurrent anxiety symptoms, burnout change, and social resources but cannot rule out unmeasured confounding, the resulting coefficients should be read as associational rather than causal.

Missing Data and Analytic Sample

The primary analysis used complete PC-PTSD-5 and GAD-7 scores and complete cases for all model variables. Respondents whose gender answer was not exactly Female or Male were excluded from the binary-gender analysis; this included missing and gender-diverse or multiple-category responses. The exclusion reflects the

limitations of the available covariate specification and sample size, not a substantive conclusion about gender-diverse students. For the short concern and support composites, the primary analysis used the mean of available items because partial item missingness was rare; requiring every composite item was examined as a sensitivity analysis.

Statistical Analysis

We summarized the analytic sample with counts, percentages, means, standard deviations, medians, and ranges. Internal consistency was estimated with Cronbach's alpha for three-item composites and the Spearman–Brown coefficient for the two-item ethical/equity score. Multivariable logistic regression estimated adjusted odds ratios (aORs), 95% confidence intervals, and two-sided p-values for a positive screen. Sensitivity analyses used the score ≥ 4 outcome; reproduced the earlier manuscript's scoring and gender coding; evaluated other combinations of the earlier and primary rules; required complete composite items; omitted GAD-7; and added indicator variables for school after recoding names that could be identified from free text. Five symptom-specific logistic models used the same predictors. Benjamini–Hochberg false discovery rate (FDR) correction was applied across the 15 focal domain-by-symptom tests (Benjamini and Hochberg, 1995).

Diagnostics assessed variance inflation factors, convergence and fitted probabilities, centered quadratic terms for continuous predictors, and case influence. Discrimination and probability-error summaries were treated as in-sample diagnostics rather than external validation. Analyses used Python 3.12 with NumPy, pandas, SciPy, and scikit-learn. An independent unpenalized scikit-learn model was fitted to verify the custom maximum-likelihood coefficients.

Results

Sample and Descriptive Findings

Of 741 records, 732 had complete PC-PTSD-5 items. Sequential exclusions for the binary gender covariate and complete model variables yielded a primary sample of 662 students. In the raw data, 10 students gave an observed gender response other than exactly Female or Male, and 48 had no gender response; some of these records had already been excluded because PC-PTSD-5 responses were incomplete. In the final sample, 428 students (64.7%) were female and 486 (73.4%) met the clinical-exposure definition. The mean PC-PTSD-5 symptom score was 1.50 (SD 1.47), and 170 students (25.7%; Wilson 95% CI 22.5%–29.1%) screened positive at score ≥ 3 . Seventy-nine students (11.9%) met the score ≥ 4 threshold. Descriptive statistics are shown in Table 1.

Table 1. Characteristics of the primary analytic sample (N=662).

Measure	Value
Clinical exposure	486 (73.4%)
Female gender response	428 (64.7%)
Positive screen, PC-PTSD-5 ≥ 3	170 (25.7%)
Positive screen, PC-PTSD-5 ≥ 4	79 (11.9%)
PC-PTSD-5 symptom score	1.50 (1.47); median 1; range 0–5
GAD-7 total	6.61 (5.27); median 6; range 0–21
Institutional preparedness concern	4.52 (1.40); median 4.67; range 1–7
Ethical/equity concern	5.36 (1.47); median 5.50; range 1–7
Transmission-to-others concern	4.04 (2.06); median 4; range 1–7
Burnout change	0.80 (1.68); median 1; range –6 to 6
Perceived social support	4.61 (1.32); median 4.67; range 1–7
*Note: Values are n (%) or mean (SD), followed by median and range. PC-PTSD-5=Primary Care PTSD Screen for DSM-5; GAD-7=Generalized Anxiety Disorder-7.	

Primary Adjusted Associations

The eight-predictor model fit better than the intercept-only model, likelihood-ratio $\chi^2(8)=213.09$, $p<.001$ (McFadden pseudo- $R^2=.283$). Among the three focal domains, ethical/equity concern had the largest aOR: each one-point increase on the 1-to-7 scale corresponded to 53% higher adjusted odds of a positive screen (aOR 1.53, 95% CI 1.24–1.88; $p<.001$). The transmission-to-others estimate was smaller (aOR 1.13, 95% CI 1.02–1.26; $p=.025$), while the institutional-preparedness estimate had a confidence interval that included 1.00 (aOR 1.09, 95% CI 0.90–1.31; $p=.371$). GAD-7 score was associated with screening status (aOR 1.25 per point, 95% CI 1.19–1.31; $p<.001$). Confidence intervals for clinical exposure, female gender, burnout change, and perceived support also included 1.00 (Table 2).

