A national longitudinal cohort study of factors contributing to UK medical students' mental ill-health symptoms

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ABSTRACT

Background The mental health of current medical students is predictive of their mental health as future doctors. The prevalence of anxiety, depression and burnout is high among medical students, but less is known about the occurrence of other mental ill-health symptoms, such as eating or personality disorders, and factors contributing to mental ill-health.

Aims (1) To explore the prevalence of various mental ill-health symptoms in medical students and (2) to investigate what medical school factors and students' attitudes contribute to these mental ill-health symptoms.

Methods Between November 2020 and May 2021, medical students from nine geographically spread medical schools in the UK participated by completing online questionnaires at two points in time, approximately 3 months apart.

Results Of the 792 participants who filled in the questionnaire at baseline, over half experienced medium to high somatic symptoms (50.8%; 402) and drank alcohol at hazardous levels (62.4%; 494). Adjusted longitudinal data analysis of 407 students who completed the follow-up questionnaire demonstrated that less supportive educational climates that were more competitive and less centralised around the students, lower feelings of belongingness, greater stigma towards mental ill-health and lower intentions to seek help for mental ill-health, all contributed to students' mental ill-health symptoms.

Conclusions Medical students experience a high prevalence of various mental ill-health symptoms. This study suggests that medical school factors and students' attitudes towards mental ill-health are significantly associated with students' mental health.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Many medical students experience higher rates of stress-induced symptoms such as burnout and depression compared with non-medical students, which might indicate that medical schools' approach to preparing future doctors has a negative impact on students.

WHAT THIS STUDY ADDS

⇒ This study explored various mental ill-health symptoms among medical students and found a high prevalence of symptoms such as anorexic tendencies, somatic and obsessive-compulsive symptoms and hazardous drinking.

⇒ The study also revealed that medical school factors (educational climate and sense of belonging) and students' attitudes (stigma towards mental ill-health and help-seeking intentions) were associated with their mental ill-health symptoms.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ A preventative approach that safeguards learning environments and addresses negative attitudes towards mental ill-health is crucial during medical school training.

INTRODUCTION

The mental health of medical students, our future doctors, is of primary importance as the mental ill-health of doctors has wide-ranging workforce consequences, including presenteeism (working while sick), absenteeism and workforce retention issues.[1] Furthermore, doctors' poor mental health links to reduced quality of patient care and an increased frequency of medical errors.[2–4] Research suggests that students' perceived stress and mental ill-health during medical school are related to their mental health later in their careers as trainees and fully qualified physicians.[5 6] Thus, early intervention supporting the mental health of medical students is essential to prevent and improve doctors' mental ill-health as it could potentially avert more complex issues later in their careers.

Furthermore, medical students are a unique group, as illustrated by a recent meta-analysis of depression and anxiety among college students, which included 64 studies and over 100 000 students. Results showed that medical students had significantly higher rates of both depression (39.4% vs 33.6%) and anxiety (47.1% vs 39%) compared with non-medical students.[7] Understanding why medical students are more prone to mental ill-health symptoms is essential to institute appropriate health policies and interventions.

There is some indication that attitudes formed during medical school link to students' well-being. Studies have revealed that despite suffering, medical students are reluctant to admit any difficulties to others openly; stigma towards mental illness and fear of repercussions due to a mental health-related diagnosis act as powerful deterrents towards help-seeking.[8–12] Furthermore, medical school factors such as workload, lack of support and competitiveness link to burnout, reduction in empathy and career regrets.[13–16] Although there are indications that various factors may play an important role in students' mental ill-health individually, it is unclear what role these factors play when occurring together and if this role is similar for different types of mental health issues.

Researchers have also called for holistic multisite prospective longitudinal studies to identify factors associated with poor mental health among students.[17 18] Building on existing research, this study is longitudinal and includes multiple UK medical schools. Moreover, previous research into the mental ill-health of medical students has concentrated on depression, anxiety and burnout,[19–21] with less being known about other mental health conditions; investigating symptom prevalence will highlight which mental health issues might need to be prioritised through mental health interventions.

OBJECTIVES

The two objectives of this study are as follows: (1) to explore the prevalence of various mental ill-health symptoms in medical students and (2) to investigate what medical school factors and students' attitudes contribute to these mental ill-health symptoms.

METHODS
Study design

This is a longitudinal cohort study including a baseline (T0) and 3-month follow-up (T1); the study is presented following Strengthening the Reporting of Observational Studies in Epidemiology guidelines.

Study settings

A volunteer sample of medical students from nine geographically spread medical schools in the UK completed a web-based survey between November 2020 and February 2021. Medical schools originated from the following regions in England: London, North East and Cumbria, North West, South West, West Midlands and countries included in the UK (ie, Scotland, Northern Ireland, Wales). At the start of the survey, participants provided their email addresses when completing their consent forms on a secure platform—*RedCap in the UCL Data Safe Haven*. We used these email addresses to send follow-up invitations to participants. After completing the informed consent form, participants were redirected to another online platform, *Online Surveys*, to complete the survey to reassure students that their responses were
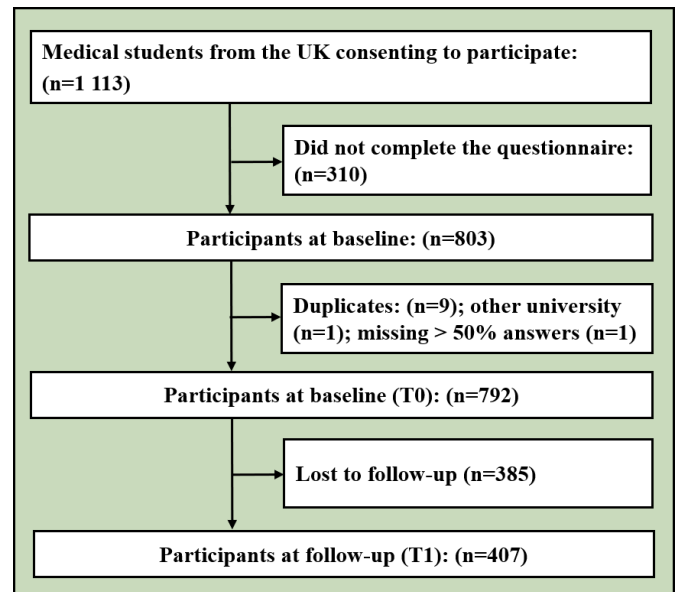

