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Worried, Weary and Worn out: A Mixed Methods Study of Stress and Wellbeing in Final Year Medical Students

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Abstract

Objectives: Although, there is much focus on burnout and psychological distress amongst doctors, studies about stress and wellbeing in medical students are limited but could inform early intervention and prevention strategies.

Design: Mixed quantitative and qualitative study examining the perspective and narrative of Final Year Medical students who report the factors they consider stressful in their lives, the impact of stress on their health, and their coping strategies.

Setting: University College Dublin, the largest University in Ireland.

Participants: 161 of 235 medical students participated in this study (response rate 69%).

Results: 65.2% of students scored over accepted norms for the PSS (34.8% low; 55.9% moderate; 9.3% high). 35% scored low; 28.7% moderate and 36.3% high on the subjective stress scale. Thematic Analysis identified worry about exams, relationships, concern about future, work-life balance and finance; 39.2% of students reported worry, 32.4% irritability and hostility; 8.8% felt worn out. Cognitive impacts were reported by 16.2% and included over-thinking, poor concentration, sense of failure, hopelessness and procrastination. 29.7% reported sleep and appetite disturbance, fatigue and weariness. 24.3% reported a "positive reaction" to stress. Positive strategies to manage stress included connection and talking (51.3%), exercise (50.7%), non-study activity (19.2%) and meditation (13%). 8.2% reported using unhelpful strategies such as isolation or substances. No student used the college support services or sought professional help.

Conclusions: Medical students experience high levels of psychological distress, similar to their more senior doctor colleagues. They are dis-inclined to avail of traditional college help services. Toxic effects of stress may impact their cognition, learning, engagement and empathy and increase patient risk and adverse outcomes. The focus of wellbeing in doctors should be extended upstream and embedded in the curriculum. Improving self-care and resilience skills of medical students could prevent future burnout, improve retention to the profession and deliver better outcomes for patients.

Strengths and limitations of this study:

- This study provides new information on the levels of stress in a cohort of Final Year Medical Students.

- The response rate is high.
- The use of subjective and objective measures of stress along with the mixed-method approach and the use of extensive free-text options provides extensive information on the student experience and their perspective on the stress of studying medicine.
- All students were surveyed over the course of the same academic year and were therefore exposed to the same demands and scheduling.
- The study is limited by the self-report nature and the absence of a control group.

Introduction

Medicine is regarded as a particularly stressful career with high rates of psychological distress and stress-related mental illness, anxiety, depression and suicide reported at all training and seniority levels, irrespective of speciality.[1-6] Studies exploring psychological distress in hospital doctors estimate that between 22 and 32% experience high distress, while a systematic review of depression and anxiety in doctors and medical students suggests a 14-60% prevalence of depression and an 18-55% prevalence of anxiety.[1 5 7 8]

This distress is known to impact of the quality of patient care and to increase negative outcomes[9 10] as well as being a factor in absenteeism and attrition from the profession[11]. Stressed individuals demonstrate less empathy, are often irritable, over-whelmed and hostile making them prone to errors of judgement and poor decision-making and an increased likelihood of mal-practice consequences.[10 12 13] With a rapidly changing modern health system with increasing demands and fewer resources, patient safety is rightly a major focus. The optimum delivery of service means that the health of providers is of critical importance, yet, the evidence suggests that this factor is often neglected.[3 4]

Stress is regarded as "the epidemic of the 21st century" and the WHO estimate that by 2020 five of the top ten illnesses world-wide will be linked to stress. Yet they also suggest that stress is preventable and manageable through life-style modifications and learned coping strategies.[14] Patterns of poor self-care and stoicism are prevalent in the health professions, identifiable in medical school and thought to deteriorate further after graduation often leading to practitioner neglect of health and unhealthy habits.[2 4-6 15 16-21]

Reliable estimates of stress and psychological distress during medical training are important and could help identify, prevent and treat causes of distress among medical students and future doctors. Intervening early at school level could provide future doctors with the strategies to improve their resilience and prevent mental health difficulties and burnout. In the broader context, strategies to improve stress in the medical workplace could lead to better outcomes for patients and improve recruitment and retention rates for the profession overall.[11 19-20]

Studies to date have focussed on the workplace demands and factors that might lead to burnout in doctors [1 2 5 6 11 22] rather than determine the factors that students identify in their career and personal life or the impact of environmental factors, thinking styles and coping strategies.

We examined final year medical students stress levels using both objective and subjective measures of stress and explored in depth the medical students' own perspectives and narrative on the factors

that impact on their wellbeing and stress levels during training, their views on the impact of stress on their health and the strategies they use to manage or cope with stress.

Methods

Participants

The participants in this study were Final Year Medical Students from Ireland's largest University, University College Dublin (UCD). A typical final medical year is made up of around 240 students who are divided into four groups and then rotate through the different specialities of Paediatrics, Obstetrics and Gynaecology, Public Health, Medicine of the Elderly, General Practice and Psychiatry.

The class included both Graduate Entry (GEM) and undergraduate (non-GEM) students. In UCD GEM and undergraduate students come together at year 4. Students participated in week five of their six-week Psychiatry Module.

Data was collected as part of a larger project that examines the impact of an eLearning module on Stress and Self-care. We embedded a new problem based small group teaching module on stress and self-care within the curriculum at pre-clinical and clinical teaching. We further developed an interactive eLearning module on Stress and Self-care and made this available to the same groups. The present study is descriptive and mixed-methods in nature and focuses on baseline stress levels in medical students prior to exposure to any educational intervention, embedded or electronic.

Students were assured that all data was anonymised and confidential. Ethical approval for the study was obtained from the Head of School in accordance with UCD Regulations. Due to the sensitive nature of the questions, students were informed of the student support services available to them and encouraged to seek help if needed. Patients and the public were not involved in this part of the study.

Patient and Public Involvement:

No patient involved.

Questionnaire

The questionnaire used in this study (Appendix 1), collected demographic details to include age, gender and GEM or non-GEM status. We used the Perceived Stress Scale (PSS), which is a widely used psychological instrument that measures individuals' perceptions of stress.[23] It is extensively reported as a validated and reliable measure of the degree to which situations in one's life are

appraised as stressful. Items are designed to explore how unpredictable, uncontrollable, and overloaded respondents find their lives and includes a number of direct questions about current levels of experienced stress. The PSS was designed for use in college and community samples. The items are easy to understand, and the response alternatives are simple to grasp. Moreover, the questions are of a general nature and hence are relatively free of content that would be considered specific to any subpopulation group.

This classic stress scale measures an individual's perceived stress levels in the previous month by asking them to rate ten statements on a scale of 0 (Never) to 4 (Very Often) based on how much they feel they apply to them. In each case, respondents are asked how often they felt a certain way and scores range from 0=never; 1=almost never; 2=sometimes; 3=fairly often and 4=very often.

Examples of items on this scale are 'In the last month how often have you been upset because of something that happened unexpectedly'; 'In the past month, how often have you felt nervous and stressed'; 'In the past month, how often have you found that you could not cope with all the things that you had to do'; ' In the past month, how often have you been angered because of things that were outside of your control'. An example of a reverse scoring item is 'In the last month, how often have you felt that things were going your way' and 'In the last month, how often have you felt that you were on top of things'.

PSS total scores are obtained by reversing responses (e.g., 0 = 4, 1 = 3, 2 = 2, 3 = 1 & 4 = 0) to the four positively stated items (items 4, 5, 7, & 8) and then summing across all scale items. The scores can be further divided into low (0-13), moderate (14-26) and high (27-40) perceived stress categories. Normative data has been reported[24]and ranges between 11.9 and 14.7[22].

We asked students' to further rate their subjective level of stress on a Likert scale (Subjective Stress Scale, SSS) and asked them to mark an X on a line between 0 (lowest) and 10 (highest) to indicate how stressed they had been in the past month. We used this as a continuous variable and also subdivided it into 3 categories low (0-3), moderate (4-6) and high (7-10). This allowed us to compare students subjective and objective measures as it has been reported that some people under-estimate and some over-estimate their stress levels.

The next section was made up of qualitative free text questions asking students to list 3 things under the following headings:

1. What things in your life make you feel stressed (triggers)?
2. How do you feel when you are stressed/ how do you react (effects)?
3. How do you cope when you are stressed (coping skills)?

The final question on the questionnaire was an open-ended, free-text, qualitative question "Any other comments?" which gave students the opportunity to add any further thoughts or comments.

Analyses

As the survey had a mixed methods design, both quantitative and qualitative analyses were undertaken. Quantitative analysis was conducted using IBM SPSS Statistics 24[25] and included t-tests and Chi-squared tests as appropriate. Qualitative analysis on the relevant questions was conducted systematically in the form of a step-by-step Thematic Analysis.[26 27] Initial analysis identified and described the themes by reading and re-reading a selection of the data sheets and summaries by two researchers working independently (AL and EC). These were further discussed and code identified. Data was then systematically coded by the two researchers independently and discrepancies checked, discussed and clarified. Following this further analysis of the data to identify the main themes was conducted according to the work of Cohen.[28]

Results

There were 235 students in total in the Final Year class of 2017; 123 females (52%) and 112 males (48%). Of these 161 (response rate 69%) participated in this study with a mean age of 24.76 years (s.d. 2.6; range 22 to 42 years). There were 88 (54.6% females) and 73 males (45.3%); 65 (40.4%) were graduate entry (GEM) and 96 (59.6%) were on the traditional undergraduate entry course (non-GEM).

Quantitative Results:

PSS: Mean scores on the PSS were 16.94 (s.d. 7.06), median 16.0 and mode 12.0, range 1 to 34. When the scores for males and females were compared, females had higher scores (mean 17.99; s.d. 7.37) compared to males (mean 15.53; s.d. 6.59) and this was statistically significant (p=0.029). There was no difference in the scores of GEM versus non-GEM 16.37; s.d. 7.56 versus 17.30; s.d. 6.77 (p=0.849). 65.2% of students' scored over accepted norms for the PSS.

SSS: On the Subjective scale the mean score was 4.88; s.d. 2.62, median 5 and mode 7, range 0 to 10. Females again scored higher than males (females 5.24; s.d. 2.54 and males 4.44; s.d. 2.67) trending towards significance at p=0.058. There was no significant difference between GEM and non-GEM (4.85; s.d. 2.72 versus 4.93; s.d. 2.57; p=0.419). (Table 1)

Table 1. Perceived Stress Scores (PSS) and Subjective Scores (SSS) Compared by Gender and GEM Status

			PSS		SSS	
	N	%	Mean	s.d	Mean	s.d
Male	73	45.3	15.53	6.59	4.44	2.67
Female	88	54.3	17.99	7.37*	5.24	2.54
GEM	65	40.4	16.37	7.56	4.85	2.72
Non GEM	96	59.6	17.30	6.77	4.93	2.57

PSS female v male*, p=0.029; GEM v Non-GEM, p=0.849. SSS female v male, p=0.058; GEM v Non-GEM p=0.419.

Scores on both measures were moderately correlated, $r = .72$, $p < .005$, based on 156 complete pairwise observations. When the PSS scores were further divided into Low (scores 0 to 13), Moderate (scores 14 to 26) and High (scores 27 to 40), 34.8% (n=56) scored in the low category, 55.9% (n=90) in the moderate and 9.3% (n=15) in the high. When the Subjective Stress Scale was divided into low (scores 0 to 3), moderate (scores 4 to 6) and high (scores 7 to 10) the results were 35% (n=55), 28.7% (n=45) and 36.3% (n=57) respectively. These data suggest that students objective and subjective reports were consistent for low stress levels (34.8% v 35%) but that they subjectively rated their stress level as high when according to the PSS it was in the moderate range (moderate PSS 55.9% v SSS 28.7% and high PSS 9.3% v SSS 36.3%). Forty-two students experienced subjectively high stress even though their objective score was low or moderate (Figure 1).

Figure 1: Comparison of Medical Students Objective and Subjective Stress Levels

The PSS Items most endorsed at a moderate of severe level are shown by each bar in Figure 2. Responses indicate that students did not feel confident about their ability to handle personal problems (60.5%); did not feel able to control irritations in their lives (59.8%); did not feel that things were going their way (53.1%); felt nervous and stressed (46.9%); did not feel that they were on top of things (46.3%); felt that they were unable to control the important things in their lives (30.2%); have been angered because of things that were outside their control (29.6%); felt difficulties were piling up so high that they could not overcome them (21%); could not cope with all the things they had to do (20.3%); have been upset because of something that happened unexpectedly (19.8%).

Figure 2: Student Responses to Perceived Stress Scale Questions

Qualitative Results:

What things make you stressed:

Answers to this question fell into 6 main categories or themes, and includes Exams, Relationships, Future, College, Finance and Work-life balance /Time management. Other less frequently reported themes included Personal Health and Illness but in the context of falling behind and not having time to recover.

Figure 3a. Sources of Stress Identified by Medical Students

Exams:

Exams as a stress was reported by 95 out of 157 (60.5%) that completed this section; this fell into two broad categories, stress related to demands of the exams and stress related to personal factors. The category of stress related to personal factors extended to students' approach to exams and to their thinking, including fear of failure or performing poorly.

Relationships:

Relationships was reported as stressful by 53 (33.7%) this included family, partner, friends and colleagues with concern about family members health, little time to spend with them and inter-personal conflict with family and friends.

Future:

Future was reported as a source of pressure by 44 (28%). Concern was expressed about immediate issues such as obtaining electives or residency's as well as future career.

College:

38 (24.2%) commented that 'College' was stressful. Most did not elaborate further but those that did included issues with the organisation of the course (medicine) in general and their perception of lack of support, poor structure and communication deficits as well as academic and financial demands. On commented that 'constant College' created stress for them.

Finance:

33 (21%) reported financial stress. Most did not comment further than 'money' and 'finances' but those that did reported financial difficulty due to loans and pressure to pay fees.

Work Life Balance:

Work life balance was reported as being stressful by 32 (20.4%) and comments fell into two broad categories, excessive demands and poor time management.

How do you feel when you are stressed /how do you react:

148 completed this section and responses were divided into three categories representing the Emotional (anxiety, anger, mood), Physical and Cognitive or Thinking manifestations of stress.

Figure 3b. Emotional, Physical and Cognitive Impact of Stress

Emotional:

58 (39.2%) reported anxiety and this included excessive worry, agitation and panic. A further 48 (32.4%) reported being irritable, angry, hostile, grumpy and argumentative and 24 (16.2%) felt low

mood, depressed and sad. Eight (5%) reported crying and tears, thirteen (8.8%) reported being 'over-whelmed'. When combined, emotional effects were reported by 96.6% of students.

Physical:

The physical manifestations of stress, such as poor energy, tiredness, sleep disturbance, appetite disturbance, nail biting, headache, abdominal pain, gastro-intestinal upset, palpitations and breathing difficulties were reported by 44 (29.7%).

Cognitive:

Thinking problems and cognitive effects were reported by 24 (16.2%) and these included overthinking, poor concentration, sense of failure, hopelessness and procrastination.

Sixteen (10.8%) reported purely positive impacts of stress that helped them increase productivity and get things done. These students reported that stress made them talk to people, exercise, sleep, read, approach the task in a different way and take a break or focus on hobbies. Twenty (13.5%) reported a mixed response to stress where they reported negative, emotional and physical impact but also positive outcomes that increased their focus and productivity. Taken together this means that for 36 students (24.3%) their reaction to stress was either totally or partially helpful.

How do you cope when you are stressed?

146 students (90.1%) completed this section. Of those twelve (8.2%) felt that they did not cope well with stress while the remaining 134 (91.8%) reported they used positive strategies to cope with stress. Students were asked to include three coping strategies and most included more.

Figure 3c. Strategies Used by Medical Students to Manage Stress

Helpful Strategies:

Overall, students reported they used five main positive strategies to cope with stress and these were Activities other than study (70.5%), Connecting with friends and family (51.3%) and Exercise (50.7%), followed by Manage Thoughts (32.8%) and Meditation /Relaxation techniques (15.7%). Considerable numbers reported using all categories but interestingly there was not one mention of using support services, trainers, college resources or professional help.

There was specific mention of reminding themselves of 'all the good things in my life' and that 'it is worth it' and this may account for students high use of activity other than study and family and friends to cope. Many specifically mentioned linking with non-medical friends as supports. A number mentioned the positive benefit of stress that helps them work harder, focus and perform but the difficulty and negative impact of what they termed 'incessant pressure'.

Unhelpful strategies:

Twelve students (8.2%) reported that they did not deal with stress well. The strategies they used were as follows: Anger /outbursts or ignoring the problem (n=10; 6.8%), Alcohol (n=6; 4.1%), Social isolation (n=5; 3.4%), Don't eat or sleep (n=3; 2%), Cry (n=3; 2%), Procrastinate (n=2; 1.4%), Skin picking (n=1; 0.7%) and not well (n=1; 0.7%). Taking drugs was reported by one respondent and one student reported smoking in order to cope.

A significant number (n=14; 9.45%) report that they ignore the signs of stress and comments included: 'put a smile on when I don't feel like it', 'usually takes a day or two to realise I'm stressed', 'don't think about it', 'try to work through it', 'start to avoid situations', 'work more hours', 'am compelled to work faster', 'a lot of time I hide away from my stresses' and 'I talk myself out of it – why I don't have to be stressed'.

Discussion:

To our knowledge, no study to date has clinically assayed the impact of stress on the wellbeing of final year medical students, or examined their coping strategies using subjective and objective measures of stress. Our findings indicate that while the majority of students use positive strategies to manage and cope with stress and improve their resilience, they also report high levels of stress.