Table 2. Multivariable logistic regression for a positive PC-PTSD-5 screen (score ≥ 3 ; N=662).

Predictor	aOR	95% CI	p
Clinical exposure	0.91	0.56–1.46	.692
Female (vs Male)	1.50	0.91–2.46	.113
Institutional preparedness concern	1.09	0.90–1.31	.371
Ethical/equity concern	1.53	1.24–1.88	<.001
Transmission-to-others concern	1.13	1.02–1.26	.025
Burnout change	1.03	0.90–1.18	.645
Perceived social support	1.00	0.85–1.19	.954
GAD-7 total	1.25	1.19–1.31	<.001

*Note: Odds ratios for continuous predictors are per one-unit increase. All predictors were entered simultaneously. aOR=adjusted odds ratio; CI=confidence interval.

Stability Across Specifications

Across sensitivity analyses, ethical/equity aORs ranged from 1.52 to 1.59, and every 95% confidence interval excluded 1.00. Transmission-to-others estimates ranged from 1.12 to 1.15. Its confidence interval excluded 1.00 in the earlier-manuscript replication, primary, complete-composite, GAD-7-omitted, and school-adjusted models, but included 1.00 when the outcome threshold was raised to ≥ 4 (aOR 1.14, 95% CI 0.99–1.32; $p=.059$). Every institutional-preparedness confidence interval included 1.00; its largest estimate occurred when GAD-7 was omitted (aOR 1.17, 95% CI 0.99–1.39; $p=.062$). These patterns were similar under the earlier N=686 scoring rules and the primary N=662 rules.

Symptom-Specific Exploratory Findings

After FDR correction, ethical/equity concern remained associated with intrusion/nightmares (aOR 1.30, 95% CI 1.10–1.54; $q=.013$), numbness/detachment (aOR 1.25, 95% CI 1.07–1.46; $q=.029$), and guilt/blame (aOR 1.93, 95% CI 1.52–2.45; $q<.001$). Transmission-to-others concern remained associated with intrusion/nightmares (aOR 1.13, 95% CI 1.03–1.24; $q=.030$). No institutional-preparedness association survived correction. These item-level findings are exploratory and should not be interpreted as distinct clinical syndromes (Table 3).

Table 3. Symptom-specific focal associations surviving Benjamini–Hochberg FDR correction (N=662).

Symptom	Concern domain	aOR	95% CI	q
Intrusion/nightmares	Ethical/equity concern	1.30	1.10–1.54	.013
Intrusion/nightmares	Transmission-to-others concern	1.13	1.03–1.24	.030
Numbness/detachment	Ethical/equity concern	1.25	1.07–1.46	.029
Guilt/blame	Ethical/equity concern	1.93	1.52–2.45	<.001

*Note: Each symptom model included all three concern domains and the same covariates as the primary model. q =Benjamini–Hochberg-adjusted p -value across 15 focal tests.

Diagnostics

Diagnostic checks did not identify material concerns regarding multicollinearity, separation, or influential observations. A joint test of six centered quadratic terms gave $p=.044$, but no individual quadratic term was significant, the AIC improvement was less than 1, and BIC increased by approximately 26; the simpler linear model was retained.

Discussion

When the three concern domains were entered in the same adjusted model, ethical/equity concern had the largest aOR and changed little across sensitivity analyses. The transmission-to-others estimate was smaller and became less precise at the score ≥ 4 threshold. The confidence interval for institutional preparedness concern included 1.00 in the primary and sensitivity models. This analysis extends the earlier descriptive reports by estimating the three domain-specific associations simultaneously. The institutional-preparedness result should not be read as evidence that inadequate PPE, testing, or institutional readiness were unimportant. Those issues were prominent in the original survey and could affect education, trust, and well-being (Harries *et al.*, 2021; Lee *et al.*, 2021). The confidence interval for this domain included both no association and a modest positive association after adjustment for the other concerns, generalized anxiety, and additional covariates. Institutional conditions may operate through perceptions of threat, burnout, or anxiety, or their effects may differ across schools and time. The cross-sectional model cannot distinguish those possibilities.

The ethical/equity estimate changed little across specifications. One item concerned ethically difficult pandemic decisions; the other concerned racial or other disparities in testing, treatment, and outcomes. Together, they may capture consequences of the pandemic that were professionally or personally salient to students. Ehlers and Clark's (2000) model offers one possible interpretation: appraisals that an event's consequences remain threatening may help maintain posttraumatic symptoms. Ozer *et al.*, (2003) likewise emphasize psychological responses around stressful events. Neither framework establishes direction in these data. Students with more symptoms may have rated ethical and inequity concerns more intensely, shared distress may have influenced both, or an unmeasured exposure may explain the association.