Figure 1 Study enrolment flowchart. T0, baseline; T1, 3-month follow-up.

completely anonymous and encourage open and honest answers. This step meant we could not match participants' names or email addresses to their survey responses. Participants were asked to create a personalised code at the start of the survey, which allowed us to match their responses from T0 to T1. Those who took part at T0 were invited to complete the questionnaire again 3 months later (T1; February–May 2021).

Participants

Staff at the nine medical schools distributed the study recruitment material to their medical students in various ways, including email, social media and lecture announcements. Of the 1 113 medical students who consented to participate in the study, 310 did not complete the baseline questionnaire. Of the 803 participants who completed the baseline questionnaire, 11 responses were excluded: 9 were identified as duplicates, 1 had missed >50% of the answers and 1 participant originated from another university that was not included in the study. A total of 792 (71.16%) responses at T0 were included in the baseline analysis. Of the 792 T0 participants, 385 students were lost to follow-up. Four hundred and seven (51.39% of a total of 792) were included in the follow-up analysis, T1. The number of participants at each stage is presented in figure 1.

Variables and measures

At both points in time, we used an identical questionnaire to measure a variety of mental ill-health symptoms (rather than clinical diagnoses) as outcomes and various influencing factors. The latter included eight measures: two educational climate measures, belongingness, help-seeking intentions, two stigma measures and two measures related to the impact of the pandemic. Two educational climate measures assessed the centrality of the learner,

reflecting a supportive, respectful learning environment and a level of competitiveness. Two stigma scales differentiated perceived stigma and observed stigma, that is, witnessing stigmatising behaviour carried out by fellow students and/or supervisors at medical schools (including teaching staff, junior doctors and consultants). As the study was conducted during the coronavirus disease 2019 (COVID-19) pandemic, to account for its impact, we measured: (1) the extent to which students felt prepared in their learning and in their readiness to practice as a doctor due to the pandemic and (2) the support provided by the medical school during the pandemic. Participants also provided their sociodemographic characteristics and a list of experienced stressful events. Table 1 describes all measures.

Quantitative variables and statistical methods

SPSS V.26.0 was used for the analysis. Participants were allowed to miss up to one-third of the data for each scale, and mean scores were computed over the remaining items. All scales were approximately normally distributed (skewness and kurtosis between −2 and 2; no extreme outliers). Internal consistencies (Cronbach's α) were deemed sufficient (>0.7; table 1), except for the pandemic scale about support (0.662). As no further improvements were possible and the scales were relevant to the study context, these scales were kept in their original form. Correlation matrixes (Pearson's correlation coefficients) are presented in online supplemental appendix 1.

The prevalence of mental health issues was calculated based on the diagnostic cut-off (table 1) for the entire baseline sample (T0). We chose this sample as we were not investigating the changes in mental health issues over time but instead aimed to understand the prevalence of mental ill-health symptoms among medical students at one given time. The T0 dataset offered a larger dataset for this aim.

Longitudinal data were used to investigate the factors associated with mental health issues. For continuous outcomes, unadjusted and adjusted growth curves were performed (an unstructured covariance matrix was compared with a compound symmetry matrix; residual maximum likelihood estimation). For dichotomous outcomes, unadjusted and adjusted Generalised Estimating Equations (GEE) (unstructured covariance matrix) were compared with the performance of an independent matrix (Fisher's scoring). Based on differences in the outcome and associated factors among demographic characteristics (online supplemental appendix 2), we adjusted for stressful events, gender, ethnicity, sexual orientation, widening participation (widening participation students are students from disadvantaged backgrounds who receive premiums and/or supportive measures when accessing education. The aim of widening participation schemes is to increase diversity and representation within education), and the school year. Missing data were not imputed but handled by the analysis procedure, except for GEE, for which missing values were

listwise deleted. P values <0.05, <0.01 and <0.001 for two-sided tests, and a Bonferroni correction (17 tests, p value with Bonferroni correction equals 0.003) are reported.

RESULTS

Participants

The majority of the 792 medical students at baseline were female (585, 73.9%), of white ethnicity (501, 63.3%) with at least one parent/guardian/carer whose occupation was higher managerial (599, 75.6%) and were first-year students (230, 29.0%) (table 2).

Prevalence of mental health issues

Two hundred and thirteen (26.9%) participants who completed the baseline survey reported having an official diagnosis of mental illness.

The prevalence of measured symptoms of mental ill-health is presented in table 3. The most prevalent mental ill-health symptoms were somatisation and hazardous drinking: over half of the students experienced medium or (very) high somatic symptoms (402, 50.8%) and were drinking hazardously (494, 62.4%). Other prevalent mental ill-health symptoms included obsessive-compulsive disorder (OCD) (384, 48.5%), schizoid personality disorder symptoms (370, 46.7%) and anorexic tendencies (353, 44.6%). Approximately one in three students were burnt-out, had moderate/severe symptoms of anxiety/depression (305, 38.5%) and had histrionic personality disorder symptoms (270, 34.1%). Nearly one in five students experienced clinical insomnia (152, 19.2%) and paranoia symptoms (148, 18.7%). Lower prevalence was reported for bulimia tendencies, drug use, bipolar and antisocial personality disorder symptoms (<7%).