The final year medical students in our study who may have benefited from professional support were not inclined to seek the counselling services provided by the college, stating difficulties with setting up appointment times, and with these clashing with their clinical course work. The same is not true for students in other college courses or countries suggesting either stoicism or stigma, or both, might explain why medical students are not inclined to avail of traditional help.[7 29] This suggests that alternative and perhaps non-traditional mechanisms and channels for delivering psychological support such as embedding skills training and self-care in the curriculum might

overcome these barriers and the stigma and fear that is particular to medical students and this warrants further research.[7 39]

The final year medical student narrative reflects the many emotional, cognitive and physical effects of stress related to becoming a doctor. Our findings align with the stress studies in doctors but provide compelling evidence that doctors stress and distress predates their exposure to the hospital environment and is not all due to the increased responsibility and the demands that doctors are exposed to after graduation.[1 2 5 6 11 30]

The transition to student life coincides with a critical period in brain development and a high-risk period for the development of mental illness; 75% of mental illness manifests before the age of 25.[31-34] The student brain is already highly sensitive to the myriad of psycho-social stresses associated with mental illness, but when combined with the particular stresses of student life the perfect environment for distress and stress related illness is created.[32 35] Medical students report being under persistent pressure and many comment on the intensity, incessant and highly-competitive nature of the course. It is incumbent on us as educators not to add to medical student stress and to act as a protective factor rather than to precipitate or perpetuate mental illness.

Effective interventions for stress take the individual and the environment into account and this requires a multi-faceted approach at University and individual level.[3 32 33 35-41]We present clear evidence that medical students stress relates primarily to the academic, administrative and financial burden of student life. This could be counteracted by creating an efficient educational experience that is agile and responsive to need and that supports all students to achieve academic excellence while equipping them with the skills to succeed in a diverse and rapidly changing society.[42] Current legislation places a duty of care on all organisations to protect against, and to manage stress, in the workplace.[43] Extending this into our educational environments could protect medical students from the negative impacts of stress by creating a supportive community and culture where every member within the university is enabled to achieve their potential.[42] Such initiatives would address our final year medical students' comments of 'feeling worthless' because of a perceived constant focus on 'what we don't know' along with little positive feedback and would ensure that, as educators, we would alleviate rather than aggravate medical student stress.

We have emerging evidence of the positive impact of practical strategies at University level such as adjusting exam and study burden, modifying the assessment process, using protected 'downtime' and scheduled rest breaks along with financial and administrative support and facilitated access to

exercise and other well-being initiatives such as yoga and mindfulness[39] . However, we know, from interventions with qualified doctors, that when these initiatives are applied in a short-term manner and in isolation of one another the improvement is often temporary rather than the enduring change needed to empower the student /future doctor to manage the particular, and often extreme, pressures of medicine as a career.[36 41 44 45] A more beneficial and long-term approach would combine practical measures at University level with an individual approach that fosters life-long personal responsibility to manage ones' health, encourages self-care and healthy habits and that focusses on resilience, reflection and cognitive flexibility to help the student to manage and embrace change irrespective of the environment they find themselves working in.[38 39] Others have called for this approach with doctors but our findings suggest the time for this intervention is well before the qualified doctor steps into the working environment.[2 7 30]

For many the experience of studying and practicing medicine is positive and they or do not succumb to the toxic effects of stress. This group receives little attention but could provide valuable clues to resilience and coping ability. Over a third of final year medical students scored in the low stress category and a quarter reported that stress was either totally or partially helpful and increased their productivity and focus. Given that all students in our study were exposed to the same demands and scheduling this finding suggests that other factors, possibly in personal life or in personality, thinking style and habits may underpin some individuals stress response.[46 47] Excessive work commitment, high and often unrealistic, intrinsic and extrinsic, academic and personal expectations, along with driven personality traits, perfectionism, and tendency towards self-criticism have been identified as typical medical student traits.[46] Known to drive success these traits also predispose and increase an individual's vulnerability to stress.[37 38 46] In a competitive environment, and when combined with conscientiousness, fear of failure and an exaggerated sense of responsibility, these characteristics are a potent source of psychological distress that includes self-doubt, guilt, ill-health and stoicism.[47] In these situations anything less than 100% is regarded as failure or a negative outcome creating fear, procrastination and worry. Medical students in this study report that stress affects their confidence in their ability to perform. Their subjective perception of stress and sense of personal failure and worthlessness is increased. There have been calls for a learning culture that includes compulsory stress management training and a 'well-being curriculum' for medical students with less emphasis on academic grades and more on embedded socio-emotional skills training that would foster deep learning, personal reflection and self-awareness. This approach would empower the student with the strategies to manage uncertainty and unpredictability in a fast-moving world where total perfection is rarely attainable.[47]

The need to address the psychological pressures of health professions education in the context of the potential negative impact of burnout on learning has been highlighted.[40] Others outline the need to provide a comprehensive service for student mental health that incorporates student services and community mental health services.[33] While this initiative could help those with established mental illness, the depleted resources of the current psychological support services are likely inadequate to support those with evolving illness or the many others who experience considerable psychological distress. Furthermore, it fails to acknowledge the clear message that when needed medical students do not find the current services user friendly and do not use them. It is firmly established that untreated or inadequately treated mental illness is associated with poorer outcomes, progression to more complex disorders, substance misuse, higher suicide rates, academic failure and persistently impaired social and occupational functioning.[32-34] Rather than wait for this adverse outcome we suggest that student life is an important window of opportunity for prevention and timely, early, intervention.[32 35 36 39]

One of the main strengths of this study is the high response rate and the use of subjective and objective measures of stress along with the mixed-method approach and the use of extensive free-text options. This provides extensive information on the student experience and their perspective on the stress of studying medicine. Furthermore, all students were surveyed over the course of the same academic year and were therefore exposed to the same demands and scheduling. Limitations are the self-report nature of the study and the absence of a control group.

Irrespective of occupation or work environment, it is recognised that less stress leads to greater wellbeing, greater productivity and contentment, less sick leave absence, fewer errors and mistakes.[37 38] These key factors influence workplace engagement, productivity and retention and better outcomes for service users. Modern workplaces now include stress management / stress inoculation as a norm and an increasingly a mandatory requirement.[43] The WHO is firm in its belief that the majority of stress related illness is preventable and the recent focus in psychiatry has embraced this initiative, to prevent and intervene early in mental illness the same as with other physical diseases.[32 36] We suggest that the focus of wellbeing and self-care in doctors should be extended upstream and into the medical students classrooms. Embedding stress and self-care skills training in the curriculum using new and novel technological advances would provide students with the skills to manage stress and self-care and the ability to protect their wellbeing and prevent illness. This format could circumvent the barriers to psychological support and services and address stigma and fear.[39]

Education interventions that highlight work stress impact, improve students self-care skills, cognitive flexibility and tolerance of adversity could improve medical students confidence and resilience and prevent future burnout. We need to empower medical students and future doctors with the skills to succeed in todays and tomorrows workforce; this can only improve recruitment and retention to the profession and most importantly, deliver better outcomes for patients.

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Data sharing statement: As per the ethics approval, the data will not be shared outside of the participating research institutions.

Patient consent for publication: Not required

Data Statement: Technical Appendix, statistical code, and dataset available from the Dryad repository DOI: Doi.org/10.5061/dryad.2jm.63xskj

Figure 1: Comparison of Medical Students Objective and Subjective Stress Levels

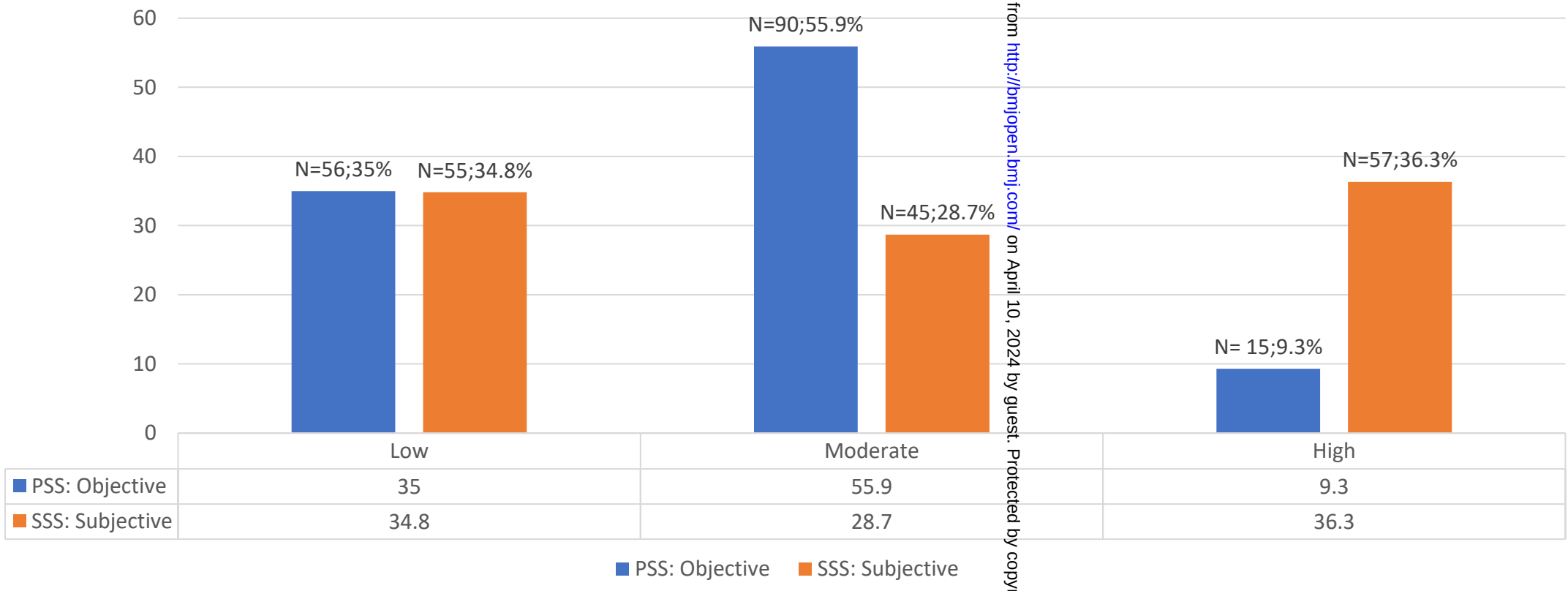


Figure 2:

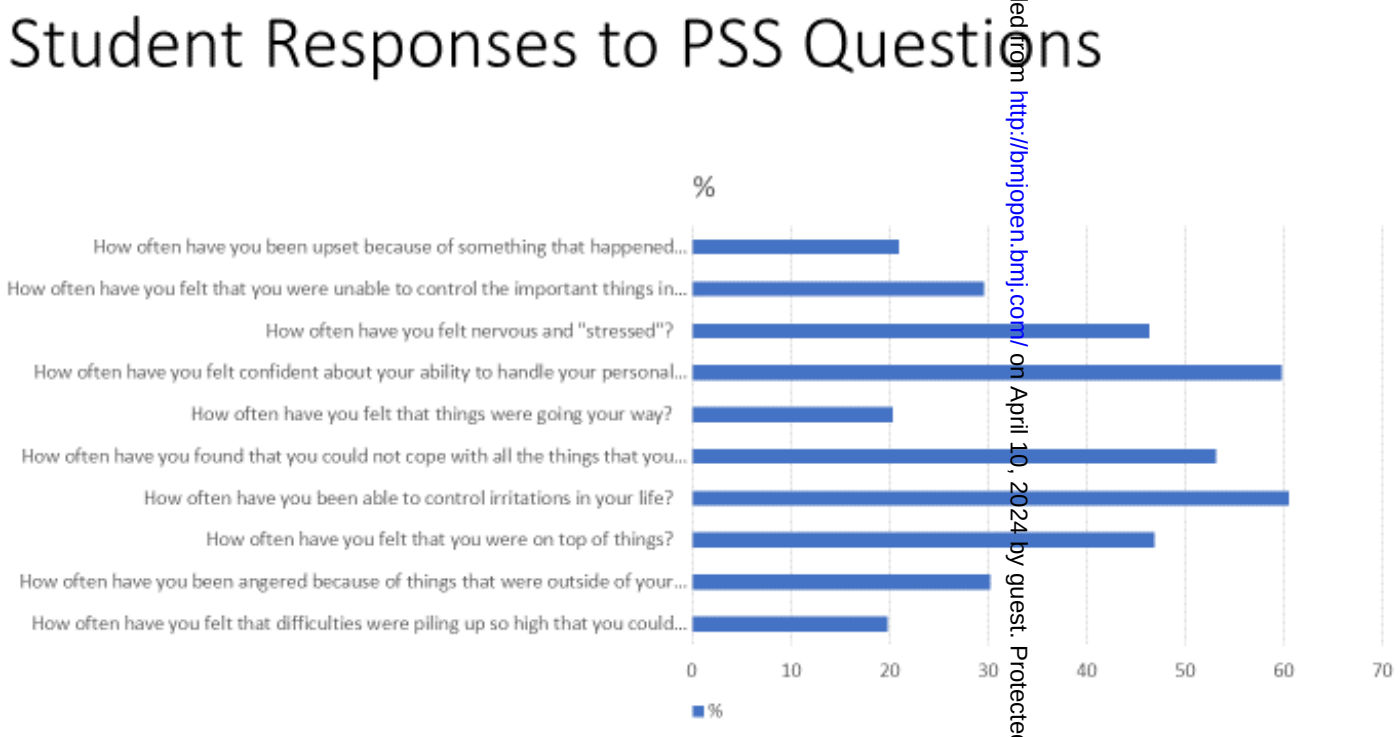


Figure 3a: Sources of Stress Identified by Medical Students

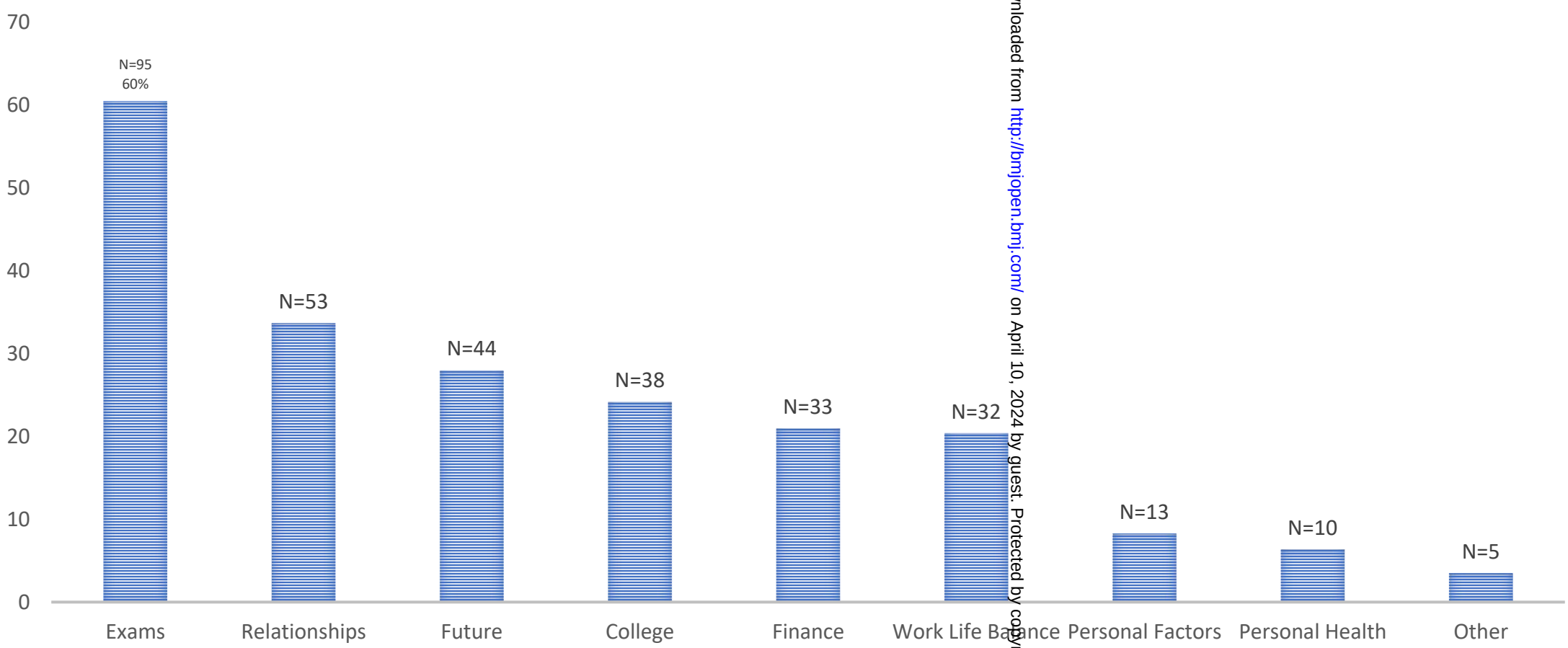


Figure 3b: Emotional, Physical and Cognitive Impact of Stress

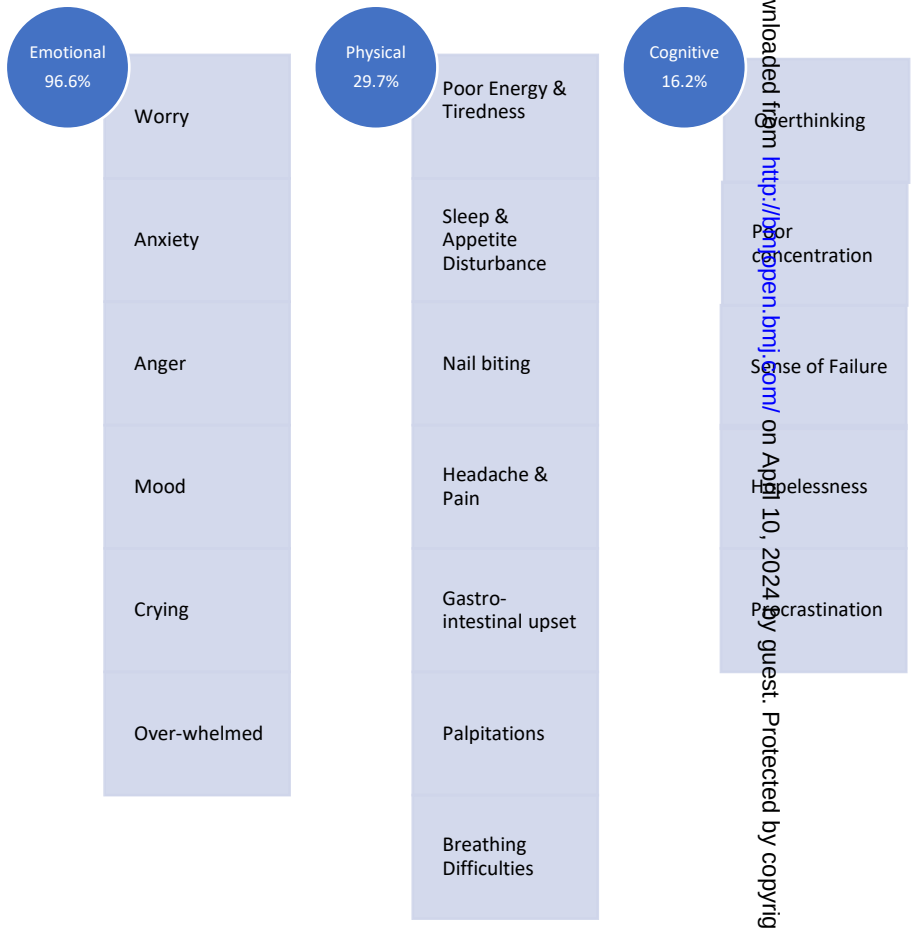
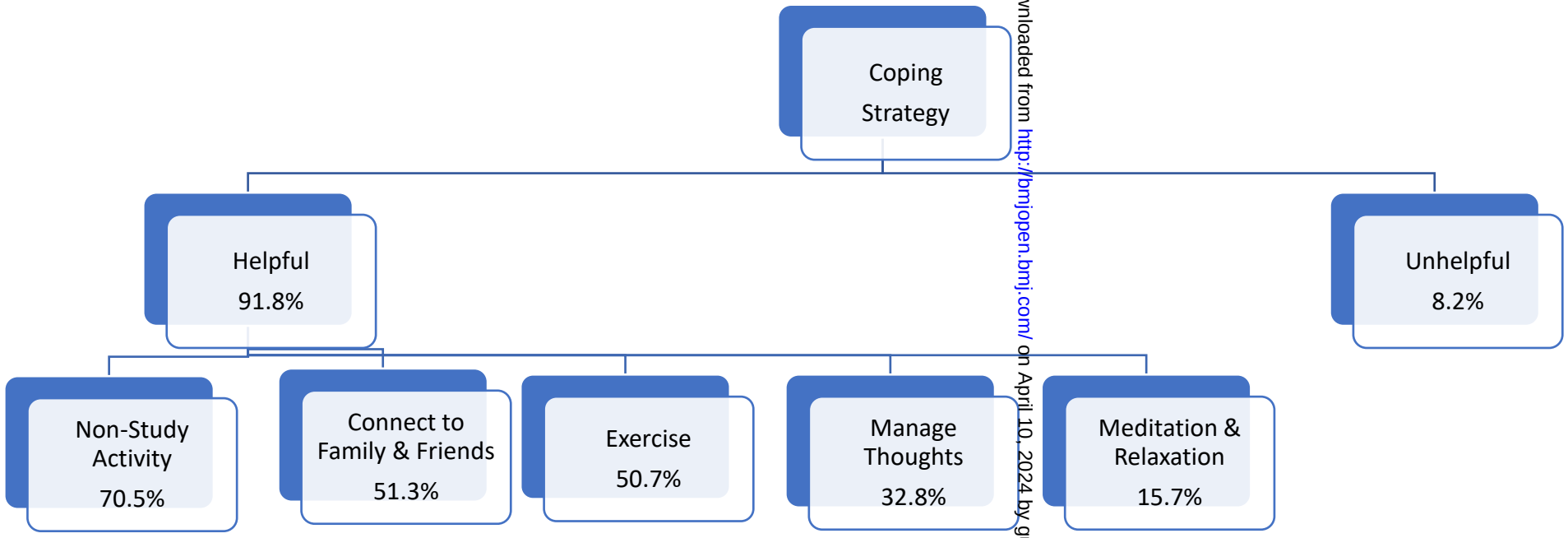


Figure 3c: Strategies Used by Medical Students to Manage Stress



Helpful Strategies included: Talk to someone, Organise, prioritise and plan, Eat and sleep, Mindfulness / breathing techniques, TV and movies, Music, Study more, Read, Pray, Tea, Podcast, Shopping, Sun, Less coffee and Time with Pet.
Unhelpful Strategies included: Anger /outbursts or ignoring the problem, Alcohol, Social isolation, Don't eat or sleep, Cry, Procrastinate, Skin picking, Not well, Taking drugs and Smoking.

Appendix 1. Stress Questionnaire for Medical Students

We are very aware of the stress of medical student life and as a Teaching and Learning group are looking to address this by developing materials to help students to identify and manage stress. To do this we need to measure baseline stress among medical students prior to the introduction of any materials and ask that you take a few moments to complete these questionnaires as they will provide us with valuable information. All data is anonymous and confidential. Thank you for your time.

Date: 2017

Age_____ **Gender** (*Circle*): M F **GEM** (*Circle*): Yes No

How stressed have you been in the past month? Mark 'X' on this line where 0 is lowest and 10 is highest.

0_____**10**

0=Lowest **10=Highest**

What things in your life make you feel stressed?

1._____

2._____

3._____

How do you feel when you are stressed /how do you react?

1._____

2._____

3._____

How do you cope when you are stressed?

1._____

2._____

3._____

Any other comments?

_____

_____ **Thank You.**

PERCEIVED STRESS SCALE

The questions in this scale ask you about your feelings and thoughts during the last MONTH**. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.**

0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often

1. In the last month, how often have you been upset because of something that happened unexpectedly?
   0 1 2 3 4

2. In the last month, how often have you felt that you were unable to control the important things in your life?
   0 1 2 3 4

3. In the last month, how often have you felt nervous and "stressed"?
   0 1 2 3 4

4. In the last month, how often have you felt confident about your ability to handle your personal problems?
   0 1 2 3 4

5. In the last month, how often have you felt that things were going your way?
   0 1 2 3 4

6. In the last month, how often have you found that you could not cope with all the things that you had to do?
   0 1 2 3 4

7. In the last month, how often have you been able to control irritations in your life?
   0 1 2 3 4

8. In the last month, how often have you felt that you were on top of things?
   0 1 2 3 4

9. In the last month, how often have you been angered because of things that were outside of your control?
   0 1 2 3 4

10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?
    0 1 2 3 4

Appendix 2 Detailed List of Qualitative Comments:

What things make you stressed:

Answers to this question fell into 7 main categories or themes, and includes exams, relationships, future, college, finance and work-life balance/time management. Other less frequently reported themes included personal health and illness but in the context of falling behind and not having time to recover. Table 4a.

157 completed this section:

Exams:

Exams as a stress was reported by 95 out of 157 (60.5%) and this fell into two broad categories, stress related to demands of the exams and stress related to personal factors. The category of stress related to personal factors extended to students' approach to exams and to their thinking, including fear of failure or performing poorly. Comments were made about constant pressure both from the college and from the students thinking and personal and college expectations. Others included expected academic performance and deadlines, balancing college and exams and work and relationships, the relentless nature of the exams and the 'incessant nature' of the final year as well as a negative focus on what students did not know rather than what they knew. Comments included 'not enough hours in the day', 'hyper-competitive environment', 'constant college demands', 'exams close together', 'volume of work'. Many reported being stressed by 'being unprepared', 'fear of not performing at my best', 'falling behind', 'failing', 'not doing well', 'being left behind', 'expectation on myself versus the reality', 'comparing myself to others and their success', 'my thoughts', 'my reactions to things', 'over-whelmed' and 'procrastination'.

Relationships:

Relationships was reported as stressful by 53 out of 157 (33.7%) this included family, partner, friends and colleagues with concern about family members health, little time to spend with them and inter-personal conflict with family and friends.

Future:

Future was reported as a source of pressure by 44 out of 157 (28%). Concern was expressed about immediate issues such as obtaining electives or residency's and the application process involved with specific mention of the pressure experienced by North American students 'trying to balance school with all the extra training, exams and applications that North Americans have'. Further comment implied a lack of support from the College through this process. Comments about future

following graduation and further career path 'deciding what type of medicine /surgery to enter' and the pressure of doing well in medicine as a career choice were prominent along with particular and frequent mention of future employment uncertainty 'unsure of my position next year – what job will I have?'. One commented that their stress was increased from the 'combination of present responsibilities along with planning for the future' as well as 'worrying about putting in work now for applications in the future (audits, research and electives) and a fear that they did not have the time (because of daily college and exam pressures) to do well in these applications and that this would affect future choices. Others mentioned worry and comparing themselves to peers who had chosen careers other than medicine and who were perceived as being more successful and further along their career path. One commented that they felt 'pressure to complete and start working when everyone in peer group has holidays to go on. Seems like other career choice would've been worth it as we are a clever bunch and could've done other things to be successful'.

College:

38 out of 157 (24.2%) commented that 'College' was stressful. Most did not elaborate further but those that did included issues with the organisation of the course (medicine) in general and their perception of lack of support, poor structure and communication deficits as well as academic and financial demands. On commented that 'constant College' created stress for them.

Finance:

33 out of 157 (21%) reported financial stress. Most did not comment further than 'money' and 'finances' but those that did reported financial difficulty due to loans, pressure to pay fees 'bank loans not being approved to pay fees', 'exam results being delayed because of bank loan not being approved for fees' and 'trying to keep on top of money issues'. Those that commented on 'having no money' added that this was in comparison to peers in other professions or 'comparing myself to others and their success'.

Work Life Balance:

Work life balance was reported as being stressful by 32 out of 157 (20.4%) and comments fell into two broad categories, excessive demands and poor time management. Comments included having few social outlets 'letting normal life go', lack of social life, lack of time with friends, limited work-life balance, lack of time to play sport or engage in activity outside college, inability to maintain balanced life-style. Students' were aware of their limited work-life balance and of 'letting other interests and

commitments slip' and of 'not seeing people outside medicine'. Others commented on their poor time management when trying to manage activities as well as study.

Other Themes:

"Personal factors" were cited by 13 (8.3%) as being the source of stress. Personal health and illness were reported as a stress by 10 out of 157 (6.4%) and comments included 'being sick' and 'falling behind' when they needed time out to recover. Others reported feeling 'lonely', 'hospital food unhealthy', 'crime in the area', 'finding housing'. One student reported 'not much at all' to the question 'what things make you stressed'.

How do you feel when you are stressed /how do you react:

148 completed this section and responses were divided into three categories representing the Emotional (anxiety, anger, mood), Cognitive or Thinking and Physical manifestations of stress. Table 4b.

Emotional:

58 out of 148 (39.2%) reported anxiety and this included excessive worry, agitation and panic. A further 48 out of 148 (32.4%) reported being irritable, angry, hostile, grumpy and argumentative and 24 out of 148 (16.2%) felt low mood, depressed and sad. Eight out of 148 reported crying and tears. When combined, the emotional response of anxiety, irritability and low mood was reported 87.8% of students. Thirteen out of 148 (8.8%) reported being 'over-whelmed'.

Cognitive:

Thinking problems and cognitive effects were reported by 24 out of 148 (16.2%) and these included overthinking, poor concentration, sense of failure, hopelessness and procrastination.

Physical:

The physical manifestations of stress, such as poor energy, tiredness, sleep disturbance, appetite disturbance, nail biting, headache, abdominal pain, gastro-intestinal upset, palpitations and breathing difficulties were reported by 44 out of 148 (29.7%).

Sixteen out of 148 (10.8%) reported purely positive impacts of stress that helped them increase productivity and get things done. These students reported that stress made them talk to people, exercise, sleep, read, approach the task in a different way and take a break or focus on hobbies. Twenty out of 148 (13.5%) reported a mixed response to stress where they reported negative, emotional and physical impact but also positive outcomes that increased their focus and productivity. Taken together this means that for 36 students out of 148 (24.3%) their reaction to stress was either totally or partially helpful.

How do you cope when you are stressed?

Of the 162 students 146 (90.1%) completed this section. Of those twelve (8.2%) felt that they did not cope well with stress while the remaining 134 (91.8%) reported they used positive strategies to cope with stress. Students were asked to include three coping strategies and most included more. Table 4c.

Helpful Strategies:

The top ten positive strategies in order included: Exercise (50.7%), Talk to someone (30.8%), Organise, prioritise and plan (23.3%), Time with friends (20.5%), Activity other than study (19.2%), Eat and sleep (17.1%), Meditation, mindfulness, breathing techniques (13%), TV and movies (10.9%), Music (6.8%), Study more (6.8%). Other strategies included Reading (4.8%), Prayer (3.4%), thought management and self-reassurance, relaxation, taking timeout all 2.7%, with Tea, Podcast, Shopping all 1.4% and Sun, Less coffee and Time with Pet all at 0.7%.

Overall, students reported they used five main positive strategies to cope with stress and these were activities other than study (70.5%), connecting with friends and family (51.3%) and exercise (50.7%), followed by Organisation and Planning (32.8%) and Meditation /Relaxation techniques (15.7%). Considerable numbers reported using all categories but interestingly there was not one mention of using support services, trainers, college resources or professional help.

Many used positive self-talk and mentioned that they try to look at 'the bigger picture' and try to 'keep perspective' and while acknowledging that exam results are important that there is a 'broader scheme of things' and that 'it is all manageable'. There was specific mention of reminding themselves of 'all the good things in my life' and that 'it is worth it' and this may account for students high use of activity other than study and family and friends to cope. Many specifically mentioned linking with non-medical friends as supports. A number mentioned the positive benefit of

stress that helps them work harder, focus and perform but the difficulty and negative impact of what they termed 'incessant pressure'.

A significant group (n=14; 9.45%) report that they ignore the signs of stress and comments included: 'put a smile on when I don't feel like it', 'usually takes a day or two to realise I'm stressed', 'don't think about it', 'try to work through it', 'start to avoid situations', 'work more hours', 'am compelled to work faster', 'a lot of time I hide away from my stresses' and 'I talk myself out of it – why I don't have to be stressed'.

Unhelpful strategies:

Twelve students (8.2%) reported that they did not deal with stress well. The strategies they used were as follows: Anger /outbursts or ignoring the problem (n=10; 6.8%), Alcohol (n=6;4.1%), Social isolation (n=5; 3.4%), Don't eat or sleep (n=3; 2%), Cry (n=3; 2%), Procrastinate (n=2; 1.4%), Skin picking (n=1; 0.7%) and not well (n=1; 0.7%). Taking drugs was reported by one respondent and one student reported smoking in order to cope.

Other Comments:

In the free text 'Other Comments' section 22 students chose to make an additional comment. A number of students thanked us for undertaking this work which was regarded as 'worthwhile' with the comment that 'guidance and direction on coping should be done more often through the college course' and that it 'would be a useful exercise to complete throughout the course'. One suggested that 'medical students can cope best when stress when plans/direction and guidance is given' and another that 'students tend to be incredibly stressed in Res (Final Year) year and that can be an over-whelming time'.

Some reported being less stressed during the past month as 'I'm very relaxed compared to my friends /peers (that is, those doing the other modules)' and 'psychiatry was a more enjoyable and organised module than medicine and surgery'. Another commented that they 'thoroughly enjoyed the module (psychiatry)'.

Students suggested possible inputs that included a 'student hotline' and the 'time to talk'. Comments included the student's tendency to self 'diagnose' and others commented that in their experience the counselling service was slow to respond and that the time of appointments

competed with course work or college commitments. Further comments suggested that ‘stress was high’ due to the ‘intensity of the course, exams’ and ‘intense competition at every stage of the path’ along with ‘the intensity of this very difficult year’ and that ‘I know what I should do but time is the biggest issue’.

Others reported that ‘not doing well upsets me’, ‘being perfectionist’ and a number reported ‘feeling worthless’ because of constant focus on what we don’t know that has negatively impacted self-esteem’. A number reported feeling a ‘lack of support’ and ‘little positive feedback’ along with ‘lack of support /encouragement from staff’ with a ‘focus on what we don’t know’ as being stressful and something they felt needed to be addressed.

