Levels of stress in medical students due to COVID-19

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ABSTRACT
For medical schools, the COVID-19 pandemic necessitated examination and curricular restructuring as well as significant changes to clinical attachments. With the available evidence suggesting that medical students’ mental health status is already poorer than that of the general population, with academic stress being a chief predictor, such changes are likely to have a significant effect on these students. This online, cross-sectional study aimed to determine the impact of COVID-19 on perceived stress levels of medical students, investigate possible contributing and alleviating factors, and produce recommendations for medical schools to implement during future healthcare emergencies. The majority (54.5%) of respondents reported levels of stress ranging from moderate to extreme. Higher levels of stress were significantly associated with female gender (p=0.039) and international status (p=0.031). A significant association was also noted between reported stress and the transition to online learning (p<0.0001) and online assessment formatting (p=0.0001), concerns for personal health (p<0.0001) and for the health of family members (p<0.0001). Students who reported higher stress levels were less confident in their government’s management of the crisis (p=0.041). Additionally, students who reported lower stress agreed highly that their medical school had an appropriate response to the crisis (p<0.0001), had provided sufficient information regarding the crisis (p=0.015), that they trust their school in handling the continuing of their education (p=0.020) and that their school had appropriate plans in place to support the continuing of education (p=0.017).

INTRODUCTION
As the number of cases of coronavirus infections increased worldwide, the WHO declared the COVID-19 outbreak a global pandemic on 11th of March 2020.1 In Ireland, this was followed by the effecting of severe restrictions aimed at containing the disease. On 12th of March, the government shut all schools, colleges, childcare facilities and cultural institutions. By 24th of March, almost all businesses, venues, facilities and amenities were shut. Three days later, on the 27th of March, the government imposed a stay-at-home order, banning all non-essential travel and contact with people outside one’s home, not to be relaxed until June.2

The response by medical schools to COVID-19 has been varied.3 In the early weeks of March 2020, universities across Ireland and the UK suspended face-to-face medical teaching and other educational activities.4,5 The closure of universities and public libraries and with limited access to alternative study spaces, countless students were forced into an unaccustomed learning environment, with many returning to their family homes. Rapid examination restructuring meant that those preparing for or undertaking examinations had to contend with new test formatting and marking structures in a short period.6 Some schools had to delay or advance examinations, with others cancelling them entirely, using previous summative and formative performance marks. Several universities removed written assessments and replaced these with remote online assessments for students.7 A recent survey of final year medical students in the UK found that over one-third had their objective structured clinical examinations cancelled, and almost half had assistantships cancelled, with significant effects on self-reported ratings of preparedness to start as doctors.8

The educational integrity of the medical programme is particularly vulnerable to the effects of COVID-19. An early focus on clinical teaching has been a central element of medical education reform in recent years.9 Academic programs now adhere to a strict template: a shortened preclinical period where students are educated within the university and a subsequent clinical component during which students operate external to their university and within the healthcare environment.10 This shift in pedagogy requires that preclinical students convene in groups for tutorials, problem-based learning, anatomy lab sessions and simulated patient interactions and that clinical students have access to patient care centres. Although lecture-based teaching is simply transitioned to an online format, interactive small group sessions and clinical exposure are not as easily replicated. Given this curricular structure, the COVID-19 pandemic has birthed a frustrating dichotomy for medical students. A virus which exploits human contact for survival is impeding an educational ecosystem which also necessitates human interaction.

These changes present both a logistical hurdle as well as a personal challenge. The available pre-pandemic evidence suggests that medical students’ mental health status is poorer than that of the general population.10 Notably, academic stress has been identified as a chief predictor of poor mental health.11 Though the institutional response to COVID-19 has been rapid, with a commitment to the delivery of academic services to students with minimal disruption,12 such swift and unparalleled reorganisation may be a trigger for students who are already susceptible to high levels of academic stress. This is particularly relevant for those transitioning from student to doctor, a transfer which has long been recognised as challenging.13 Medical graduates already report high levels of psychological distress, anxiety and depression at the end of their first year.14 There is no doubt that many students are ready to accept this challenge. However, for many, this is likely to be a daunting experience.
In addition to academic-related changes, other impacts of the pandemic are likely to impress negatively on student well-being. The loss of peer interaction and social connectedness and financial stresses including loss of part-time employment caused by the economic consequences of the pandemic are all expected to cause further psychological distress and disrupt the daily life and studies of medical students. Furthermore, the possibility of students being fast-tracked to the frontline or deployed to other areas within the health service, concerns regarding their own health and well-being and that of their family may also have heightened their stress levels. Medical schools have ethical obligations to their students in facilitating adaptive coping strategies in the face of day-to-day clinical work, to actively assess and monitor stress levels in the face of adversity and to mitigate negative impacts and provide appropriate support to students.