Predicting mental health issues

Results from the adjusted models are presented in tables 4 and 5 (complete information can be found in online supplemental appendix 3).

Burnout

More supportive medical schools' educational climates, focusing on the centrality of the learner and with lower levels of competitiveness, significantly linked with less emotional exhaustion (centrality: $B_{adjusted}=-0.51$, 95% CI: 0.80 to −0.23, p<0.001; competition: $B_{adjusted}=-0.42$, 95% CI: −0.66 to −0.18, p<0.001), cynicism (centrality: $B_{adjusted}=-0.72$, 95% CI: −1.03 to −0.41, p<0.001; competition: $B_{adjusted}=-0.33$, 95% CI: −0.60 to −0.07, p=0.012) and higher personal accomplishment (centrality: $B_{adjusted}=0.62$, 95% CI: 0.40 to 0.84, p<0.001; competition: $B_{adjusted}=0.21$, 95% CI: 0.02 to 0.40, p=0.031). Students who felt that they belonged experienced lower levels of exhaustion ($B_{adjusted}=-0.19$, 95% CI: −0.30 to −0.08, p<0.001) and had higher levels of personal accomplishment ($B_{adjusted}=0.22$, 95% CI: 0.13 to 0.30, p<0.001).

Students who perceived mental health issues as more stigmatised ($B_{adjusted}=0.28$, 95% CI: 0.08 to 0.48, p=0.006)

Table 1 Overview of variables and measures used in the study of factors contributing to UK medical students' mental ill-health symptoms

Variables	Measure/Study	Subscales	No. of items/ Scoring	Example item	Cronbach's α	Diagnostic or recoding of the scale
Burnout	Maslach Burnout Inventory—General Survey for Students[48]	Emotional exhaustion	5 items, 0 (never) to 6 (every day)	I feel emotionally drained by my studies.	0.894	The scores for each subscale were categorised into tertiles, and the lower, middle and higher tertiles were labelled as 'low', 'average' or 'high', respectively.
		Cynicism	5 items, 0 (never) to 6 (every day)	I have become less interested in my studies since my enrolment.	0.839	
		Professional accomplishment	6 items, 0 (never) to 6 (every day)	I have accomplished many worthwhile things in my studies.	0.811	
Insomnia	The Insomnia Severity Index[49]	n/a	7 items, 0 (scores showing no insomnia) to 4 (showing severe insomnia)	How satisfied/dissatisfied are you with your current sleep pattern?	0.866	No signs of insomnia: 0–7 Subthreshold insomnia: 8–14 Clinical insomnia (moderate severity): 15–21 Clinical insomnia (severe insomnia): ≥22
Somatisation	The Somatic Symptom Scale-8[50]	n/a	8 items, 0 (not at all) to 4 (very much)	During the past 7 days, how much have you been bothered by stomach or bowel problems?	0.770	No to minimal symptoms: 0–3 Low: 4–7 Medium: 8–11 High: 12–15 Very high: 16–32
Hazardous drinking	The Alcohol Use Disorders Identification Test–C[51]	n/a	3 items, 0 (never; 1 or 2) to 4 (daily or mostly daily; 10 or more)	How often do you have a drink containing alcohol?	0.780	Answering three to four or more drinks consumed containing alcohol on a typical day of drinking or consuming six or more drinks on one occasion were classified as drinking hazardously.
Drug use	Authors developed	n/a	1 item, 0 (no) and 1 (yes) and prefer not to tell	Have you taken any substances (drugs, not including alcohol) for recreational use in the last month?	n/a	n/a
Anxiety/ Depression	The Patient Health Questionnaire-4[52]	n/a	4 items, 0 (not at all) to 3 (nearly every day)	Over the last 2 weeks, how often have you been bothered by little interest or pleasure in doing things?	0.852	No symptoms: 0–2 Mild symptoms: 3–5 Moderate symptoms: 6–8 Severe symptoms: 9–12

Continued

Table 1 Continued

Variables	Measure/Study	Subscales	No. of items/ Scoring	Example item	Cronbach's α	Diagnostic or recoding of the scale
Eating disorders	The Eating Disorder Diagnostic Scale[53]	Anorexia tendencies	18 items, a variety of question types: 4 questions: 0 (not at all) and 6 (extremely) 8 questions: 0 (no) and 1 (yes) 1 question: 1 (1 day) to 7 (7 days) 5 questions: 0 (0 times) to 14 (14 times)	Have you had a definite fear that you might gain weight or become fat?	n/a	Cut-off scores were calculated based on the procedure described by Stice et al,[53] except for using BMI and distinguishing from other eating disorders as measuring tendencies. Data on participants' BMI were not collected as it was considered as sensitive and was left out of the calculations of scales.
		Bulimic tendencies		How many times per week on average over the past 3 months have you eaten an unusually large amount of food and experienced a loss of control?	n/a	
		Binge-eating tendencies		During these episodes of overeating and loss of control, did you eat much more rapidly than normal?	n/a	
Obsessive-compulsive disorder	Obsessive-Compulsive Inventory-Revised[54]	n/a	3 items, 0 (not at all) to 4 (extremely)	I find it difficult to control my own thoughts.	0.916	The scores were summed and if scores were ≥4, participants were classified as having obsessive-compulsive symptoms.
Personality disorder	The International Personality Disorder Examination[55]	Schizoid	9 items, 0 (false) and 1 (true)	I almost never get angry about anything.	n/a	For each subscale, if scores were ≥3 participants were classified as having a personality disorder symptom.
		Histrionic	6 items, 0 (false) and 1 (true)	I show my feelings for everyone to see.	n/a	
		Antisocial (dissocial)	7 items, 0 (false) and 1 (true)	I will lie or con someone if it serves my purpose.	n/a	
Paranoia	The Persecution and Deservedness Scale[56]	n/a	10 items, 0 (not at all) to 4 (certainly true)	There are times when I worry that others might be plotting against me.	0.883	The scores were averaged using the mean, and the formula mean+1 SD was used to classify participants with paranoia symptoms (above the cut-off) and no paranoia symptoms (below the cut-off).
Bipolar	Hypomanic Personality Scale[57]	n/a	6 items, 0 (false) and 1 (true)	There have often been times when I had such an excess of energy that I felt little need to sleep at night.	0.713	The scores were summed, and those participants scoring 6 points were classified as having bipolar symptoms.