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross sectionalreporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1

Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	#3	State specific objectives, including any prespecified hypotheses	4-5
Methods			
Study design	#4	Present key elements of study design early in the paper	5-6
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	5-6
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	N/A Observational study of a whole class student population
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment	5-7

		(measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	
Bias	#9	Describe any efforts to address potential sources of bias	6
Study size	#10	Explain how the study size was arrived at	5
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	5-7
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	6
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	7-8
Statistical methods	#12c	Explain how missing data were addressed	7
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy	N/A Observational study of a whole class student population
Statistical methods	#12e	Describe any sensitivity analyses	N/A Observational study

Results

Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	7-12
Participants	#13b	Give reasons for non-participation at each stage	N/A
Participants	#13c	Consider use of a flow diagram	N/A
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	5
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	5-7
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	N/A Observational study of a whole class student population
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which	N/A Observational study of a whole class student population

		confounders were adjusted for and why they were included	
Main results	#16b	Report category boundaries when continuous variables were categorized	8
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A Observational study of a whole class student population
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	7-8
Discussion			
Key results	#18	Summarise key results with reference to study objectives	12-13
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	12-15
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	13-15

Generalisability	#21	Discuss the generalisability (external validity) of the study results	13
Other Information			
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

BMJ Open

Worried, Weary and Worn out: A Mixed Methods Study of Stress and Wellbeing in Final Year Medical Students

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Worried, Weary and Worn out: A Mixed Methods Study of Stress and Wellbeing in Final Year Medical Students

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Abstract

Objectives: Although there is much focus on burnout and psychological distress amongst doctors, studies about stress and wellbeing in medical students are limited but could inform early intervention and prevention strategies.

Design: The primary aim of this mixed methods, cross-sectional survey was to examine objective and subjective levels of stress in Final Year Medical students (2017) and to explore their perspectives on the factors they considered relevant to their wellbeing.

Setting: University College Dublin, the largest University in Ireland.

Participants: 161 of 235 medical students participated in this study (response rate 69%).

Results: 65.2% of students scored over accepted norms for the Perceived Stress Scale (34.8% low; 55.9% moderate; 9.3% high). 35% scored low; 28.7% moderate and 36.3% high on the Subjective Stress Scale. Thematic Analysis identified worry about exams, relationships, concern about future, work-life balance and finance; 1 in 3 students reported worry, irritability and hostility; many felt worn out. Cognitive impacts included over-thinking, poor concentration, sense of failure, hopelessness and procrastination. Almost a third reported sleep and appetite disturbance, fatigue and weariness. A quarter reported a "positive reaction" to stress. Positive strategies to manage stress included connection and talking, exercise, non-study activity and meditation. Unhelpful strategies included isolation and substance use. No student reported using the college support services or sought professional help.

Conclusions: Medical students experience high levels of psychological distress, similar to their more senior doctor colleagues. They are disinclined to avail of traditional college help services. Toxic effects of stress may impact their cognition, learning, engagement and empathy and increase patient risk and adverse outcomes. The focus of wellbeing in doctors should be extended upstream and embedded in the curriculum where it could prevent future burnout, improve retention to the profession and deliver better outcomes for patients.

Strengths and limitations of this study:

- The response rate is high compared to other studies in medical student groups.
- Inclusion of subjective and objective measures of stress and a mixed-method approach gives more insight into students' experiences.
- All students were exposed to the same academic demands and scheduling.
- The cross-sectional nature of this survey and the lack of information about ethnicity may limit its generalisability and representativeness
- The study is limited by the absence of a control group.

Introduction

Medicine is regarded as a particularly stressful career with high rates of psychological distress and stress-related mental illness, anxiety, depression and suicide reported at all training and seniority levels, irrespective of speciality.[1-6] Studies exploring psychological distress in hospital doctors estimate that between 22% and 32% experience high distress, while a systematic review of depression and anxiety in doctors and medical students suggests a 14-60% prevalence of depression and an 18-55% prevalence of anxiety.[1 5 7-11]

This distress is known to impact on the quality of patient care and to increase negative outcomes[12 13] and is linked to absenteeism, attrition from the profession[14] and, more importantly, the stigma and guilt induced presenteeism that is known to significantly impact on doctor health and patient care.[15-19] Stressed individuals may demonstrate less empathy, are often irritable, overwhelmed and hostile, making them prone to errors of judgement and poor decision-making and an increased likelihood of malpractice consequences.[13 20 21] With a rapidly changing modern health system with increasing demands and fewer resources, patient safety is rightly a major focus. The optimum delivery of service means that the health of providers is of critical importance, yet the evidence suggests that this factor is often neglected.[3 4 16]

Stress is regarded as "the epidemic of the 21st century" and the WHO estimated that by 2020 five of the top ten illnesses world-wide will be linked to stress. Yet they also suggest that stress is preventable and manageable through life-style modifications and learned coping strategies.[22] Patterns of poor self-care and stoicism are prevalent in the health professions, identifiable in medical school and thought to deteriorate further after graduation often leading to practitioner neglect of health and unhealthy habits.[2 4-6 23 24-29]

Reliable estimates of stress and psychological distress during medical training are important and could help identify, prevent and treat causes of distress among medical students and future doctors. Intervening early at school level could provide future doctors with the strategies to improve their ability to withstand stress and to prevent mental health difficulties and burnout. In the broader context, strategies to improve stress in the medical workplace could lead to better outcomes for patients and improve recruitment and retention rates for the profession overall.[14 16 27-32]

Studies to date have focussed on the workplace demands and factors that might lead to burnout in doctors [1 2 5 6 14 29 30] rather than fully determine the factors that students identify in their career and personal life or the impact of environmental factors, thinking styles and coping strategies.

We examined final year medical students stress levels using both objective and subjective measures of stress and explored in depth the medical students' own perspectives and narrative on the factors that impact on their wellbeing and stress levels during training, their views on the impact of stress on their health and the strategies they use to manage or cope with stress.

Methods

Participants

The participants in this study were Final Year Medical Students from Ireland's largest University, University College Dublin (UCD). We chose to examine Final Year Students as they were closest to graduation and this cohort seemed a natural extension to the Hayes et al post-graduate cohort.[2]

Final Year Medicine is made up of around 240 students who are divided into four groups. Teaching follows a Modular Curriculum, with an end of module integrated knowledge-based and clinical examination in the four clinical sub-specialities of Psychiatry, Obstetrics and Gynaecology, General Practice and Paediatrics. The Psychiatry Module is part of the core curriculum for the MB Bch BAO degree in Medicine. The survey was conducted in week five of the six-week Psychiatry Module, measuring stress levels in the previous four weeks, when students were engaged in clinical placements and continuous formative and summative assessments, and at least ten days in advance of the final modular assessment.

The class included both Graduate Entry (GEM) and undergraduate (non-GEM) students. In UCD, GEM and undergraduate students come together at year 4. Graduate Entry Students (GEM) must have obtained a 2:1 undergraduate degree prior to completing The Graduate Medical School Admissions Test (GAMSAT, formerly known as the Graduate Australian Medical School Admissions Test) and undergoing an application process. Undergraduate Medical School Entrants (non-GEM) are allocated places based on their Health Professions Admission Test (HPAT) which was developed by the Australian Council for Educational Research and used to help select students into medicine and some other health science courses at university) and their Central Applications Office (CAO) application, which ranks their performance in the National State Examination (Leaving Certificate or A-Levels) and which centrally processes applications for undergraduate courses in Irish Higher Education Institutions.

The present study is descriptive, mixed-methods and cross-sectional in nature and focuses on baseline, subjective and objective, stress levels in medical students.

Students provided written informed consent and were assured that all data was anonymised and confidential. Ethical approval for the study was obtained from the Head of School in accordance with UCD Regulations. Due to the sensitive nature of the questions, students were informed of the student support services available to them and encouraged to seek help if needed. Patients and the public were not involved in this part of the study.

Patient and Public Involvement:

No patient involved.

Questionnaire: The questionnaire used in this study (Appendix 1), collected demographic details to include age, gender and GEM or non-GEM status. We used the Perceived Stress Scale (PSS), which is a widely used, validated and reliable psychological instrument that measures individuals perceptions of stress.[33] Items are designed to explore how unpredictable, uncontrollable, and overloaded respondents find their lives and includes questions about current levels of stress. The PSS was designed for use in college and community samples. The questions are of a general nature and hence relatively free of content that would be considered specific to any subpopulation group. The scale measures an individual's perceived stress levels in the previous month; responses can be summed across all scale items and further divided into low (0-13), moderate (14-26) and high (27-40) perceived stress categories[33]. Normative data has been reported[34] and ranges between 11.9 and 14.7.

We asked students to further rate their subjective level of stress on a Likert scale (Subjective Stress Scale, SSS) and asked them to mark an X on a line between 0 (lowest) and 10 (highest) to indicate how stressed they had been in the past month. We used this as a continuous variable and also subdivided it into 3 categories low (0-3), moderate (4-6) and high (7-10). This allowed us to compare students subjective and objective measures as it has been reported that some people under-estimate and some over-estimate their stress levels.[35]

The next section was made up of qualitative free text questions asking students to list 3 things under the following headings:

1. What things in your life make you feel stressed (triggers)?
2. How do you feel when you are stressed/ how do you react (effects)?
3. How do you cope when you are stressed (coping skills)?

The final question on the questionnaire was an open-ended, free-text, qualitative question "Any other comments?" which gave students the opportunity to add any further thoughts or comments.

Analyses

As the survey had a mixed methods design, both quantitative and qualitative analyses were undertaken. Quantitative analysis was conducted using IBM SPSS Statistics 24[36] and included t-tests and Chi-squared tests and Correlation Analysis as appropriate with significance level set at $p<0.05$. Qualitative analysis on the relevant questions was conducted systematically in the form of a step-by-step Thematic Analysis.[37 38] Initial analysis identified and described the themes by reading and re-reading a selection of the data sheets and summaries by two researchers working independently (AL and EC). These were further discussed and code identified. Data was then systematically coded by the two researchers independently and discrepancies checked, discussed and clarified. Following this, further analysis of the data to identify the main themes was conducted according to the work of Cohen.[39]

Results

There were 235 students in total in the Final Year class of 2017; 123 females (52%) and 112 males (48%); 44% GEM and 56% non-GEM; age range 22 to 46 years. Of these 161 (response rate 69%) participated in this study with a mean age of 24.76 years (s.d. 2.6; range 22 to 42 years). There were 88 (54.6% females) and 73 males (45.3%); 65 (40.4%) were graduate entry (GEM) and 96 (59.6%) were on the undergraduate entry course (non-GEM).

Quantitative Results:

PSS: Mean scores on the PSS were 16.94 (s.d. 7.06), median 16.0 and mode 12.0, range 1 to 34. When the scores for males and females were compared, females had higher scores (mean 17.99; s.d. 7.37) compared to males (mean 15.53; s.d. 6.59) and this was statistically significant ($p=0.029$). There was no difference in the scores of GEM versus non-GEM 16.37; s.d. 7.56 versus 17.30; s.d. 6.77 ($p=0.849$). 65.2% of students' scored over accepted norms for the PSS.

SSS: On the Subjective scale the mean score was 4.88; s.d. 2.62, median 5 and mode 7, range 0 to 10. Females again scored higher than males (females 5.24; s.d. 2.54 and males 4.44; s.d. 2.67) trending towards significance at $p=0.058$. There was no significant difference between GEM and non-GEM (4.85; s.d. 2.72 versus 4.93; s.d. 2.57; $p=0.419$). (Table 1)

Table 1. Perceived Stress Scores (PSS) and Subjective Scores (SSS) Compared by Gender and GEM Status

			PSS		SSS	
	N	%	Mean	s.d	Mean	s.d
Male	73	45.3	15.53	6.59	4.44	2.67
Female	88	54.3	17.99	7.37*	5.24	2.54
GEM	65	40.4	16.37	7.56	4.85	2.72
Non GEM	96	59.6	17.30	6.77	4.93	2.57

PSS female v male*, p=0.029; GEM v Non-GEM, p=0.849. SSS female v male, p=0.058; GEM v Non-GEM p=0.419.

Scores on both measures were moderately correlated, *r = .72, p < .005*, based on 156 complete pairwise observations. Age did not correlate with total scores on the PSS *(r=.142, p= 0.069*) or SSS (*r=.123, p=0.128)*.

When the PSS scores were further divided into Low (scores 0 to 13), Moderate (scores 14 to 26) and High (scores 27 to 40), 34.8% (n=56) scored in the low category, 55.9% (n=90) in the moderate and 9.3% (n=15) in the high. When the Subjective Stress Scale was divided into low (scores 0 to 3), moderate (scores 4 to 6) and high (scores 7 to 10) the results were 35% (n=55), 28.7% (n=45) and 36.3% (n=57) respectively. Students' objective and subjective reports were consistent for low stress levels (34.8% v 35%) but differed for moderate PSS 55.9% v SSS 28.7% and high PSS 9.3% v SSS 36.3% (Chi-squared 52.76; df 4; p<0.001). Forty-two students reported subjectively high stress although their objective score was low or moderate (Figure 1).

Figure 1: Comparison of Medical Students Objective and Subjective Stress Levels

The PSS Items most endorsed at a moderate of severe level are shown by each bar in Figure 2. Responses indicate that students did not feel confident about their ability to handle personal problems (60.5%); did not feel able to control irritations in their lives (59.8%); did not feel that things were going their way (53.1%); felt nervous and stressed (46.9%); did not feel that they were on top

of things (46.3%); felt that they were unable to control the important things in their lives (30.2%); have been angered because of things that were outside their control (29.6%); felt difficulties were piling up so high that they could not overcome them (21%); could not cope with all the things they had to do (20.3%); have been upset because of something that happened unexpectedly (19.8%).

Figure 2: Student Responses to Perceived Stress Scale Questions

Qualitative Results:

What things make you stressed:

Answers to this question fell into 6 main categories or themes, and included Exams, Relationships, Future, College, Finance and Work-life balance /Time management (Figure 3). Other less frequently reported themes included Personal Health and Illness but in the context of falling behind and not having time to recover. See Appendix 2 for the detailed list of qualitative comments.

Figure 3. Sources of Stress Identified by Medical Students

Exams:

Exams as a stress was reported by 95 out of the 157 that completed this section; this fell into two broad categories, stress related to demands of the exams and stress related to personal factors such as students' approach to exams and to their thinking. Many commented on college and personal expectations along with a fear of failure or performing poorly.

Comments included deadlines, balancing college and exams and work and relationships, the relentless nature of the exams and the 'incessant nature' of the final year as well as a negative focus on what students did not know rather than what they knew. Students reported 'not enough hours in the day', 'hyper-competitive environment', 'constant college demands', 'exams close together' and 'volume of work'. Many reported being stressed by 'being unprepared', 'fear of not performing at my best', 'falling behind', 'failing', 'not doing well', 'being left behind', 'expectation on myself

versus the reality', 'comparing myself to others and their success', 'my thoughts', 'my reactions to things', 'over-whelmed' and 'procrastination'.

Relationships:

Relationships was reported as stressful by 53 and this included family, partner, friends and colleagues with concern about family members health, little time to spend with them and inter-personal conflict with family and friends.

Future:

Future was reported as a source of pressure by 44. Concern was expressed about immediate issues such as obtaining electives or residencies as well as future career. Comments about future following graduation and further career path 'deciding what type of medicine /surgery to enter' and the pressure of doing well in medicine as a career choice were prominent along with particular and frequent mention of future employment uncertainty 'unsure of my position next year – what job will I have?'. One commented that their stress was increased from the 'combination of present responsibilities along with planning for the future' as well as 'worrying about putting in work now for applications in the future (audits, research and electives) and a fear that they did not have the time (because of daily college and exam pressures) to do well in these applications and that this would affect future choices. Others mentioned worry and comparing themselves to peers who had chosen careers other than medicine and who were perceived as being more successful and further along their career path. One commented that they felt 'pressure to complete and start working when everyone in peer group has holidays to go on. Seems like other career choice would've been worth it as we are a clever bunch and could've done other things to be successful'.

College:

38 commented that 'College' was stressful. Most did not elaborate further but those that did included issues with the organisation of the course (medicine) in general and their perception of lack of support, poor structure and communication deficits as well as academic and financial demands. One commented that 'constant College' created stress for them.

Finance:

33 reported financial stress. Most did not comment further than 'money' and 'finances' but those that did reported financial difficulty due to loans and pressure to pay fees.

Work Life Balance:

Work life balance was reported as being stressful by 32 and comments fell into two broad categories, excessive demands and poor time management. Comments included having few social outlets 'letting normal life go', lack of social life, lack of time with friends, limited work-life balance, lack of time to play sport or engage in activity outside college, inability to maintain balanced life-style. Students were aware of their limited work-life balance and of 'letting other interests and commitments slip' and of 'not seeing people outside medicine'. Others commented on their poor time management when trying to manage activities as well as study.

How do you feel when you are stressed /how do you react:

148 completed this section and responses were divided into three categories representing the Emotional (anxiety, anger, mood), Physical and Cognitive or Thinking manifestations of stress (Figure 4).

Figure 4. Emotional, Physical and Cognitive Impact of Stress

Emotional:

58 reported anxiety and this included excessive worry, agitation and panic. A further 48 reported being irritable, angry, hostile, grumpy and argumentative and 24 felt low mood, depressed and sad. Eight reported crying and tears, thirteen reported being 'overwhelmed'. When combined, almost all students reported the emotional effects of stress.

Physical:

The physical manifestations of stress, such as poor energy, tiredness, sleep disturbance, appetite disturbance, nail-biting, headache, abdominal pain, gastro-intestinal upset, palpitations and breathing difficulties were reported by 44.

Cognitive:

Thinking problems and cognitive effects were reported by 24 and these included overthinking, poor concentration, sense of failure, hopelessness and procrastination.

Sixteen reported purely positive impacts of stress that helped them increase productivity and get things done. These students reported that stress made them talk to people, exercise, sleep, read, approach the task in a different way and take a break or focus on hobbies. Twenty reported a mixed response to stress where they reported negative, emotional and physical impact but also positive outcomes that increased their focus and productivity. Taken together this means that for 36 students or a quarter of the sample reported that their reaction to stress was either totally or partially helpful.

How do you cope when you are stressed?

Twelve students reported that they did not cope well with stress while the remaining group reported they used positive strategies to cope with stress. Students were asked to include three coping strategies and most included more (Figure 5).