The study aimed to:
1. Determine the impact of COVID-19 on perceived stress levels of University College Dublin (UCD) medical students.
2. Investigate the possible contributing and protective factors of this stress.
3. Generate recommendations for medical schools to incorporate to lessen stress for students during future healthcare emergencies.

METHODS
Study design and setting
The present study was a cross-sectional observational study, conducted throughout June 2020 following the initial COVID-19 lockdown in Ireland. All medical students enrolled at the School of Medicine, UCD were eligible to participate.

Procedure
An online survey was developed and distributed to medical students at UCD (N=760). SurveyMonkey was the online platform chosen to deliver the self-administered surveys. Dissemination was completed through the emailing list of UCD Medical Society, a student-led organisation which has members in every academic year and represents the demographics of students across the school. In order to maintain anonymity, email addresses used were not collected. Study participation was voluntary, and no identifying information was collected.

Questionnaire
This online survey was designed combining dichotomous, multiple-choice and Likert response scale questions. The survey aimed to collect information on medical students’ self-perceived stress in addition to the causes and possible mitigating factors of this stress. A pilot study involving 10 students was conducted to test the acceptability of the questionnaire. Based on the feedback received, appropriate changes to questions and survey length were made. The final version contained 42 questions, split into four sections (demographics, working during COVID-19, COVID-19-related stress and institutional support).

Variables
Demographic information included age (recorded as interval), gender (male, female, other), class level (undergraduate/graduate and year of study), nationality (Irish or non-Irish) and COVID-19 status.

Further, data on the following questions were collected:
1. Level of stress. A single question was asked on how stressed the participant was feeling with regard to the current COVID-19 pandemic. Responses were recorded on a 5-point scale that ranged from 0='no stress' to 4='extreme amount of stress'.
2. Causes of stress. In order to delineate the causes of COVID-19-related stress, students were asked to rate a list of possible contributors on a 5-point scale, ranging from 0='not at all' to 4='a great deal'. These variables included (a) transitioning to online learning, (b) transitioning to online assessment, (c) loss of own job/financial security, (d) loss of job/financial security by parent/family member, (e) concern for your own health, (f) concern for the health of your family members and (g) having to move/relocate due to COVID-19.
3. Institutional support. In order to evaluate students’ feelings toward institutional support, they were asked the following questions on the management of the COVID-19 crisis by their government and university:
   a. Government support: a single question on how much confidence the participant had in the government managing the COVID-19 pandemic. Responses were recorded on a 5-point Likert scale (0='a great deal of confidence'; 4='no confidence at all').
   b. University support: the following questions were measured on a Likert scale from 0 to 4 (0='strongly disagree'; 4='strongly agree'): 'The response of my school was appropriate to the current crisis', 'my medical school has provided me/is providing me with sufficient information regarding the current situation', 'I trust my medical school to best handle the continuing of my education' and 'there are appropriate contingency plans in place to support me continuing in my medical education'.
4. Coping mechanisms. The use of coping strategies during the COVID-19 crisis was also examined. Adaptive strategies included exercise, healthy eating and talking to others, while maladaptive strategies covered behaviours such as smoking, increased alcohol intake, drug use and/or unhealthy eating. The response was recorded dichotomously as yes or no to either engaging in positive or negative coping mechanisms only, or both positive and negative mechanisms together.

Study size
The questionnaire was sent to 760 medical students. The response rate was 26.32% giving a cohort of 200 students. Of those students, 35 were excluded as they did not fill out the questions pertaining to stress during COVID-19. Therefore, 165 students were included in the final statistical analyses.