Continued

Table 1 Continued

Variables	Measure/Study	Subscales	No. of items/ Scoring	Example item	Cronbach's α	Diagnostic or recoding of the scale
Educational climate	The Educational Climate Inventory[58]	Centrality of learning and mutual respect	10 items, 0 (strongly disagree) to 3 (strongly agree)	I often get valuable and supportive advice from medical school teaching staff on how to improve.	0.890	n/a
		Competitiveness	6 items, 0 (strongly disagree) to 3 (strongly agree)	The atmosphere here is highly competitive.	0.765	Values are reversed, with higher scores representing a less competitive environment.
Belongingness: perceived peer support	Belongingness Full Scale[59]	n/a	6 items, 0 (completely true) to 4 (completely untrue)	I have developed personal relationships with other students in class/ placements.	0.898	n/a
Help-seeking behaviour	General Help-Seeking Questionnaire[60]	n/a	16 items, 0 (extremely unlikely) to 6 (extremely likely)	If you were having mental health or emotional problems, how likely is it that you would seek help from your intimate partner?	0.868	n/a
Perceived stigma	Perceived Stigmatisation[61]	n/a	10 items, 1 (strongly disagree) to 4 (strongly agree)	It is a sign of personal weakness or inadequacy to receive treatment for emotional or mental health problems.	0.814	n/a
Observed stigma	Observed Stigmatising Experiences[61]	n/a	6 items, 0 (never) to 3 (4 or more times)	How many times have you observed your supervisors (eg, junior doctors, consultants/GPs, and medical school teaching staff) at your institution reveal students' emotional problems to others?	n/a	A sum of one or more represents that stigmatising behaviour was observed.
The impact of the pandemic	Authors developed	Unpreparedness	2 items, 0 (strongly disagree) to 4 (strongly agree)	I feel I am behind on my learning due to the pandemic.	0.738	n/a
		Unsupported	2 items, 0 (strongly disagree) to 4 (strongly agree)	My medical school/ university provided an appropriate support to me to deal with the COVID-19-related challenges.	0.662	Values are reversed, with higher scores representing a less competitive environment.

Continued

Table 1 Continued

Variables	Measure/Study	Subscales	No. of items/ Scoring	Example item	Cronbach's α	Diagnostic or recoding of the scale
Stressful life events	Stressful Life Events Questionnaire[62]	n/a	12 items, yes and no	Have you personally experienced assault within the prior year?	n/a	If a student did not experience any stressful events, it was coded as 0; if they experienced one or more stressful events, it was coded as 1.
Demographic characteristics	Self-developed items by the authors of this paper	n/a	9 items, a variety of question types (described in table 2)	Which of the following best describes your gender identity?	n/a	n/a

Cronbach's α calculated for all baseline participants.
BMI, body mass index; COVID-19, coronavirus disease 2019; GP, general practitioner; n/a, not available.

Table 2 Demographic characteristics of baseline and follow-up participants

Variables	792 baseline participants (T0) N (%)	407 follow-up participants (T1) N (%)
Gender (female)	585 (73.9%)	305 (74.9%)
Missing	9 (1.1%)	3 (0.7%)
Age, Mean (SD)*	21.48 (3.23)*	21.49 (3.24)*
Missing	1 (0.1%)	n/a
Ethnicity (white)	501 (63.3%)	263 (64.6%)
Missing	15 (1.9%)	5 (1.2%)
Sexuality (heterosexual)	617 (77.9%)	311 (76.4%)
Missing	33 (4.2%)	13 (3.2%)
Relationship status (single/never married)	717 (90.5%)	362 (88.9%)
Widening participation student (yes)	124 (15.7%)	62 (15.2%)
Missing	4 (0.5%)	n/a
Parents/Guardians/Carers occupation† (higher managerial)	599 (75.6%)	324 (79.6%)
Missing	3 (0.4%)	n/a
University year		
First	230 (29.0%)	121 (29.7%)
Second	130 (16.4%)	74 (18.2%)
Third	112 (14.1%)	58 (14.3%)
Fourth	149 (18.8%)	75 (18.4%)
Fifth	119 (15.0%)	56 (13.8%)
Sixth	50 (6.3%)	22 (5.4%)
Missing	2 (0.3%)	1 (0.2%)
University (UNI)		
UNI1	68 (8.6%)	38 (9.3%)
UNI2	3 (0.4%)	3 (0.7%)
UNI3	252 (31.8%)	127 (31.2%)
UNI4	181 (22.9%)	92 (22.6%)
UNI5	46 (5.8%)	30 (7.4%)
UNI6	27 (3.4%)	16 (3.9%)
UNI7	90 (11.4%)	39 (9.6%)
UNI8	54 (6.8%)	28 (6.9%)
UNI9	68 (8.6%)	34 (8.4%)
Missing	3 (0.4%)	n/a

*Age is listed as Mean (SD).
†Based on the highest occupation of both parents/guardians/carers.
n/a, not available.