Figure 5. Strategies Used by Medical Students to Manage Stress

Helpful Strategies:

Overall, students reported they used five main positive strategies to cope with stress and these were Activities other than study, Connecting with friends and family, and Exercise, followed by Manage Thoughts, and Meditation/Relaxation techniques. Considerable numbers reported using all categories but interestingly there was not one mention of using support services, trainers, college resources or professional help.

There was specific mention of reminding themselves of 'all the good things in my life' and that 'it is worth it' and this may account for students high use of activity other than study and family and friends to cope. Many specifically mentioned linking with non-medical friends as supports. A number mentioned the positive benefit of stress that helps them work harder, focus and perform but the difficulty and negative impact of what they termed 'incessant pressure'.

Unhelpful strategies:

Twelve students reported that they did not deal with stress well. The strategies they used were as follows: Anger/outbursts or ignoring the problem (n=10), Alcohol (n=6), Social isolation (n=5), Don't eat or sleep (n=3), Cry (n=3), Procrastinate (n=2), Skin picking (n=1) and not well (n=1). Taking drugs was reported by one respondent and one student reported smoking in order to cope.

A significant number (n=14) report that they ignore the signs of stress and comments included: 'put a smile on when I don't feel like it', 'usually takes a day or two to realise I'm stressed', 'don't think about it', 'try to work through it', 'start to avoid situations', 'work more hours', 'am compelled to work faster', 'a lot of time I hide away from my stresses' and 'I talk myself out of it – why I don't have to be stressed'.

Discussion:

To our knowledge, no study to date has explored the impact of stress on the wellbeing of final year medical students, or examined their coping strategies using subjective and objective measures of stress. Our findings indicate that while the majority of students use positive strategies to manage and cope with stress and improve their resilience, they also report high levels of stress. This is in keeping with suggestions that training in resilience skills alone may not prevent stress.[31 32]

The final year medical student narrative reflects the many emotional, cognitive and physical effects of stress related to becoming a doctor. Our findings align with previous stress studies in doctors but provide compelling evidence that doctors' stress and distress predates their exposure to the hospital environment and is not all due to the increased responsibility and the demands that doctors are exposed to after graduation.[1 2 5 6 14 40]

The final year medical students in our study who may have benefited from professional support were not inclined to seek out the counselling services provided by the college, stating difficulties with setting up appointment times, and with these clashing with their clinical course work. The same pattern is evident, but not to the same extent, for students in other college courses or countries suggesting that medical students are not inclined to avail of traditional help often citing stigma, fear and concern about confidentiality.[7 41 42] These barriers to help-seeking might be overcome by alternative and perhaps non-traditional mechanisms for delivering psychological support. The Royal Medical Benevolent Fund, Practitioner Health Programme and the Stanford Model of Professional Fulfilment are two such initiatives. [31 32 43]However, embedding stress training and self-care in the curriculum might overcome these barriers at student level and this warrants further research.[7 39 44]

Effective interventions for stress take the individual and the environment into account and this requires a multi-faceted approach at University and individual level.[3 31 44 45 46 47] Rather than focus on academic excellence and the assessment of factual knowledge we need to provide students with the skills to succeed in a diverse and rapidly changing society.[48] Current legislation places a duty of care on all organisations to protect against stress in the workplace.[49] Extending this into our educational environments could protect medical students from the negative impacts of stress.[48] The calls for a learning culture that includes compulsory stress management training and a 'well-being curriculum' for medical students have been met with some resistance. Obstacles include lack of time in an already packed curriculum, difficulty engaging students who often view these lessons as 'waste of time that could be better spent studying' as well as limited faculty buy-in and lack of suitable resources. [50]

Excessive work commitment, high expectations, perfectionism and self-criticism have been identified as typical medical student traits.[51] Although drivers of success, these traits are known to increase an individual's tendency towards distress, self-doubt and guilt where anything less than 100% is regarded as failure.[51-54] Medical students in this study report that stress affects their confidence in their ability to perform and describe a sense of personal failure and worthlessness with comments such as 'feeling worthless' because of a perceived constant focus on 'what we do not know' along with little positive feedback. We need to ensure that, as educators, we alleviate rather than aggravate medical student stress by employing a strengths-based approach to formative feedback.

For many the experience of studying and practicing medicine is positive and they do not succumb to the toxic effects of stress. This group receives little attention but could provide valuable clues to resilience and coping ability. Over a third of final year medical students scored in the low stress category and a quarter reported that stress was either totally or partially helpful and increased their productivity and focus. All students in our study were exposed to the same demands and scheduling and while this could affect the extent to which our findings could be generalised to other groups, a strength of this approach is that it suggest that other factors, possibly in personal life or in personality or thinking style and habits may underpin some individual's stress response.[51 52]

We have emerging evidence of the positive impact of strategies at University level that adjust exam burden through a modified assessment process, that promote protected 'downtime' and schedule rest breaks, that provide financial and administrative support and facilitate access to well-being

initiatives such as exercise, yoga and mindfulness.[44] However, we know, from interventions with qualified doctors, that when these initiatives are applied in a short-term manner and in isolation the improvement is often temporary.[55-58] A more enduring and long-term approach would support the student /future doctor to manage the pressures of medicine as a career and combine practical and academic measures at University level with an individual approach that fosters life-long reflection and personal responsibility. Such an approach, while encouraging self-care and healthy habits, would also enable students to develop the cognitive flexibility to tolerate uncertainty and distress and to manage change irrespective of the environment in which they find themselves working.[39 44 54] Others have called for this approach with doctors but our findings suggest the time for this intervention is well before the qualified doctor steps into the working environment.[2 7 31 54] We contend that embedding socio-emotional skills training could empower the student with the strategies to manage uncertainty and unpredictability in a fast-moving world where total perfection is rarely attainable. [52]

The need to address the negative impact of burnout on learning has been highlighted.[59] Others outline the need to provide a comprehensive service for student mental health that incorporates student services and community mental health services.[46] While this initiative could help those with identified mental health issues, the depleted resources of the current psychological support services are likely inadequate to support those with evolving illness or the many others who experience considerable psychological distress. Furthermore, it fails to acknowledge the clear message that, when needed, medical students do not find the current services user friendly and do not use them.

The transition to student life coincides with a critical period in brain development and a high-risk period for the development of mental illness; 75% of mental illness manifests before the age of 25.[45 46 60 61] The student brain is already highly sensitive to the myriad of psycho-social stresses associated with mental illness, but when combined with the particular stresses of student life the perfect environment for distress and stress related illness is created.[39 44 45 47 62] Medical students report being under persistent pressure and many comment on the intense, incessant and highly-competitive nature of the course. It is incumbent on us as educators not to add to medical student stress and to act as a protective factor rather than to precipitate or perpetuate mental illness.

It is firmly established that untreated or inadequately treated mental illness is associated with poorer outcomes, progression to more complex disorders, substance misuse, higher suicide rates, academic failure and persistently impaired social and occupational functioning.[45-47 61] Rather than

wait for this adverse outcome we suggest that student life is an important window of opportunity for prevention and timely, early, intervention.[39 44 45 47 55]

Conclusion:

Our findings suggest that the focus of wellbeing and self-care in doctors should be extended upstream and into the medical students' classrooms. Embedding stress and self-care skills training in the curriculum would provide students with the skills to manage stress and the ability to protect their wellbeing and prevent illness. This format could circumvent some of the barriers to psychological support.[31 42 44]

Empowering medical students and future doctors with the skills to succeed in today's and tomorrow's workforce can only improve outcomes for doctors and their patients.

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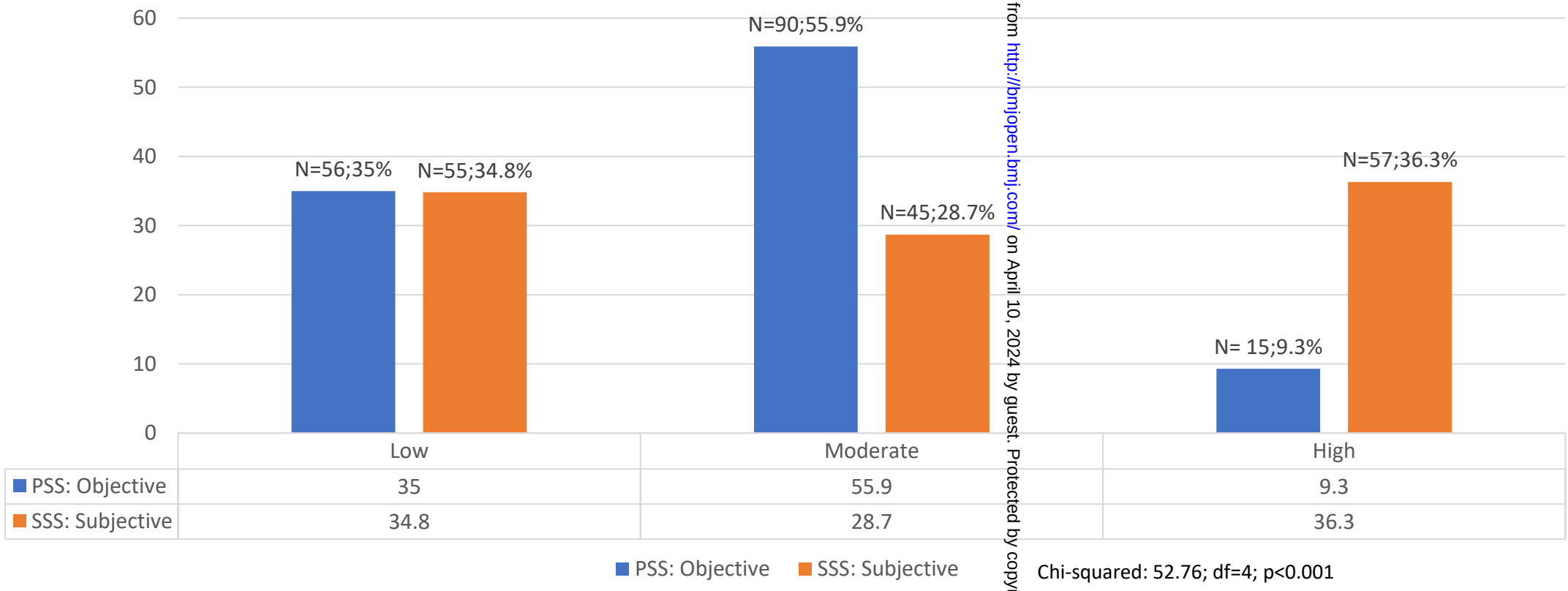
Data sharing statement: As per the ethics approval, the data will not be shared outside of the participating research institutions.

Patient consent for publication: Not required

Data Statement: Technical Appendix, statistical code, and dataset available from the Dryad repository DOI: Doi.org/10.5061/dryad.2jm.63xskj

Figure 1: Comparison of Medical Students Objective and Subjective Stress Levels



Chi-squared: 52.76; df=4; p<0.001

Figure 2: Student Responses to PSS Questions

Perceived Stress Scale Items

1. In the past month, how often have you been upset because of something that happened unexpectedly?
2. In the past month, how often have you felt that you were unable to control the important things in your life?
3. In the past month, how often have you felt nervous and 'stressed'?
4. In the last month, how often have you felt confident about your ability to handle your personal problems?
5. In the last month, how often have you felt that things were going your way?
6. In the last month, how often have you found that you could not cope with all the things that you had to do?
7. In the last month, how often have you been able to control irritations in your life?
8. In the last month, how often have you felt that you were on top of things?
9. In the last month, how often have you been angered because of things that were outside of your control?
10. In the past month, how often have you felt difficulties were piling up so high that you could not overcome them?