The survey does not support labeling the ethical/equity score as moral distress or moral injury. Moral distress has been documented in medical training and among frontline workers, and later guilt may follow morally distressing experiences (Lomis *et al.*, 2009; Wiggleton *et al.*, 2010; Norman *et al.*, 2021; Fischer *et al.*, 2022). However, moral injury entails more specific events, appraisals, and sequelae than concern about ethical decisions or disparities (Litz *et al.*, 2009). The present association, especially its link with the guilt/blame item, is best treated as a hypothesis-generating signal for studies that directly measure ethically salient exposures, constraint, betrayal, guilt, shame, and moral injury-related outcomes.

The decision to adjust for GAD-7 is important because generalized anxiety and trauma-related symptoms both reflect current distress. Including GAD-7 estimates associations beyond concurrent generalized anxiety; omitting it allows shared distress pathways to remain in the estimates. The ethical/equity estimate was similar in both models. Transmission-to-others concern was slightly stronger without GAD-7, and the institutional-preparedness confidence interval still included 1.00. Thus, the ethical/equity result did not depend on this single modeling choice, although no adjustment set can remove all potential confounding.

Item-level results were consistent with, but do not prove, domain-specific processes. Ethical/equity concern was most strongly associated with guilt/blame and was also related to intrusion/nightmares and numbness/detachment after FDR correction. Transmission-to-others concern was related to intrusion/nightmares. Because these analyses reused the same cross-sectional items, involved multiple testing, and lacked clinical assessment, they should guide measurement in prospective work rather than support mechanistic claims.

These data do not identify an effective intervention. They do, however, point to topics that future support programs could test: explanations of triage and allocation policies, discussion of ethical uncertainty and inequitable outcomes, infection-control guidance, and practical support for students worried about exposing household members. Such programs could be evaluated alongside confidential mental-health screening and referral pathways.

Several limitations constrain inference. First, the study was cross-sectional, so temporality, mediation, and causality cannot be established. Second, data were collected during a distinctive early-pandemic period in 2020 and may not generalize to later pandemic phases or other emergencies. Third, the 29.5% response rate, purposive selection of six schools, and complete-case analysis allow selection bias and limit national representativeness. Fourth, the outcome was a pandemic-anchored adaptation of PC-PTSD-5 items without the standard trauma-exposure gate, Criterion A assessment, or diagnostic interview; a positive score indicates PTSD-like symptoms, not a PTSD diagnosis. Fifth, all measures were self-reported at one time, creating shared-method and recall concerns. Sixth, focal predictors were brief, study-specific scores: ethical/equity concern combined two distinguishable topics, transmission concern was a single item, and construct validity beyond internal consistency was not established. Seventh, unmeasured factors—including prior trauma, prior mental-health diagnoses, local disease burden, and detailed clinical exposure—could confound associations. Eighth, the binary gender covariate required excluding gender-diverse, multiple-category, and missing responses; the data were insufficient for responsible subgroup estimation. Finally, school adjustment reduced the sample because some school entries could not be resolved, symptom analyses remained exploratory despite FDR control, and in-sample diagnostics do not demonstrate external validity.

Conclusion

After adjustment for the other concern domains and covariates, ethical/equity concern had the largest and most stable association with a positive PC-PTSD-5 screen. The transmission-to-others estimate was smaller and less precise at the stricter cutoff, and the institutional-preparedness confidence intervals included 1.00. Because the data were cross-sectional and the focal measures were brief, prospective studies using validated measures and diagnostic assessment are needed to clarify direction and mechanism.

Declarations

Acknowledgments: The author thanks the original investigators for making the de-identified survey dataset publicly available.

Artificial Intelligence (AI) Use Statement: The author confirms that no artificial intelligence (AI) tools were employed in developing, analyzing, interpreting, or writing this manuscript.

Author Contribution: William Ryu was solely responsible for all aspects of the study, including conceptualization, study design, data analysis, interpretation of findings, and preparation of the manuscript.

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Data Availability Statement: The de-identified dataset analyzed in this study is publicly available through Kaggle at <https://www.kaggle.com/carmenmarielee/medstudent-mental-health-2020/> and was originally described by Lee *et al.*, (2021).

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Research Content: The research content of the manuscript is original and has not been published elsewhere.

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