Table 3 Prevalence of mental health issues in medical students in the UK

Category of mental health issue	Mental health issues		N (%)
Burnout	High emotional exhaustion		222 (28.0%)
	High cynicism		253 (31.9%)
	Low personal accomplishment		262 (33.1%)
Anxiety/Depression-induced symptoms	Anxiety/Depression symptoms	Severe	129 (16.3%)
		Moderate	176 (22.2%)
		Mild	228 (28.8%)
		No symptoms	254 (32.1%)
	Anorexic tendencies		353 (44.6%)
	Bulimic tendencies		22 (2.8%)
	Binge-eating tendencies		67 (8.5%)
	Obsessive-compulsive disorder symptoms		384 (48.5%)
Physical symptoms	Insomnia symptoms	Severe (clinical)	19 (2.4%)
		Moderately severe (clinical)	133 (16.8%)
		Subthreshold	287 (36.2%)
		No symptoms	342 (43.2%)
	Somatisation symptoms	Very high	118 (14.9%)
		High	102 (12.9%)
		Medium	182 (23.0%)
		Low	237 (29.9%)
		No symptoms	142 (17.9%)
Substance use	Hazardous drinking		494 (62.4%)
	Drug use	Yes	48 (6.1%)
		No	703 (88.8%)
		Prefer not to tell	38 (4.8%)
Personality disorders	Schizoid personality disorder symptoms		370 (46.7%)
	Histrionic personality disorder symptoms		270 (34.1%)
	Antisocial personality disorder symptoms		15 (1.9%)
	Paranoia symptoms		148 (18.7%)
Mood disorder	Bipolar symptoms		33 (4.2%)
Any of the mental health issues*			768 (97.0%)

*When measuring if students had any of the symptoms for anxiety/depression and insomnia, we included those who had severe and moderate symptoms; for somatisation symptoms, we included those selecting medium to very high.

and who were less inclined to seek help were more cynical ($B_{adjusted}$=−0.18, 95% CI: −0.31 to −0.04, p=0.01). Feeling unprepared (with learning and for becoming a doctor) due to the pandemic was linked to higher levels of burnout (emotional exhaustion: $B_{adjusted}$=0.19, 95% CI: 0.07 to 0.30, p=0.001; cynicism: $B_{adjusted}$=0.15, 95% CI: 0.03 to 0.27, p=0.014; low personal accomplishment: $B_{adjusted}$=−0.11, 95% CI: −0.20 to −0.03, p=0.012).

Anxiety/Depression-induced symptoms
Students who felt they belonged experienced lower levels of anxiety/depression symptoms ($B_{adjusted}$=−0.08, 95% CI: −0.14 to −0.01, p=0.031) and higher levels of

bulimic tendencies ($B_{adjusted}$=0.58, 95% CI: 0.05 to 1.11, p=0.033). Perceived stigma about mental ill-health linked with increased levels of anxiety/depression symptoms ($B_{adjusted}$=0.20, 95% CI: 0.09 to 0.31, p=0.001), anorexic tendencies ($B_{adjusted}$=0.71, 95% CI: 0.37 to 1.04, p<0.001), bulimic tendencies ($B_{adjusted}$=1.41, 95% CI: 0.43 to 2.38, p=0.005), binge-eating tendencies ($B_{adjusted}$=0.74, 95% CI: 0.13 to 1.36, p=0.018) and OCD symptoms ($B_{adjusted}$=0.39, 95% CI: 0.22 to 0.55, p<0.001). Students who felt unprepared due to the pandemic also experienced higher levels of anxiety/depression symptoms ($B_{adjusted}$=0.11, 95% CI: 0.04 to 0.18, p=0.003). Observed stigmatising behaviour

Table 4 Estimates with 95% CI of adjusted models testing what factors associated with the mental ill-health symptoms—burnout and anxiety/depression-induced issues

	Burnout			Anxiety/Depression-induced issues				
	Exhaustion	Cynicism	Personal accomplishment	Anxiety/Depression	Anorexia	Bulimia	Binge eating	OCD
Time (reference T2)	−0.19 (−0.30 to −0.08)***sg	−0.34 (−0.47 to −0.21)***sg	0.11 (0.02 to 0.20)*	0.02 (−0.06 to 0.09)	0.10 (−0.11 to 0.30)	−0.67 (−1.34 to 0.10)	0.02 (−0.35 to 0.38)	0.11 (0.02 to 0.20)*
Educational climate: centrality	−0.51 (−0.80 to −0.23)***sg	−0.72 (−1.03 to −0.41)***sg	0.62 (0.40 to 0.84)***sg	−0.13 (−0.31 to 0.05)	0.21 (−0.30 to 0.73)	−0.51 (−1.65 to 0.62)	−0.55 (−1.32 to 0.21)	−0.11 (−0.27 to 0.17)
Educational climate: competitive	−0.42 (−0.66 to −0.18)***sg	−0.33 (−0.60 to −0.07)*	0.21 (0.02 to 0.40)*	−0.12 (−0.28 to 0.03)	−0.41 (−0.87 to 0.05)	0.48 (−0.48 to 1.44)	−0.13 (−0.85 to 0.59)	−0.02 (−0.12 to 0.08)
Belongingness	−0.19 (−0.30 to −0.08)***sg	−0.10 (−0.22 to 0.02)	0.22 (0.13 to 0.30)***sg	−0.08 (−0.14 to −0.01)*	−0.37 (−0.83 to 0.09)	0.58 (0.05 to 1.11)*	−0.10 (−0.21 to 0.41)	0.05 (−0.16 to 0.27)
Observed stigma (reference no)	−0.08 (−0.32 to 0.15)	−0.16 (−0.42 to 0.10)	0.03 (−0.16 to 0.21)	0.05 (−0.10 to 0.20)	0.07 (−0.13 to 0.27)	−1.03 (−2.17 to 0.11)	−0.77 (−1.51 to −0.04)*	−0.02 (−0.16 to 0.27)
Perceived stigma	0.17 (−0.01 to 0.35)	0.28 (0.08 to 0.48)**	−0.13 (−0.27 to 0.01)	0.20 (0.09 to 0.31)***sg	0.71 (0.37 to 1.04)***sg	1.41 (0.43 to 2.38)**	0.74 (0.13 to 1.36)*	0.39 (0.22 to 0.55)***sg
Help-seeking behaviour	−0.05 (−0.17 to 0.08)	−0.18 (−0.31 to −0.04)**	0.08 (−0.02 to 0.17)	−0.07 (−0.15 to 0.01)	0.04 (−0.18 to 0.27)	0.32 (−0.35 to 0.98)	0.22 (−0.16 to 0.60)	−0.07 (−0.18 to 0.04)
COVID-19: underprepared	0.19 (0.07 to 0.30)***sg	0.15 (0.03 to 0.27)*	−0.11 (−0.20 to −0.03)*	0.11 (0.04 to 0.18)**sg	0.14 (−0.07 to 0.35)	−0.09 (−0.70 to 0.52)	0.06 (−0.26 to 0.38)	0.07 (−0.03 to 0.18)
COVID-19: unsupported	−0.03 (−0.19 to 0.12)	0.12 (−0.03 to 0.28)	0.07 (−0.04 to 0.19)	0.02 (−0.07 to 0.11)	0.04 (−0.23 to 0.31)	0.48 (−0.28 to 1.25)	−0.07 (−0.49 to 0.34)	0.04 (−0.09 to 0.18)