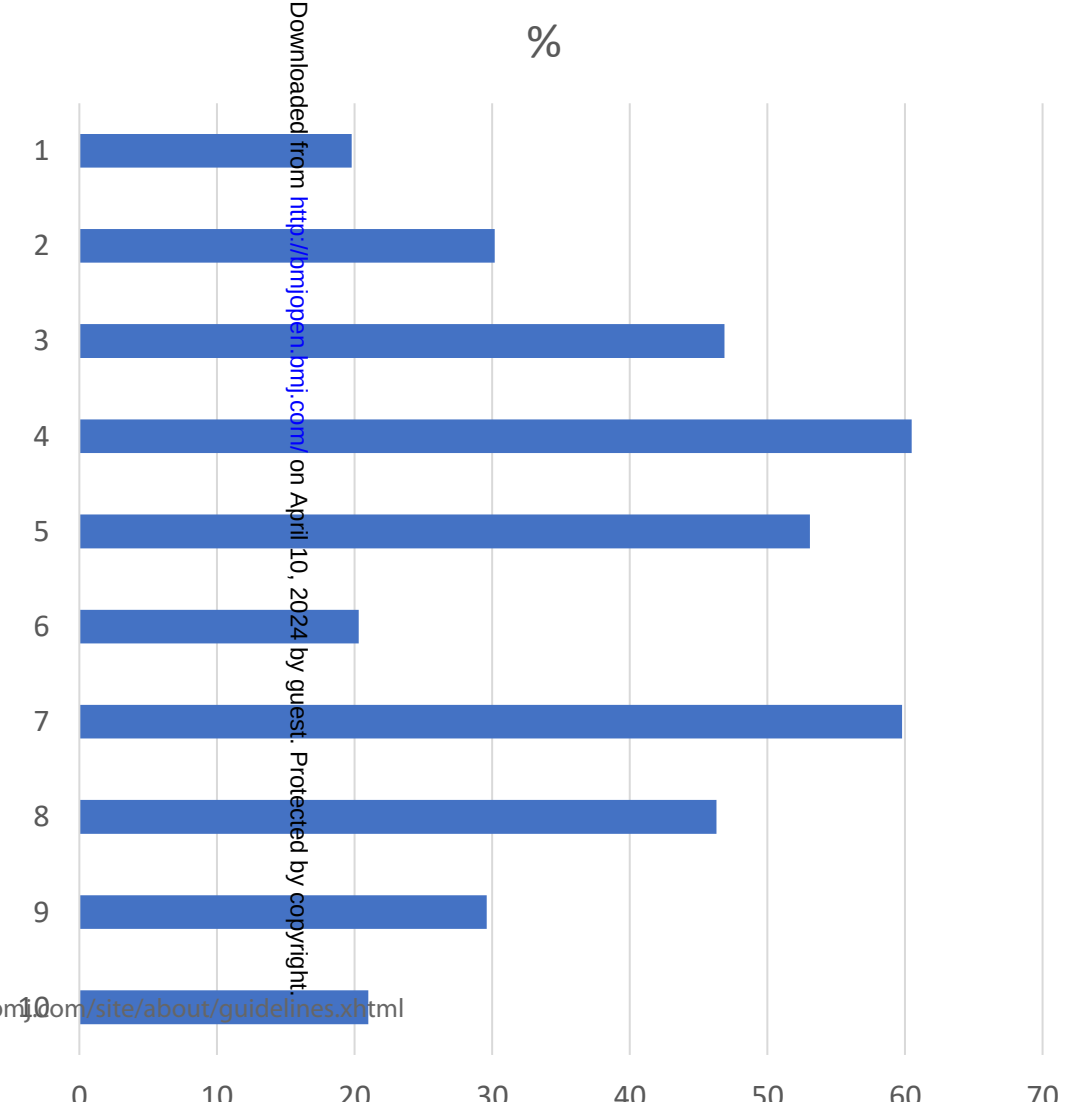


Figure 3: Sources of Stress Identified by Medical Students

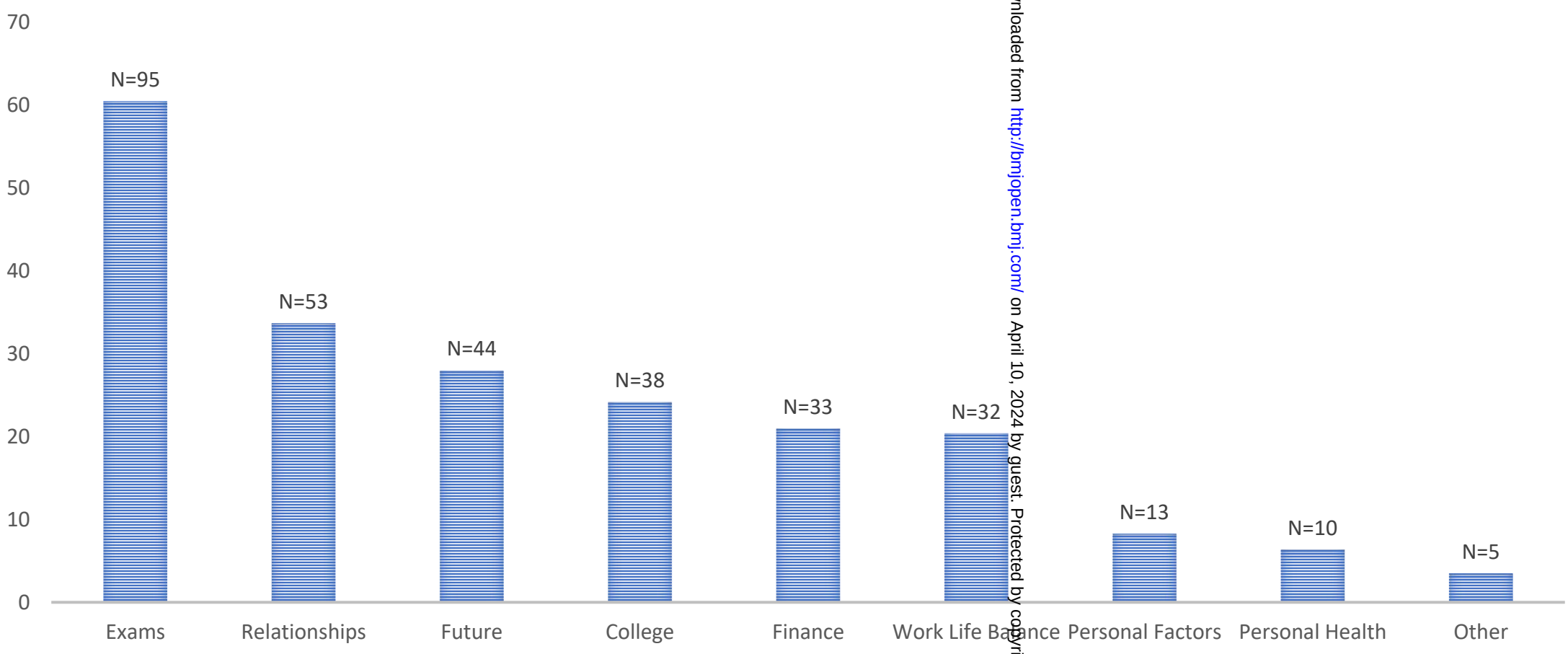


Figure 4: Emotional, Physical and Cognitive Impact of Stress

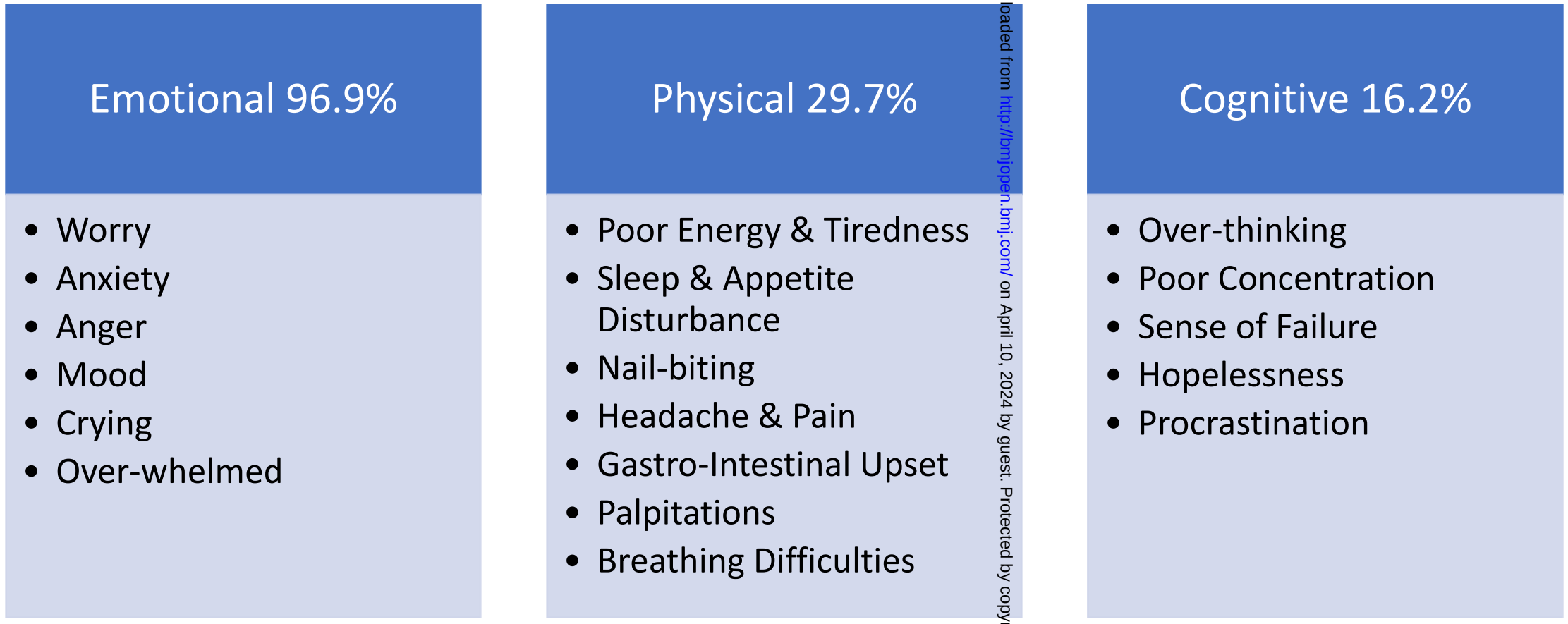
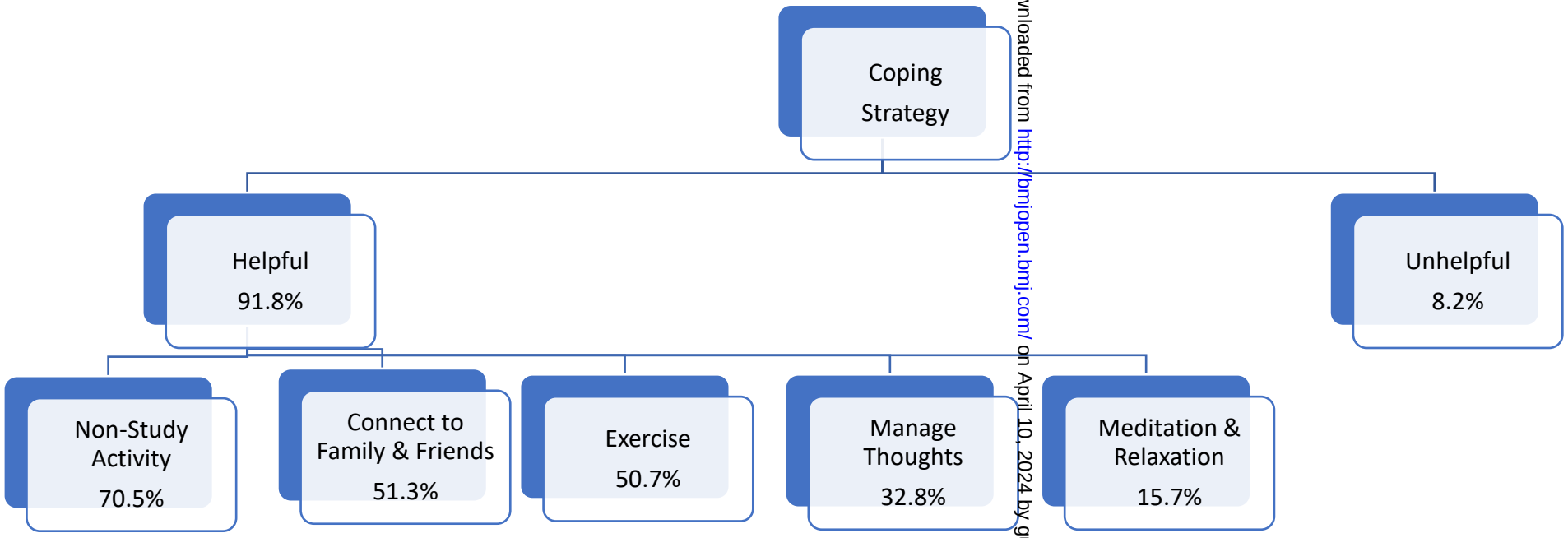


Figure 5: Strategies Used by Medical Students to Manage Stress



Helpful Strategies included: Talk to someone, Organise, prioritise and plan, Eat and sleep, Mindfulness / breathing techniques, TV and movies, Music, Study more, Read, Pray, Tea, Podcast, Shopping, Sun, Less coffee and Time with Pet.
Unhelpful Strategies included: Anger /outbursts or ignoring the problem, Alcohol, Social isolation, Don't eat or sleep, Cry, Procrastinate, Skin picking, Not well, Taking drugs and Smoking.

Appendix 1. Stress Questionnaire for Medical Students

We are very aware of the stress of medical student life and as a Teaching and Learning group are looking to address this by developing materials to help students to identify and manage stress. To do this we need to measure baseline stress among medical students prior to the introduction of any materials and ask that you take a few moments to complete these questionnaires as they will provide us with valuable information. All data is anonymous and confidential. Thank you for your time.

Date: 2017

Age_____ **Gender** (*Circle*): M F **GEM** (*Circle*): Yes No

How stressed have you been in the past month? Mark 'X' on this line where 0 is lowest and 10 is highest.

0_____**10**

0=Lowest **10=Highest**

What things in your life make you feel stressed?

1._____

2._____

3._____

How do you feel when you are stressed /how do you react?

1._____

2._____

3._____

How do you cope when you are stressed?

1._____

2._____

3._____

Any other comments?

_____

_____ **Thank You.**

PERCEIVED STRESS SCALE

The questions in this scale ask you about your feelings and thoughts during the last MONTH**. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.**

0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often

1. In the last month, how often have you been upset because of something that happened unexpectedly?
   0 1 2 3 4

2. In the last month, how often have you felt that you were unable to control the important things in your life?
   0 1 2 3 4

3. In the last month, how often have you felt nervous and "stressed"?
   0 1 2 3 4

4. In the last month, how often have you felt confident about your ability to handle your personal problems?
   0 1 2 3 4

5. In the last month, how often have you felt that things were going your way?
   0 1 2 3 4

6. In the last month, how often have you found that you could not cope with all the things that you had to do?
   0 1 2 3 4

7. In the last month, how often have you been able to control irritations in your life?
   0 1 2 3 4

8. In the last month, how often have you felt that you were on top of things?
   0 1 2 3 4

9. In the last month, how often have you been angered because of things that were outside of your control?
   0 1 2 3 4

10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?
    0 1 2 3 4

Appendix 2 Detailed List of Qualitative Comments:

What things make you stressed:

Answers to this question fell into 7 main categories or themes, and includes exams, relationships, future, college, finance and work-life balance/time management. Other less frequently reported themes included personal health and illness but in the context of falling behind and not having time to recover. Table 4a.

157 completed this section:

Exams:

Exams as a stress was reported by 95 out of 157 (60.5%) and this fell into two broad categories, stress related to demands of the exams and stress related to personal factors. The category of stress related to personal factors extended to students' approach to exams and to their thinking, including fear of failure or performing poorly. Comments were made about constant pressure both from the college and from the students thinking and personal and college expectations. Others included expected academic performance and deadlines, balancing college and exams and work and relationships, the relentless nature of the exams and the 'incessant nature' of the final year as well as a negative focus on what students did not know rather than what they knew. Comments included 'not enough hours in the day', 'hyper-competitive environment', 'constant college demands', 'exams close together', 'volume of work'. Many reported being stressed by 'being unprepared', 'fear of not performing at my best', 'falling behind', 'failing', 'not doing well', 'being left behind', 'expectation on myself versus the reality', 'comparing myself to others and their success', 'my thoughts', 'my reactions to things', 'over-whelmed' and 'procrastination'.

Relationships:

Relationships was reported as stressful by 53 out of 157 (33.7%) this included family, partner, friends and colleagues with concern about family members health, little time to spend with them and inter-personal conflict with family and friends.

Future:

Future was reported as a source of pressure by 44 out of 157 (28%). Concern was expressed about immediate issues such as obtaining electives or residency's and the application process involved with specific mention of the pressure experienced by North American students 'trying to balance school with all the extra training, exams and applications that North Americans have'. Further comment implied a lack of support from the College through this process. Comments about future

following graduation and further career path 'deciding what type of medicine /surgery to enter' and the pressure of doing well in medicine as a career choice were prominent along with particular and frequent mention of future employment uncertainty 'unsure of my position next year – what job will I have?'. One commented that their stress was increased from the 'combination of present responsibilities along with planning for the future' as well as 'worrying about putting in work now for applications in the future (audits, research and electives) and a fear that they did not have the time (because of daily college and exam pressures) to do well in these applications and that this would affect future choices. Others mentioned worry and comparing themselves to peers who had chosen careers other than medicine and who were perceived as being more successful and further along their career path. One commented that they felt 'pressure to complete and start working when everyone in peer group has holidays to go on. Seems like other career choice would've been worth it as we are a clever bunch and could've done other things to be successful'.

College:

38 out of 157 (24.2%) commented that 'College' was stressful. Most did not elaborate further but those that did included issues with the organisation of the course (medicine) in general and their perception of lack of support, poor structure and communication deficits as well as academic and financial demands. On commented that 'constant College' created stress for them.

Finance:

33 out of 157 (21%) reported financial stress. Most did not comment further than 'money' and 'finances' but those that did reported financial difficulty due to loans, pressure to pay fees 'bank loans not being approved to pay fees', 'exam results being delayed because of bank loan not being approved for fees' and 'trying to keep on top of money issues'. Those that commented on 'having no money' added that this was in comparison to peers in other professions or 'comparing myself to others and their success'.

Work Life Balance:

Work life balance was reported as being stressful by 32 out of 157 (20.4%) and comments fell into two broad categories, excessive demands and poor time management. Comments included having few social outlets 'letting normal life go', lack of social life, lack of time with friends, limited work-life balance, lack of time to play sport or engage in activity outside college, inability to maintain balanced life-style. Students' were aware of their limited work-life balance and of 'letting other interests and

commitments slip' and of 'not seeing people outside medicine'. Others commented on their poor time management when trying to manage activities as well as study.

Other Themes:

"Personal factors" were cited by 13 (8.3%) as being the source of stress. Personal health and illness were reported as a stress by 10 out of 157 (6.4%) and comments included 'being sick' and 'falling behind' when they needed time out to recover. Others reported feeling 'lonely', 'hospital food unhealthy', 'crime in the area', 'finding housing'. One student reported 'not much at all' to the question 'what things make you stressed'.

How do you feel when you are stressed /how do you react:

148 completed this section and responses were divided into three categories representing the Emotional (anxiety, anger, mood), Cognitive or Thinking and Physical manifestations of stress. Table 4b.

Emotional:

58 out of 148 (39.2%) reported anxiety and this included excessive worry, agitation and panic. A further 48 out of 148 (32.4%) reported being irritable, angry, hostile, grumpy and argumentative and 24 out of 148 (16.2%) felt low mood, depressed and sad. Eight out of 148 reported crying and tears. When combined, the emotional response of anxiety, irritability and low mood was reported 87.8% of students. Thirteen out of 148 (8.8%) reported being 'over-whelmed'.

Cognitive:

Thinking problems and cognitive effects were reported by 24 out of 148 (16.2%) and these included overthinking, poor concentration, sense of failure, hopelessness and procrastination.

Physical:

The physical manifestations of stress, such as poor energy, tiredness, sleep disturbance, appetite disturbance, nail biting, headache, abdominal pain, gastro-intestinal upset, palpitations and breathing difficulties were reported by 44 out of 148 (29.7%).

Sixteen out of 148 (10.8%) reported purely positive impacts of stress that helped them increase productivity and get things done. These students reported that stress made them talk to people, exercise, sleep, read, approach the task in a different way and take a break or focus on hobbies. Twenty out of 148 (13.5%) reported a mixed response to stress where they reported negative, emotional and physical impact but also positive outcomes that increased their focus and productivity. Taken together this means that for 36 students out of 148 (24.3%) their reaction to stress was either totally or partially helpful.

How do you cope when you are stressed?

Of the 162 students 146 (90.1%) completed this section. Of those twelve (8.2%) felt that they did not cope well with stress while the remaining 134 (91.8%) reported they used positive strategies to cope with stress. Students were asked to include three coping strategies and most included more. Table 4c.

Helpful Strategies:

The top ten positive strategies in order included: Exercise (50.7%), Talk to someone (30.8%), Organise, prioritise and plan (23.3%), Time with friends (20.5%), Activity other than study (19.2%), Eat and sleep (17.1%), Meditation, mindfulness, breathing techniques (13%), TV and movies (10.9%), Music (6.8%), Study more (6.8%). Other strategies included Reading (4.8%), Prayer (3.4%), thought management and self-reassurance, relaxation, taking timeout all 2.7%, with Tea, Podcast, Shopping all 1.4% and Sun, Less coffee and Time with Pet all at 0.7%.

Overall, students reported they used five main positive strategies to cope with stress and these were activities other than study (70.5%), connecting with friends and family (51.3%) and exercise (50.7%), followed by Organisation and Planning (32.8%) and Meditation /Relaxation techniques (15.7%). Considerable numbers reported using all categories but interestingly there was not one mention of using support services, trainers, college resources or professional help.

Many used positive self-talk and mentioned that they try to look at 'the bigger picture' and try to 'keep perspective' and while acknowledging that exam results are important that there is a 'broader scheme of things' and that 'it is all manageable'. There was specific mention of reminding themselves of 'all the good things in my life' and that 'it is worth it' and this may account for students high use of activity other than study and family and friends to cope. Many specifically mentioned linking with non-medical friends as supports. A number mentioned the positive benefit of

stress that helps them work harder, focus and perform but the difficulty and negative impact of what they termed 'incessant pressure'.

A significant group (n=14; 9.45%) report that they ignore the signs of stress and comments included: 'put a smile on when I don't feel like it', 'usually takes a day or two to realise I'm stressed', 'don't think about it', 'try to work through it', 'start to avoid situations', 'work more hours', 'am compelled to work faster', 'a lot of time I hide away from my stresses' and 'I talk myself out of it – why I don't have to be stressed'.

Unhelpful strategies:

Twelve students (8.2%) reported that they did not deal with stress well. The strategies they used were as follows: Anger /outbursts or ignoring the problem (n=10; 6.8%), Alcohol (n=6;4.1%), Social isolation (n=5; 3.4%), Don't eat or sleep (n=3; 2%), Cry (n=3; 2%), Procrastinate (n=2; 1.4%), Skin picking (n=1; 0.7%) and not well (n=1; 0.7%). Taking drugs was reported by one respondent and one student reported smoking in order to cope.