Statistical analysis
The data obtained from surveying was then analysed using IBM-SPSS (V.26). Descriptive data were presented as counts and percentages if categorical, and as means and SDs if data were continuous. Non-parametric tests were used to compare groups.

RESULTS
Demographics
Two hundred medical students responded, giving a response rate of 26.32%. Thirty-five students were excluded as they did not fill out the questions pertaining to stress during COVID-19. Therefore 165 students were included in the final statistical analyses. Of the remaining students, the mean age was 22.57 (SD: 2.818; range 18–34) years, 103 (62.4%) were women, 103 (62.4%) were of Irish nationality and 61 (37.6%) were international students.

Psychological well-being
Students were asked to rate their level of stress with regard to the current COVID-19 pandemic on a 5-point scale, ranging from
0='no stress’ to 4='extreme amount of stress’ (table 1). The majority (54.5%) of respondents reported stress at moderate or higher levels. Only 9.1% reported no levels of stress. A Mann-Whitney U test revealed a significant difference in the stress levels of women (median=2, n=103) and men (median=1, n=62) (U=2607.5, Z=–2.066, p=0.039). Similarly, a Mann-Whitney U test revealed a significant difference in the stress levels of international (median=2, n=61) and Irish (median=1, n=103) students (U=2536.5, Z=–2.157, p=0.031) (table 1). A Mann-Whitney U test did not reveal a significant stress difference between those students who entered the medical degree as undergraduate (n=98) or as graduate (n=67) students (U=2893, Z=–1.357, p=0.175).

In order to delineate the causes of COVID-19-related stress, students were asked to rate a list of possible contributors on a 5-point scale (table 2). Non-parametric correlation analysis found a positive relationship between the level of stress and transition to online learning (p<0.0001), the transition to online assessment formats (p<0.0001), concerns for personal health (p<0.0001) and concerns for the health of family members (p<0.0001).

Table 1 Perceived COVID-19-related stress in study participants

| Stress level                        | Frequency (N) | Per cent | Cumulative per cent |
|-------------------------------------|---------------|----------|---------------------|
| No stress                           | 15            | 9.1      | 9.1                 |
| Mildly stressed                     | 60            | 36.4     | 45.5                |
| Moderately stressed                 | 52            | 31.5     | 77                  |
| A lot of stress                     | 36            | 21.8     | 98.8                |
| Extreme amounts of stress           | 2             | 1.2      | 100                 |
| Total                               | 165           | 100      |                      |

Coping
A Kruskal-Wallis test revealed a statistically significant difference in stress levels across those who engaged with positive, negative, or both positive and negative coping mechanisms (n=67, n=15, n=83), $\chi^2(2, n=165)=9.241$, p=0.010. Those engaging in negative and mixed coping mechanisms recorded a higher median stress scores (median=2) than the positive-only coping group which recorded a median value of 1.

Stress and institutional support
A Spearman’s rho correlation analysis demonstrated a relationship between stress and confidence in the government’s management of the crisis (p=0.041); students with lower levels of confidence in the government had significantly higher reported stress levels (table 3). Regarding support from their university, students with lower reported stress levels agreed highly that the UCD School of Medicine had an appropriate response to the crisis (p<0.0001), had provided/is providing sufficient information regarding the crisis (p=0.015) and had appropriate contingency plans in place to support the continuing of education (p=0.017). Students who showed high levels of trust in the UCD School of Medicine to handle their continuing education throughout the pandemic were significantly more likely to have lower stress levels (p=0.020). Students’ personal or family health concerns were also correlated with higher stress levels (table 3).