*p≤0.05; **p≤0.01; ***p≤0.001.
CI, confidence interval; COVID-19, coronavirus disease 2019; OCD, obsessive-compulsive disorder; sg, significant after Bonferroni correction.

Table 5 Estimates with 95% CI of adjusted models testing what factors associated with mental ill-health symptoms—physical symptoms, substance use, personality disorder, mood disorder and official diagnosis

	Physical symptoms		Substance use		Personality disorder			Mood disorder
	Insomnia	Somatisation	Hazardous drinking	Drug use	Schizoid	Histrionic	Paranoia	Bipolar
Time (reference T2)	0.02 (−0.04 to 0.09)	0.01 (−0.04 to 0.07)	0.08 (−0.11 to 0.26)	−0.36 (−0.82 to 0.10)	−0.05 (−0.26 to 0.16)	−0.09 (−0.31 to 0.13)	0.01 (−0.05 to 0.08)	**0.03 (0.01 to 0.05)***
Educational climate: centrality	−0.14 (−0.32 to 0.05)	−0.11 (−0.28 to 0.05)	0.18 (−0.31 to 0.68)	−0.19 (−0.97 to 0.60)	0.29 (−0.17 to 0.75)	−0.10 (−0.60 to 0.39)	0.07 (−0.14 to 0.28)	0.01 (−0.05 to 0.08)
Educational climate: competitive	−0.07 (−0.23 to 0.09)	−0.10 (−0.24 to 0.04)	0.32 (−0.14 to 0.79)	0.31 (−0.55 to 1.18)	−0.18 (−0.59 to 0.22)	−0.08 (−0.55 to 0.39)	−0.15 (−0.33 to 0.02)	−0.01 (−0.06 to 0.04)
Belongingness	**−0.10 (−0.17 to −0.03)**	−0.03 (−0.09 to 0.03)	**0.28 (0.07 to 0.49)**	0.03 (−0.39 to 0.44)	**−0.31 (−0.50 to −0.11)**sg	−0.09 (−0.12 to 0.30)	0.02 (−0.06 to 0.10)	**0.03 (0.01 to 0.05)***
Observed stigma (reference no)	0.11 (−0.05 to 0.26)	0.14 (0.00 to 0.27)	**0.81 (0.36 to 1.27)***sg	**1.04 (0.27 to 1.80)**	0.25 (−0.18 to 0.68)	**0.48 (0.04 to 0.93)***	0.13 (−0.05 to 0.30)	0.04 (−0.01 to 0.09)
Perceived stigma	**0.23 (0.11 to 0.35)***sg	**0.15 (0.05 to 0.26)**	−0.25 (−0.60 to 0.10)	**−0.75 (−1.43 to −0.07)***	**0.56 (0.24 to 0.89)***sg	0.21 (−0.13 to 0.55)	**0.42 (0.29 to 0.55)***sg	0.04 (0.00 to 0.08)
Help-seeking behaviour	**−0.10 (−0.19 to −0.02)***	−0.06 (−0.13 to 0.02)	**−0.30 (−0.54 to −0.07)***	−0.02 (−0.38 to 0.34)	−0.14 (−0.36 to 0.07)	0.05 (−0.18 to 0.29)	**−0.09 (−0.18 to 0.00)***	**−0.05 (−0.08 to −0.03)***sg
COVID-19: underprepared	0.06 (−0.02 to 0.13)	**0.07 (0.01 to 0.13)***	0.00 (−0.22 to 0.21)	0.32 (−0.22 to 0.86)	0.01 (−0.19 to 0.20)	**−0.23 (−0.44 to −0.02)***	0.05 (−0.03 to 0.13)	0.00 (−0.02 to 0.03)
COVID-19: unsupported	−0.08 (−0.17 to 0.02)	−0.05 (−0.12 to −0.03)	0.17 (−0.12 to 0.46)	0.35 (−0.20 to 0.91)	−0.15 (−0.41 to 0.10)	−0.03 (−0.32 to 0.26)	0.02 (−0.09 to 0.12)	0.01 (−0.02 to 0.04)

*p≤0.05; **p≤0.01; ***p≤0.001.
CI, confidence interval; COVID-19, coronavirus disease 2019; sg, significant after Bonferroni correction.

was associated with reduced binge-eating tendencies ($B_{adjusted}$=−0.77, 95% CI: −1.51 to −0.04, p=0.039).