Other Comments:

In the free text 'Other Comments' section 22 students chose to make an additional comment. A number of students thanked us for undertaking this work which was regarded as 'worthwhile' with the comment that 'guidance and direction on coping should be done more often through the college course' and that it 'would be a useful exercise to complete throughout the course'. One suggested that 'medical students can cope best when stress when plans/direction and guidance is given' and another that 'students tend to be incredibly stressed in Res (Final Year) year and that can be an over-whelming time'.

Some reported being less stressed during the past month as 'I'm very relaxed compared to my friends /peers (that is, those doing the other modules)' and 'psychiatry was a more enjoyable and organised module than medicine and surgery'. Another commented that they 'thoroughly enjoyed the module (psychiatry)'.

Students suggested possible inputs that included a 'student hotline' and the 'time to talk'. Comments included the student's tendency to self 'diagnose' and others commented that in their experience the counselling service was slow to respond and that the time of appointments

competed with course work or college commitments. Further comments suggested that 'stress was high' due to the 'intensity of the course, exams' and 'intense competition at every stage of the path' along with 'the intensity of this very difficult year' and that 'I know what I should do but time is the biggest issue'.

Others reported that 'not doing well upsets me', 'being perfectionist' and a number reported 'feeling worthless' because of constant focus on what we don't know that has negatively impacted self-esteem'. A number reported feeling a 'lack of support' and 'little positive feedback' along with 'lack of support /encouragement from staff' with a 'focus on what we don't know' as being stressful and something they felt needed to be addressed.

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross sectionalreporting guidelines, and cite them as:

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		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1

Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	#3	State specific objectives, including any prespecified hypotheses	4-5
Methods			
Study design	#4	Present key elements of study design early in the paper	5-6
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	5-6
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	N/A Observational study of a whole class student population
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment	5-7

		(measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	
Bias	#9	Describe any efforts to address potential sources of bias	6
Study size	#10	Explain how the study size was arrived at	5
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	5-7
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	6
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	7-8
Statistical methods	#12c	Explain how missing data were addressed	7
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy	N/A Observational study of a whole class student population
Statistical methods	#12e	Describe any sensitivity analyses	N/A Observational study

Results

Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	7-12
Participants	#13b	Give reasons for non-participation at each stage	N/A
Participants	#13c	Consider use of a flow diagram	N/A
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	5
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	5-7
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	N/A Observational study of a whole class student population
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which	N/A Observational study of a whole class student population

		confounders were adjusted for and why they were included	
Main results	#16b	Report category boundaries when continuous variables were categorized	8
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A Observational study of a whole class student population
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	7-8
Discussion			
Key results	#18	Summarise key results with reference to study objectives	12-13
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	12-15
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	13-15

Generalisability	#21	Discuss the generalisability (external validity) of the study results	13
Other Information			
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

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Worried, Weary and Worn out: A Mixed Methods Study of Stress and Wellbeing in Final Year Medical Students

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Worried, Weary and Worn out: A Mixed Methods Study of Stress and Wellbeing in Final Year Medical Students

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Abstract

Objectives: Although there is much focus on burnout and psychological distress amongst doctors, studies about stress and wellbeing in medical students are limited but could inform early intervention and prevention strategies.

Design: The primary aim of this mixed methods, cross-sectional survey was to compare objective and subjective levels of stress in Final Year Medical students (2017) and to explore their perspectives on the factors they considered relevant to their wellbeing.

Setting: University College Dublin, the largest University in Ireland.

Participants: 161 of 235 medical students participated in this study (response rate 69%).

Results: 65.2% of students scored over accepted norms for the Perceived Stress Scale (34.8% low; 55.9% moderate; 9.3% high). 35% scored low; 28.7% moderate and 36.3% high on the Subjective Stress Scale. Thematic Analysis identified worry about exams, relationships, concern about future, work-life balance and finance; 1 in 3 students reported worry, irritability and hostility; many felt worn out. Cognitive impacts included over-thinking, poor concentration, sense of failure, hopelessness and procrastination. Almost a third reported sleep and appetite disturbance, fatigue and weariness. A quarter reported a "positive reaction" to stress. Positive strategies to manage stress included connection and talking, exercise, non-study activity and meditation. Unhelpful strategies included isolation and substance use. No student reported using the college support services or sought professional help.

Conclusions: Medical students experience high levels of psychological distress, similar to their more senior doctor colleagues. They are disinclined to avail of traditional college help services. Toxic effects of stress may impact their cognition, learning, engagement and empathy and increase patient risk and adverse outcomes. The focus of wellbeing in doctors should be extended upstream and embedded in the curriculum where it could prevent future burnout, improve retention to the profession and deliver better outcomes for patients.

Strengths and limitations of this study:

- The response rate is high compared to other studies in medical student groups.
- Inclusion of subjective and objective measures of stress and a mixed-method approach gives more insight into students' experiences.
- All students were exposed to the same academic demands and scheduling.
- The cross-sectional nature of this survey and the lack of information about ethnicity may limit its generalisability and representativeness
- The study is limited by the absence of a control group.

Introduction

Medicine is regarded as a particularly stressful career with high rates of psychological distress and stress-related mental illness, anxiety, depression and suicide reported at all training and seniority levels, irrespective of speciality.[1-6] Studies exploring psychological distress in hospital doctors estimate that between 22% and 32% experience high distress, while a systematic review of depression and anxiety in doctors and medical students suggests a 14-60% prevalence of depression and an 18-55% prevalence of anxiety.[1 5 7-11]

This distress is known to impact on the quality of patient care and to increase negative outcomes[12 13] and is linked to absenteeism, attrition from the profession[14] and, more importantly, the stigma and guilt induced presenteeism that is known to significantly impact on doctor health and patient care.[15-19] Stressed individuals may demonstrate less empathy, are often irritable, overwhelmed and hostile, making them prone to errors of judgement and poor decision-making and an increased likelihood of malpractice consequences.[13 20 21] With a rapidly changing modern health system with increasing demands and fewer resources, patient safety is rightly a major focus. The optimum delivery of service means that the health of providers is of critical importance, yet the evidence suggests that this factor is often neglected.[3 4 16]

Stress is regarded as "the epidemic of the 21st century" and the WHO estimated that by 2020 five of the top ten illnesses world-wide will be linked to stress. Yet they also suggest that stress is preventable and manageable through life-style modifications and learned coping strategies.[22] Patterns of poor self-care and stoicism are prevalent in the health professions, identifiable in medical school and thought to deteriorate further after graduation often leading to practitioner neglect of health and unhealthy habits.[2 4-6 23 24-29]

Reliable estimates of stress and psychological distress during medical training are important and could help identify, prevent and treat causes of distress among medical students and future doctors. Intervening early at school level could provide future doctors with the strategies to improve their ability to withstand stress and to prevent mental health difficulties and burnout. In the broader context, strategies to improve stress in the medical workplace could lead to better outcomes for patients and improve recruitment and retention rates for the profession overall.[14 16 27-32]

Studies to date have focussed on the workplace demands and factors that might lead to burnout in doctors [1 2 5 6 14 29 30] rather than fully determine the factors that students identify in their career and personal life or the impact of environmental factors, thinking styles and coping strategies.

We examined final year medical students stress levels using both objective and subjective measures of stress and explored in depth the medical students' own perspectives and narrative on the factors that impact on their wellbeing and stress levels during training, their views on the impact of stress on their health and the strategies they use to manage or cope with stress.

Methods

Participants

The participants in this study were Final Year Medical Students from Ireland's largest University, University College Dublin (UCD). We chose to examine Final Year Students as they were closest to graduation and this cohort seemed a natural extension to the Hayes et al post-graduate cohort.[2]

Final Year Medicine is made up of around 240 students who are divided into four groups. Teaching follows a Modular Curriculum, with an end of module integrated knowledge-based and clinical examination in the four clinical sub-specialities of Psychiatry, Obstetrics and Gynaecology, General Practice and Paediatrics. The Psychiatry Module is part of the core curriculum for the MB Bch BAO degree in Medicine. The survey was conducted in week five of the six-week Psychiatry Module, measuring stress levels in the previous four weeks, when students were engaged in clinical placements and continuous formative and summative assessments, and at least ten days in advance of the final modular assessment.

The class included both Graduate Entry (GEM) and undergraduate (non-GEM) students. In UCD, GEM and undergraduate students come together at year 4. Graduate Entry Students (GEM) must have obtained a 2:1 undergraduate degree prior to completing The Graduate Medical School Admissions Test (GAMSAT, formerly known as the Graduate Australian Medical School Admissions Test) and undergoing an application process. Undergraduate Medical School Entrants (non-GEM) are allocated places based on their Health Professions Admission Test (HPAT) which was developed by the Australian Council for Educational Research and used to help select students into medicine and some other health science courses at university) and their Central Applications Office (CAO) application, which ranks their performance in the National State Examination (Leaving Certificate or A-Levels) and which centrally processes applications for undergraduate courses in Irish Higher Education Institutions.

The present study is descriptive, mixed-methods and cross-sectional in nature and focuses on baseline, subjective and objective, stress levels in medical students.

Students provided written informed consent and were assured that all data was anonymised and confidential. Ethical approval for the study was obtained from the Head of School in accordance with UCD Regulations. Due to the sensitive nature of the questions, students were informed of the student support services available to them and encouraged to seek help if needed. Patients and the public were not involved in this part of the study.

Patient and Public Involvement:

No patient involved.

Questionnaire: The questionnaire used in this study (Appendix 1), collected demographic details to include age, gender and GEM or non-GEM status. We used the Perceived Stress Scale (PSS), which is a widely used, validated and reliable psychological instrument that measures individuals perceptions of stress.[33] Items are designed to explore how unpredictable, uncontrollable, and overloaded respondents find their lives and includes questions about current levels of stress. The PSS was designed for use in college and community samples. The questions are of a general nature and hence relatively free of content that would be considered specific to any subpopulation group. The scale measures an individual's perceived stress levels in the previous month; responses can be summed across all scale items and further divided into low (0-13), moderate (14-26) and high (27-40) perceived stress categories[33]. Normative data has been reported[34] and ranges between 11.9 and 14.7.

We asked students to further rate their subjective level of stress on a Likert scale (Subjective Stress Scale, SSS) and asked them to mark an X on a line between 0 (lowest) and 10 (highest) to indicate how stressed they had been in the past month. We used this as a continuous variable and also subdivided it into 3 categories low (0-3), moderate (4-6) and high (7-10). This allowed us to compare students subjective and objective measures as it has been reported that some people under-estimate and some over-estimate their stress levels.[35]

The next section was made up of qualitative free text questions asking students to list 3 things under the following headings:

1. What things in your life make you feel stressed (triggers)?
2. How do you feel when you are stressed/ how do you react (effects)?
3. How do you cope when you are stressed (coping skills)?

The final question on the questionnaire was an open-ended, free-text, qualitative question "Any other comments?" which gave students the opportunity to add any further thoughts or comments.

Analyses

As the survey had a mixed methods design, both quantitative and qualitative analyses were undertaken. Quantitative analysis was conducted using IBM SPSS Statistics 24[36] and included t-tests and Chi-squared tests and Correlation Analysis between objective (PSS) and subjective (SSS) measures of stress with the significance level set at $p<0.05$. The scores were not normally distributed using the Shapiro Wilks test. Qualitative analysis on the relevant questions was conducted systematically in the form of a step-by-step Thematic Analysis.[37 38] Initial analysis identified and described the themes by reading and re-reading a selection of the data sheets and summaries by two researchers working independently (AL and EC). These were further discussed and code identified. Data was then systematically coded by the two researchers independently and discrepancies checked, discussed and clarified. Following this, further analysis of the data to identify the main themes was conducted according to the work of Cohen.[39]

Results

There were 235 students in total in the Final Year class of 2017; 123 females (52%) and 112 males (48%); 44% GEM and 56% non-GEM; age range 22 to 46 years. Of these 161 (response rate 69%) participated in this study with a mean age of 24.76 years (s.d. 2.6; range 22 to 42 years). There were 88 (54.6% females) and 73 males (45.3%); 65 (40.4%) were graduate entry (GEM) and 96 (59.6%) were on the undergraduate entry course (non-GEM).

Quantitative Results:

PSS: Mean scores on the PSS were 16.94 (s.d. 7.06), median 16.0 and mode 12.0, range 1 to 34. When the scores for males and females were compared, females had higher scores (mean 17.99; s.d. 7.37) compared to males (mean 15.53; s.d. 6.59) and this was statistically significant ($p=0.029$). There was no difference in the scores of GEM versus non-GEM 16.37; s.d. 7.56 versus 17.30; s.d. 6.77 ($p=0.849$). 65.2% of students' scored over accepted norms for the PSS.

SSS: On the Subjective scale the mean score was 4.88; s.d. 2.62, median 5 and mode 7, range 0 to 10. Females again scored higher than males (females 5.24; s.d. 2.54 and males 4.44; s.d. 2.67) trending towards significance at $p=0.058$. There was no significant difference between GEM and non-GEM (4.85; s.d. 2.72 versus 4.93; s.d. 2.57; $p=0.419$). (Table 1)

Table 1. Perceived Stress Scores (PSS) and Subjective Scores (SSS) Compared by Gender and GEM Status

			PSS		SSS	
	N	%	Mean	s.d	Mean	s.d
Male	73	45.3	15.53	6.59	4.44	2.67
Female	88	54.3	17.99	7.37*	5.24	2.54
GEM	65	40.4	16.37	7.56	4.85	2.72
Non GEM	96	59.6	17.30	6.77	4.93	2.57

PSS female v male*, p=0.029; GEM v Non-GEM, p=0.849. SSS female v male, p=0.058; GEM v Non-GEM p=0.419.

Scores on both measures were moderately correlated, *r = .72, p < .005*, based on 156 complete pairwise observations. Age did not correlate with total scores on the PSS *(r=.142, p= 0.069*) or SSS (*r=.123, p=0.128)*.

When the PSS scores were further divided into Low (scores 0 to 13), Moderate (scores 14 to 26) and High (scores 27 to 40), 34.8% (n=56) scored in the low category, 55.9% (n=90) in the moderate and 9.3% (n=15) in the high. When the Subjective Stress Scale was divided into low (scores 0 to 3), moderate (scores 4 to 6) and high (scores 7 to 10) the results were 35% (n=55), 28.7% (n=45) and 36.3% (n=57) respectively. Students' objective and subjective reports were consistent for low stress levels (34.8% v 35%) but differed for moderate PSS 55.9% v SSS 28.7% and high PSS 9.3% v SSS 36.3% (Chi-squared 52.76; df 4; p<0.001). Forty-two students reported subjectively high stress although their objective score was low or moderate (Figure 1).

Figure 1: Comparison of Medical Students Objective and Subjective Stress Levels

The PSS Items most endorsed at a moderate of severe level are shown by each bar in Figure 2. Responses indicate that students did not feel confident about their ability to handle personal problems (60.5%); did not feel able to control irritations in their lives (59.8%); did not feel that things were going their way (53.1%); felt nervous and stressed (46.9%); did not feel that they were on top

of things (46.3%); felt that they were unable to control the important things in their lives (30.2%); have been angered because of things that were outside their control (29.6%); felt difficulties were piling up so high that they could not overcome them (21%); could not cope with all the things they had to do (20.3%); have been upset because of something that happened unexpectedly (19.8%).

Figure 2: Student Responses to Perceived Stress Scale Questions

Qualitative Results:

What things make you stressed:

Answers to this question fell into 6 main categories or themes, and included Exams, Relationships, Future, College, Finance and Work-life balance /Time management (Figure 3). Other less frequently reported themes included Personal Health and Illness but in the context of falling behind and not having time to recover. See supplementary file Appendix 2 for the detailed list of qualitative comments.

Figure 3. Sources of Stress Identified by Medical Students

Exams:

Exams as a stress was reported by 95 out of the 157 that completed this section; this fell into two broad categories, stress related to demands of the exams and stress related to personal factors such as students' approach to exams and to their thinking. Many commented on college and personal expectations along with a fear of failure or performing poorly.

Comments included deadlines, balancing college and exams and work and relationships, the relentless nature of the exams and the 'incessant nature' of the final year as well as a negative focus on what students did not know rather than what they knew. Students reported 'not enough hours in the day', 'hyper-competitive environment', 'constant college demands', 'exams close together' and 'volume of work'. Many reported being stressed by 'being unprepared', 'fear of not performing at my best', 'falling behind', 'failing', 'not doing well', 'being left behind', 'expectation on myself

versus the reality', 'comparing myself to others and their success', 'my thoughts', 'my reactions to things', 'over-whelmed' and 'procrastination'.

Relationships:

Relationships was reported as stressful by 53 and this included family, partner, friends and colleagues with concern about family members health, little time to spend with them and inter-personal conflict with family and friends.

Future:

Future was reported as a source of pressure by 44. Concern was expressed about immediate issues such as obtaining electives or residencies as well as future career. Comments about future following graduation and further career path 'deciding what type of medicine /surgery to enter' and the pressure of doing well in medicine as a career choice were prominent along with particular and frequent mention of future employment uncertainty 'unsure of my position next year – what job will I have?'. One commented that their stress was increased from the 'combination of present responsibilities along with planning for the future' as well as 'worrying about putting in work now for applications in the future (audits, research and electives) and a fear that they did not have the time (because of daily college and exam pressures) to do well in these applications and that this would affect future choices. Others mentioned worry and comparing themselves to peers who had chosen careers other than medicine and who were perceived as being more successful and further along their career path. One commented that they felt 'pressure to complete and start working when everyone in peer group has holidays to go on. Seems like other career choice would've been worth it as we are a clever bunch and could've done other things to be successful'.