Table 2 Contributors to COVID-19-related stress in study participants

| Contributor                        | Transition to online learning, N (%) | Transition to online assessment, N (%) | Personal financial situation, N (%) | Family financial situation, N (%) | Personal health, N (%) | Family health, N (%) | Relocation, N (%) |
|------------------------------------|-------------------------------------|---------------------------------------|------------------------------------|----------------------------------|-----------------------|---------------------|-------------------|
| None                               | 20 (12.1)                           | 17 (10.3)                             | 56 (33.9)                          | 75 (45.5)                       | 44 (26.7)             | 5 (3)               | 58 (35.2)         |
| A Little                            | 34 (20.6)                           | 28 (17)                               | 25 (15.2)                          | 23 (13.9)                       | 59 (35.8)             | 22 (13.3)           | 23 (13.9)         |
| A moderate amount                   | 47 (28.5)                           | 49 (29.7)                             | 30 (18.2)                          | 25 (15.2)                       | 39 (23.6)             | 35 (21.2)           | 23 (13.9)         |
| A lot                               | 37 (22.4)                           | 39 (23.6)                             | 18 (10.9)                          | 14 (8.5)                        | 14 (8.5)              | 42 (25.5)           | 15 (9.1)          |
| A great deal                        | 26 (15.8)                           | 31 (18.8)                             | 12 (7.3)                           | 11 (6.7)                        | 9 (5.5)               | 60 (36.4)           | 19 (11.5)         |
| Not applicable                      | 1 (0.6)                             | 1 (0.6)                               | 24 (14.5)                          | 17 (10.3)                       | 0 (0)                 | 1 (0.6)             | 27 (16.4)         |

DISCUSSION
The recognition of occupational stress among healthcare workers has become a recent concern in healthcare settings, both in terms of patient safety and staff well-being. Eighty-two per cent of doctors in Irish hospitals reported significant workplace stress, with one-third reaching levels of burnout. Similarly, one-third of doctors in the UK report burnout and suffering from secondary traumatic stress as well as over one-half of US physicians. Junior status increases the likelihood of stress, suggesting a need to support those newly exposed to clinical decision-making and ensuring adequate attention to doctor well-being in undergraduate courses. Furthermore, high levels of stress among medical students have been reported, with rates as high as one-third exhibiting some type of psychological distress during medical school. In these uncertain times, improving student mental well-being has become a greater priority in an effort to reduce the known consequences of ongoing psychological distress and minimise any adverse effects of the pandemic on mental health. Research already exists about the additive weight of the pandemic on healthcare workers. A recent systematic review viewed them as a ‘fragile population’, recommending urgent primary preventative measures such as screening and educational programmes. Results of this study provide further sustenance to these concerns, in that the majority of medical students surveyed experienced moderate or higher levels of psychological distress. It is likely that the COVID-19 pandemic has contributed to their level of stress.

Certain studies have focused on developing mechanisms to mitigate the negative mental health outcomes related to healthcare emergencies. One such strategy centres on the development of resilience, that is, one’s ability to mentally or emotionally cope with a crisis. This skill is an interplay between that person’s own capacity to manage their stress, as well as factors intrinsic to their workplace structure, such as effective leadership and access to support networks. Several studies on the variables which mediated the outcomes of stress related to SARS-CoV-1 have highlighted certain focus areas which may enhance the development of such resilience. These individually focused interventions include improving self-efficacy (one’s belief
Table 3  Spearman's rho correlation of COVID-19-related stress and contributing factors

| Stress                      | Transition to online learning | Transition to online assessment | Confidence in the government | School response | School information | School trust | School plans | Personal health |
|-----------------------------|-------------------------------|---------------------------------|------------------------------|----------------|-------------------|--------------|--------------|-----------------|
| Spearman’s rho              |                               |                                 |                              |                |                   |              |              |                 |
| Transition to online learning | Correlation coefficient   | 0.444*                          |                               |                |                   |              |              |                 |
| Sig. (2-tailed)             |                               | 0.000                           |                              |                |                   |              |              |                 |
| Transition to online assessment | Correlation coefficient   | 0.315*                          | 0.583*                      |                |                   |              |              |                 |
| Sig. (2-tailed)             |                               | 0.000                           | 0.000                       |                |                   |              |              |                 |
| Confidence in government   | Correlation coefficient   | 0.160†                          | 0.155†                      | 0.110          |                   |              |              |                 |
| Sig. (2-tailed)             |                               | 0.041                           | 0.048                       | 0.164          |                   |              |              |                 |
| School response            | Correlation coefficient   | -0.292*                         | -0.227*                     | -0.327*        | -0.320*           |              |              |                 |
| Sig. (2-tailed)             |                               | 0.000                           | 0.005                       | 0.000          | 0.000             |              |              |                 |
| School information         | Correlation coefficient   | -0.195†                         | -0.224*                     | -0.321*        | -0.136            | 0.604*       |              |                 |
| Sig. (2-tailed)             |                               | 0.015                           | 0.005                       | 0.094          | 0.000             |              |              |                 |
| School trust               | Correlation coefficient   | -0.187†                         | -0.100                      | -0.215*        | -0.319*           | 0.612*       | 0.587*       |                 |
| Sig. (2-tailed)             |                               | 0.020                           | 0.217                       | 0.007          | 0.000             | 0.000        | 0.000        |                 |
| School plans               | Correlation coefficient   | -0.192†                         | -0.171†                     | -0.244*        | -0.180*           | 0.481*       | 0.585*       | 0.630*          |
| Sig. (2-tailed)             |                               | 0.017                           | 0.034                       | 0.002          | 0.026             | 0.000        | 0.000        | 0.000           |
| Personal health            | Correlation coefficient   | 0.345*                          | 0.068                       | 0.076          | 0.078             | -0.093       | -0.105       | -0.077          |
| Sig. (2-tailed)             |                               | 0.000                           | 0.389                       | 0.329          | 0.322             | 0.250        | 0.195        | 0.344           |
| Family health              | Correlation coefficient   | 0.359*                          | 0.123                       | 0.089          | 0.049             | -0.183†      | -0.059       | -0.125          |
| Sig. (2-tailed)             |                               | 0.000                           | 0.116                       | 0.255          | 0.537             | 0.023        | 0.466        | 0.122           |