Physical symptoms
Students who felt that they belonged ($B_{adjusted}$=−0.10, 95% CI: −0.17 to −0.03, p=0.006) and who were more inclined to seek help ($B_{adjusted}$=−0.10, 95% CI: −0.19 to −0.02, p=0.013) experienced lower levels of insomnia symptoms. Perceived stigma was associated with insomnia ($B_{adjusted}$=0.23, 95% CI: 0.11 to 0.35, p<0.001) and somatisation symptoms ($B_{adjusted}$=0.15, 95% CI: 0.05 to 0.26, p=0.005). Those students who felt unprepared due to the pandemic expressed more severe symptoms of somatisation ($B_{adjusted}$=0.07, 95% CI: 0.01 to 0.13, p=0.034).

Substance use
Belongingness was linked to higher odds of hazardous drinking ($B_{adjusted}$=0.28, 95% CI: 0.07 to 0.49, p=0.010) while help-seeking intentions linked to lower odds of hazardous drinking ($B_{adjusted}$=−0.30, 95% CI: −0.54 to −0.07, p=0.012). Students who observed stigmatising behaviour from their peers and supervisors were at higher odds of hazardous drinking ($B_{adjusted}$=0.81, 95% CI: 0.36 to 1.27, p<0.001) and drug use ($B_{adjusted}$=1.04, 95% CI: 0.27 to 1.80, p=0.008). Perceived stigma reduced the odds of drug use ($B_{adjusted}$=−0.75, 95% CI: −1.43 to −0.07, p=0.031).

Personality disorders
Perceived stigma was positively linked to schizoid personality disorder ($B_{adjusted}$=0.56, 95% CI: 0.24 to 0.89, p=0.001) and paranoia symptoms ($B_{adjusted}$=0.42, 95% CI: 0.29 to 0.55, p<0.001). Belongingness was linked to lower odds of schizoid personality disorder symptoms ($B_{adjusted}$=−0.31, 95% CI: −0.50 to −0.11, p=0.002) and help-seeking was linked to lower odds of paranoia symptoms ($B_{adjusted}$=−0.09, 95% CI: −0.18 to 0.00, p=0.042). Students who observed stigmatised behaviour ($B_{adjusted}$=0.48, 95% CI: 0.04 to 0.93, p=0.034) and those who felt more prepared due to the pandemic ($B_{adjusted}$=−0.23, 95% CI: −0.44 to −0.02, p=0.035) had higher odds of developing histrionic personality disorder symptoms.

For the antisocial behaviour scale, running an adjusted model was impossible because of the small number of students scoring positive on this diagnostic test. Therefore, we performed two logistic regressions (with and without control variables), including antisocial personality disorder symptoms at baseline (online supplemental appendix 4). The adjusted model revealed that students from a less competitive environment (B=2.04, SE=1.04, p=0.049) and those who felt they belonged (B=−1.29, SE=0.56, p=0.022) were less likely to have antisocial personality disorder symptoms.

Mood disorder
There was a significant positive link between belongingness and bipolar symptoms ($B_{adjusted}$=0.03, 95% CI: 0.01 to 0.05, p=0.013). Students inclined to seek help were experiencing lower levels of bipolar symptoms ($B_{adjusted}$=−0.05, 95% CI: −0.08 to −0.03, p<0.001).

Official diagnosis of mental illness
Help-seeking intentions ($B_{adjusted}$=−0.51, 95% CI: −0.81 to −0.21, p=0.001) and perceived ($B_{adjusted}$=−0.77, 95% CI: −1.19 to −0.36, p<0.001) and observed ($B_{adjusted}$=−0.53, 95% CI: −1.05 to −0.02, p=0.043) stigma increased the odds of having a mental health diagnosis (see online supplemental appendix 3).

DISCUSSION
Main findings
Prevalence of mental health issues
The prevalence of mental health issues among UK medical students who participated in this study was high, with some mental ill-health symptoms occurring in more than half of the students. For example, 62% of medical students reported drinking hazardously. Both coping (ie, reducing negative affect and anxiety) and enhancement (ie, increasing positive affect) motivations could help explain these findings,[22] considering the challenging medical school environment and the importance of socialising for young people. The time over which the data were collected in the present study included periods of easing pandemic-related social restrictions. Thus, students may have engaged in more frequent socialising activities and drank more than usual. However, other studies on students before the pandemic more generally report a similar or higher prevalence of alcohol use among undergraduate students in the UK and Ireland (62.8%–84%).[23]

Comparing findings from studies on medical students globally (see online supplemental appendix 5), the prevalence reported for more commonly explored mental health issues was mostly similar to those found here. For example, we found that 33.1% of medical students perceived their personal accomplishments as low and 38.5% had anxiety/depression symptoms, while systematic reviews on medical students globally report that 27.4% had low personal accomplishments[21] and 39.4% had depression.[7] However, general population studies report lower prevalence in comparison with our findings: systematic reviews show that 28% of the general population globally had depression and 26.9% had anxiety[24] in comparison with 38.5% of medical students expressing anxiety/depression symptoms in our study. Other mental health issues, such as eating or personality disorders, have been less often explored in medical students, and evidence in comparable samples is lacking. Those issues are, however, significant to consider as higher stigma might be associated with these mental health issues and therefore reduce disclosing; for example, doctors are less likely to reveal substance use problems than anxiety.[25] Health policy should specifically focus on preventative and awareness-raising campaigns regarding these issues to ensure that those who need support seek it.

Comparing our findings with studies exploring the prevalence of these mental health issues in the general population, we find the prevalence is higher among

medical students (eg, binge eating: 1.4%[26] vs 8.5%), including some drastic differences (eg, schizoid personality disorder: 2.82%[27] vs 46.7%). This high prevalence may be partially due to the sample's characteristics. The study focuses on young individuals facing several challenging life circumstances: becoming independent, establishing a career and long-lasting relationships, facing a changed learning environment and experiencing an increased workload.[28] However, the COVID-19 pandemic may also have influenced the prevalence of specific health issues. Alcohol use and eating disorders such as anorexia nervosa, for example, have increased in prevalence since the beginning of the pandemic.[29 30] Research also shows that the pandemic exacerbated symptoms for those with personality disorders.[31]

Factors associated with mental ill-health

An underlying medical learning climate in which disrespectful behaviours are engrained has been identified as the potential culprit for the issues experienced by medical students.[32 33] Our study notably showed the detrimental impact of such a climate on burnout. Occupational and professional demands catalyse burnout[34]; for medical students, these occupational and professional demands manifest in their learning environment. A direct link between educational climate and burnout is also shown elsewhere.[35] Interestingly, the educational climate—the centrality of the learner and competitiveness—did not significantly impact other mental health issues. This could be due to burnout being a mediator, as studies have shown that burnout is predictive of mental disorders.[36] Therefore, improving the educational climate in medical schools is crucial for students' well-being as it might prevent the exacerbation of mental health issues. Although the educational climate is resistant to change, successful efforts to improve learning environments have been reported, such as implementing a pass/fail grading system rather than numerical marking to reduce competitiveness among medical students.[32]

Furthermore, our results imply that students with a stronger sense of belongingness experienced lower symptoms of mental ill-health issues, aligning with the literature describing that not belonging and even uncertainty about belonging can lead to isolation, emotional distress, exhaustion and other health issues.[37] These findings were relevant to a variety of mental health problems. Nonetheless, there is a potential flipside to belongingness, such as increased drinking behaviour: intoxication through alcohol is seen as a collective activity to be enjoyed in a group.[38] Therefore, the students in our sample may feel like they belong due to more extensive networks of peers with whom they can engage in social activities, including drinking.

Stigma and help-seeking intentions were particularly impactful on students' mental health. There are stigmatising attitudes to mental illness in the wider medical culture,[39] and it is strongly represented in medical school.[40] Stigma might prevent timely support-seeking[40] and cause students to hide their symptoms, potentially worsening the problem or leading to self-medication.[41] This is problematic in medical school and later when these students progress to become physicians. Research shows that, despite a recent reduction in public stigma towards mental ill-health[42] and increased mental health campaigns specific for medical professionals,[43] younger doctors still report holding more stigmatising attitudes towards mental illness and experience more barriers when seeking help than older doctors.[39] This indicates there is still work to be done, and our research implies that efforts to reduce stigma towards mental illness in the medical community must start in medical school.

Finally, the results of this study showed the pandemic's effects on medical students' learning—leading them to feel underprepared for their studies and less equipped to become exemplary physicians—decreased their mental health. The culture of perfectionism in medicine can leave learners with diminished self-worth, a stigmatised sense of failing, less sleep due to worrying and prioritising learning activities and ultimately mental health issues.[44] The findings were particularly relevant for burnout (manifesting from the professional environment) potentially because substantial changes were implemented in medical schools due to the pandemic, such as online learning and suspended placements.[45] Noteworthy, the amount of perceived support from medical schools during the pandemic did not significantly impact students' mental health. Despite the many policy changes, students may have felt medical schools were doing all they could to support them through the pandemic.

Limitations

This study's participants may represent a particular type of students. For example, students experiencing mental health issues may have been more or less keen to participate. But due to the recruitment strategy, the researchers had little influence on whom and how many students were reached. The researchers mitigated this risk to the best of their ability by collaborating with medical schools to recruit a diverse sample and designing inclusive recruitment materials, both written and spoken. Furthermore, the geographical and demographically diverse selection means the sample is more likely to accurately represent the overall population of medical students, thereby contributing to the generalisability of the study.

Attrition bias, caused by the drop-out of participants, could impact the generalisability and sharpen the selection bias. However, there were no substantial differences between those who completed the follow-up survey (407) with those who did not (385) (online supplemental appendix 6).

Despite the elaborate recruitment strategy, some analyses were conducted over small groups of students, particularly for outcomes with a low prevalence, such as bulimic and binge-eating tendencies, antisocial personality disorder symptoms, bipolar symptoms and drug use. Although we were able to perform the analysis for

these outcomes, the findings should be interpreted with caution. This may also explain why some results found for these outcomes are counterintuitive, such as students feeling underprepared due to the pandemic experiencing lower odds of binge-eating tendencies.

Data collection took place during the COVID-19 pandemic, and the possible impact of the pandemic on the results deserves consideration. Research in the UK on the COVID-19 pandemic's impact on medical students' mental health is explicitly scant. However, one study reported that students studying healthcare-related courses at a British university have had a negative impact on lifestyle behaviours, such as changes in diet and decreased exercise, and mental health, for example, worrying too much and feeling unable to cope.[46] This reflects the global literature, which suggests the pandemic has negatively affected medical students' mental health. For example, a study of 2 280 medical students across 148 medical schools in 9 countries (Brazil, Chile, Columbia, Germany, Italy, Japan, Mexico, Spain and Venezuela) found students reported negative changes in both their mental and physical health, including insomnia, emotional irritability, anhedonia, headaches and ocular tiredness.[47] Therefore, as mentioned above, it is important to consider that the COVID-19 pandemic may have inflated the prevalence of certain mental health issues.

Implications

First, the educational climate and students' attitudes towards mental illness impact the mental health of medical students. Thus, a preventative approach that safeguards learning environments and addresses perceived stigma and encourages help-seeking is crucial. Interventions should be tailored to students with a broad range of mental health problems and created through collaboration and dialogue between staff and students. Second, medical schools should stress the importance of healthy peer-to-peer and student-to-staff relationships, address stigma and avoid unnecessary competitiveness to help to create a healthier learning environment for students.

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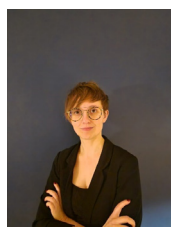
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