*Correlation is significant at the 0.01 level (2-tailed).
†Correlation is significant at the 0.05 level (2-tailed).
in their personal ability to respond adaptively to pandemic-related stresses, reducing interpersonal problems (as such issues are associated with job stress in healthcare workers) and enhancing adaptive strategies of coping. Organisational approaches are equally important, aimed at augmenting an individual’s confidence in being well supported by their hospital/ workplace and adequately preparing staff for the job and associated challenges. It has also been posited that medical schools should make an increased effort to ensure the resilience of their students. Further, it has been shown that resilience is related to reduced burnout and increased satisfaction in medical students. The findings of this study corroborate the conceptual framework of resilience. Those students who felt supported by and who had confidence in their university had lower levels of reported stress. This emphasises the importance of effective communication in mitigating stress for students in future emergency situations. For example, despite the physical restraints imposed by COVID-19, social media platforms have already been used and found to be helpful in allowing senior medical students to support junior students with the guidance of faculty members. This is a simple step which is easily implemented at an administrative level and is poised to have a significant impact on student stress levels.

Similarly, regarding the intrinsic factors of resilience, this study highlights potential target groups which may benefit from increased surveillance during unprecedented times. Of note, and with approximately half of the medical student body in Ireland consisting of international students (OECD Publishing, 2019), the additional stressors of studying overseas need to be considered, especially at a time of a crisis. Moreover, the formal incorporation of education on culturally sensitive coping mechanisms into the curriculum may be of use in the development of individual resilience among students.

For medical students, the development of such resilience may prove beneficial beyond the confines of a pandemic. Internationally, medical students spend the latter years of their academic programme operating within a healthcare environment where they encounter novel stressors. Such challenges include experiencing patient death and dying, perceptions of unfair treatment, difficult team dynamics, and uncertainty in both their clinical and learning environments. Based on what is known about the role of resilience in mitigating against negative psychological outcomes, it is reasonable to hypothesise that enhancing the resilience of medical students will lead to better coping in such environments. Furthermore, it is suggested that higher levels of resilience are associated with lower levels of burnout in healthcare professionals. Thus, nurturing resilience at an early stage may be of enormous benefit to students while in university and during the ensuing transition to medical graduate.

Limitations of the study include its relatively low response rate (response rate: 26.3%), meaning that the full range of impacts and concerns relating to the pandemic may not have been captured.

In conclusion, this study has provided insights into the impact of COVID-19 on medical students’ well-being and provided an opportunity to address their concerns. This work is significant in that it tenders several simple yet effective measures which may be implemented by medical schools in future healthcare emergencies. These are: communicate with students, reach out often to perceived ‘vulnerable’ groups within your institution, and prepare and provide for the stress generated from abrupt changes to the programme structure. In addition, this research adds to the growing body of evidence that suggests that resilience is protective to medical students and junior doctors.

Accordingly, we recommend that steps be taken to incorporate resilience training into early medical education curricula.

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