College:

38 commented that 'College' was stressful. Most did not elaborate further but those that did included issues with the organisation of the course (medicine) in general and their perception of lack of support, poor structure and communication deficits as well as academic and financial demands. One commented that 'constant College' created stress for them.

Finance:

33 reported financial stress. Most did not comment further than 'money' and 'finances' but those that did reported financial difficulty due to loans and pressure to pay fees.

Work Life Balance:

Work life balance was reported as being stressful by 32 and comments fell into two broad categories, excessive demands and poor time management. Comments included having few social outlets 'letting normal life go', lack of social life, lack of time with friends, limited work-life balance, lack of time to play sport or engage in activity outside college, inability to maintain balanced life-style. Students were aware of their limited work-life balance and of 'letting other interests and commitments slip' and of 'not seeing people outside medicine'. Others commented on their poor time management when trying to manage activities as well as study.

How do you feel when you are stressed /how do you react:

148 completed this section and responses were divided into three categories representing the Emotional (anxiety, anger, mood), Physical and Cognitive or Thinking manifestations of stress (Figure 4).

Figure 4. Emotional, Physical and Cognitive Impact of Stress

Emotional:

58 reported anxiety and this included excessive worry, agitation and panic. A further 48 reported being irritable, angry, hostile, grumpy and argumentative and 24 felt low mood, depressed and sad. Eight reported crying and tears, thirteen reported being 'overwhelmed'. When combined, almost all students reported the emotional effects of stress.

Physical:

The physical manifestations of stress, such as poor energy, tiredness, sleep disturbance, appetite disturbance, nail-biting, headache, abdominal pain, gastro-intestinal upset, palpitations and breathing difficulties were reported by 44.

Cognitive:

Thinking problems and cognitive effects were reported by 24 and these included overthinking, poor concentration, sense of failure, hopelessness and procrastination.

Sixteen reported purely positive impacts of stress that helped them increase productivity and get things done. These students reported that stress made them talk to people, exercise, sleep, read, approach the task in a different way and take a break or focus on hobbies. Twenty reported a mixed response to stress where they reported negative, emotional and physical impact but also positive outcomes that increased their focus and productivity. Taken together this means that for 36 students or a quarter of the sample reported that their reaction to stress was either totally or partially helpful.

How do you cope when you are stressed?

Twelve students reported that they did not cope well with stress while the remaining group reported they used positive strategies to cope with stress. Students were asked to include three coping strategies and most included more (Figure 5).

Figure 5. Strategies Used by Medical Students to Manage Stress

Helpful Strategies:

Overall, students reported they used five main positive strategies to cope with stress and these were Activities other than study, Connecting with friends and family, and Exercise, followed by Manage Thoughts, and Meditation/Relaxation techniques. Considerable numbers reported using all categories but interestingly there was not one mention of using support services, trainers, college resources or professional help.

There was specific mention of reminding themselves of 'all the good things in my life' and that 'it is worth it' and this may account for students high use of activity other than study and family and friends to cope. Many specifically mentioned linking with non-medical friends as supports. A number mentioned the positive benefit of stress that helps them work harder, focus and perform but the difficulty and negative impact of what they termed 'incessant pressure'.

Unhelpful strategies:

Twelve students reported that they did not deal with stress well. The strategies they used were as follows: Anger/outbursts or ignoring the problem (n=10), Alcohol (n=6), Social isolation (n=5), Don't eat or sleep (n=3), Cry (n=3), Procrastinate (n=2), Skin picking (n=1) and not well (n=1). Taking drugs was reported by one respondent and one student reported smoking in order to cope.

A significant number (n=14) report that they ignore the signs of stress and comments included: 'put a smile on when I don't feel like it', 'usually takes a day or two to realise I'm stressed', 'don't think about it', 'try to work through it', 'start to avoid situations', 'work more hours', 'am compelled to work faster', 'a lot of time I hide away from my stresses' and 'I talk myself out of it – why I don't have to be stressed'.

Discussion:

To our knowledge, no study to date has explored the impact of stress on the wellbeing of final year medical students, or examined their coping strategies using subjective and objective measures of stress. Our findings indicate that while the majority of students use positive strategies to manage and cope with stress and improve their resilience, they also report high levels of stress. This is in keeping with suggestions that training in resilience skills alone may not prevent stress.[31 32]

The final year medical student narrative reflects the many emotional, cognitive and physical effects of stress related to becoming a doctor. Our findings align with previous stress studies in doctors but provide compelling evidence that doctors' stress and distress predates their exposure to the hospital environment and is not all due to the increased responsibility and the demands that doctors are exposed to after graduation.[1 2 5 6 14 40]

The final year medical students in our study who may have benefited from professional support were not inclined to seek out the counselling services provided by the college, stating difficulties with setting up appointment times, and with these clashing with their clinical course work. The same pattern is evident, but not to the same extent, for students in other college courses or countries suggesting that medical students are not inclined to avail of traditional help often citing stigma, fear and concern about confidentiality.[7 41 42] These barriers to help-seeking might be overcome by alternative and perhaps non-traditional mechanisms for delivering psychological support. The Royal Medical Benevolent Fund, Practitioner Health Programme and the Stanford Model of Professional Fulfilment are two such initiatives. [31 32 43]However, embedding stress training and self-care in the curriculum might overcome these barriers at student level and this warrants further research.[7 39 44]

Effective interventions for stress take the individual and the environment into account and this requires a multi-faceted approach at University and individual level.[3 31 44 45 46 47] Rather than focus on academic excellence and the assessment of factual knowledge we need to provide students with the skills to succeed in a diverse and rapidly changing society.[48] Current legislation places a duty of care on all organisations to protect against stress in the workplace.[49] Extending this into our educational environments could protect medical students from the negative impacts of stress.[48] The calls for a learning culture that includes compulsory stress management training and a 'well-being curriculum' for medical students have been met with some resistance. Obstacles include lack of time in an already packed curriculum, difficulty engaging students who often view these lessons as 'waste of time that could be better spent studying' as well as limited faculty buy-in and lack of suitable resources. [50]

Excessive work commitment, high expectations, perfectionism and self-criticism have been identified as typical medical student traits.[51] Although drivers of success, these traits are known to increase an individual's tendency towards distress, self-doubt and guilt where anything less than 100% is regarded as failure.[51-54] Medical students in this study report that stress affects their confidence in their ability to perform and describe a sense of personal failure and worthlessness with comments such as 'feeling worthless' because of a perceived constant focus on 'what we do not know' along with little positive feedback. We need to ensure that, as educators, we alleviate rather than aggravate medical student stress by employing a strengths-based approach to formative feedback.

For many the experience of studying and practicing medicine is positive and they do not succumb to the toxic effects of stress. This group receives little attention but could provide valuable clues to resilience and coping ability. Over a third of final year medical students scored in the low stress category and a quarter reported that stress was either totally or partially helpful and increased their productivity and focus. All students in our study were exposed to the same demands and scheduling and while this could affect the extent to which our findings could be generalised to other groups, a strength of this approach is that it suggest that other factors, possibly in personal life or in personality or thinking style and habits may underpin some individual's stress response.[51 52]

We have emerging evidence of the positive impact of strategies at University level that adjust exam burden through a modified assessment process, that promote protected 'downtime' and schedule rest breaks, that provide financial and administrative support and facilitate access to well-being

initiatives such as exercise, yoga and mindfulness.[44] However, we know, from interventions with qualified doctors, that when these initiatives are applied in a short-term manner and in isolation the improvement is often temporary.[55-58] A more enduring and long-term approach would support the student /future doctor to manage the pressures of medicine as a career and combine practical and academic measures at University level with an individual approach that fosters life-long reflection and personal responsibility. Such an approach, while encouraging self-care and healthy habits, would also enable students to develop the cognitive flexibility to tolerate uncertainty and distress and to manage change irrespective of the environment in which they find themselves working.[39 44 54] Others have called for this approach with doctors but our findings suggest the time for this intervention is well before the qualified doctor steps into the working environment.[2 7 31 54] We contend that embedding socio-emotional skills training could empower the student with the strategies to manage uncertainty and unpredictability in a fast-moving world where total perfection is rarely attainable. [52]

The need to address the negative impact of burnout on learning has been highlighted.[59] Others outline the need to provide a comprehensive service for student mental health that incorporates student services and community mental health services.[46] While this initiative could help those with identified mental health issues, the depleted resources of the current psychological support services are likely inadequate to support those with evolving illness or the many others who experience considerable psychological distress. Furthermore, it fails to acknowledge the clear message that, when needed, medical students do not find the current services user friendly and do not use them.

The transition to student life coincides with a critical period in brain development and a high-risk period for the development of mental illness; 75% of mental illness manifests before the age of 25.[45 46 60 61] The student brain is already highly sensitive to the myriad of psycho-social stresses associated with mental illness, but when combined with the particular stresses of student life the perfect environment for distress and stress related illness is created.[39 44 45 47 62] Medical students report being under persistent pressure and many comment on the intense, incessant and highly-competitive nature of the course. It is incumbent on us as educators not to add to medical student stress and to act as a protective factor rather than to precipitate or perpetuate mental illness.

It is firmly established that untreated or inadequately treated mental illness is associated with poorer outcomes, progression to more complex disorders, substance misuse, higher suicide rates, academic failure and persistently impaired social and occupational functioning.[45-47 61] Rather than

wait for this adverse outcome we suggest that student life is an important window of opportunity for prevention and timely, early, intervention.[39 44 45 47 55]

Conclusion:

Our findings suggest that the focus of wellbeing and self-care in doctors should be extended upstream and into the medical students' classrooms. Embedding stress and self-care skills training in the curriculum would provide students with the skills to manage stress and the ability to protect their wellbeing and prevent illness. This format could circumvent some of the barriers to psychological support.[31 42 44]

Empowering medical students and future doctors with the skills to succeed in today's and tomorrow's workforce can only improve outcomes for doctors and their patients.

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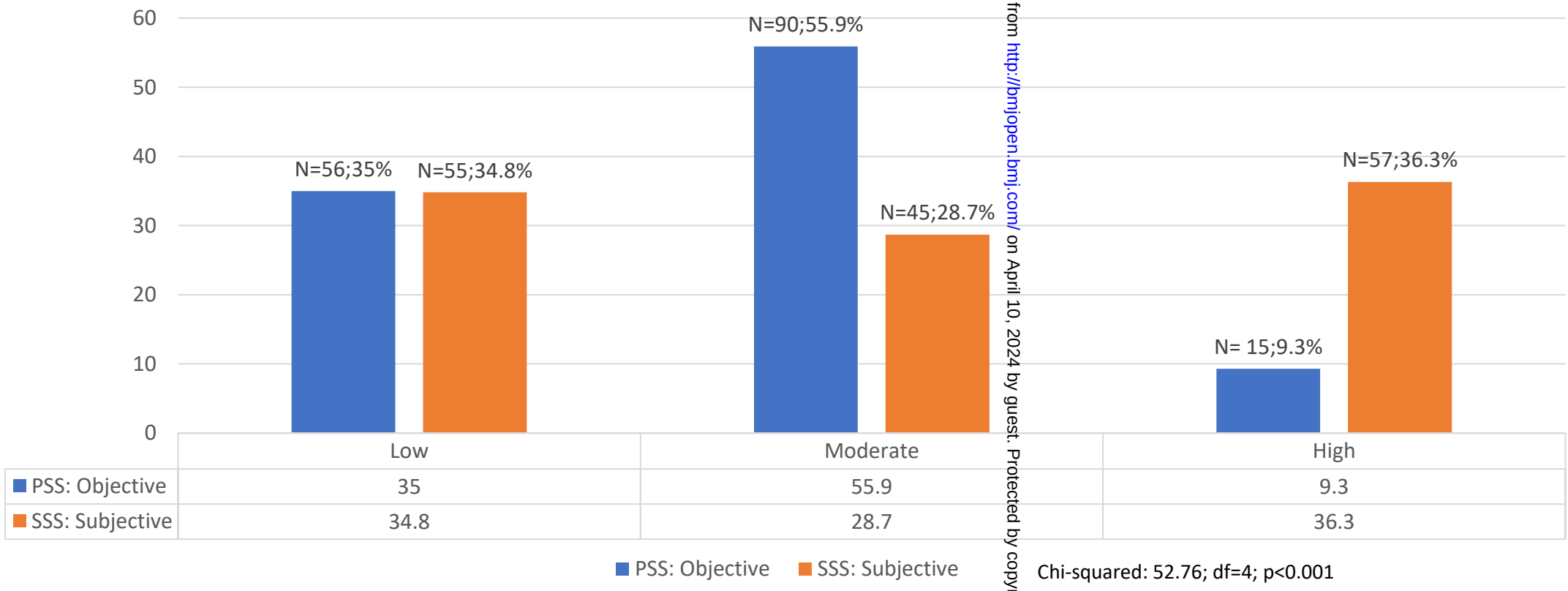
Patient consent for publication: Not required

Data Statement: Technical Appendix, statistical code, and dataset available from the Dryad repository doi:10.5061/dryad.2jm63xskj

Figure 1: Comparison of Medical Students Objective and Subjective Stress Levels



Chi-squared: 52.76; df=4; p<0.001

Figure 2: Student Responses to PSS Questions

Perceived Stress Scale Items

1. In the past month, how often have you been upset because of something that happened unexpectedly?
2. In the past month, how often have you felt that you were unable to control the important things in your life?
3. In the past month, how often have you felt nervous and 'stressed'?
4. In the last month, how often have you felt confident about your ability to handle your personal problems?
5. In the last month, how often have you felt that things were going your way?
6. In the last month, how often have you found that you could not cope with all the things that you had to do?
7. In the last month, how often have you been able to control irritations in your life?
8. In the last month, how often have you felt that you were on top of things?
9. In the last month, how often have you been angered because of things that were outside of your control?
10. In the past month, how often have you felt difficulties were piling up so high that you could not overcome them?

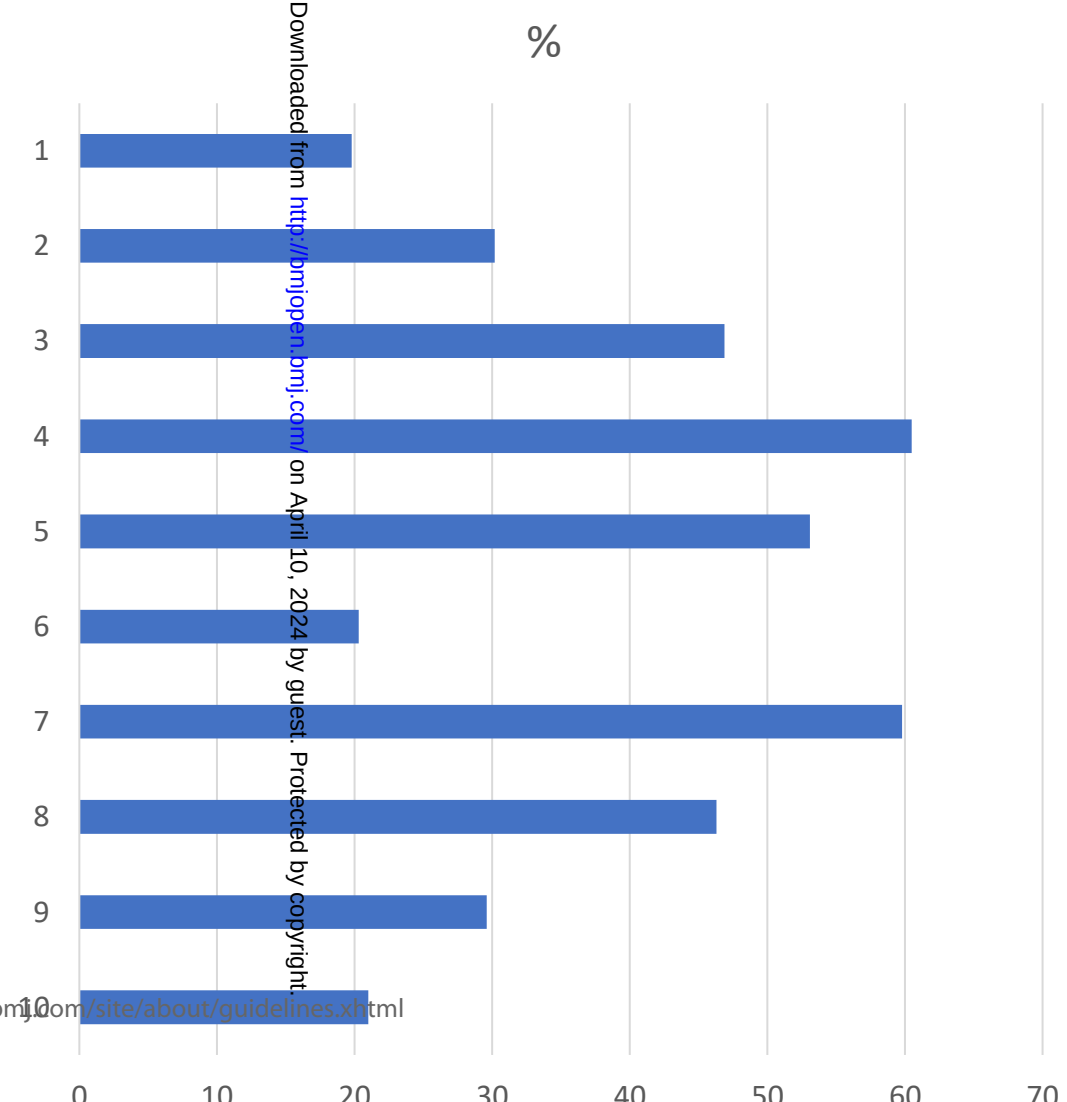


Figure 3: Sources of Stress Identified by Medical Students

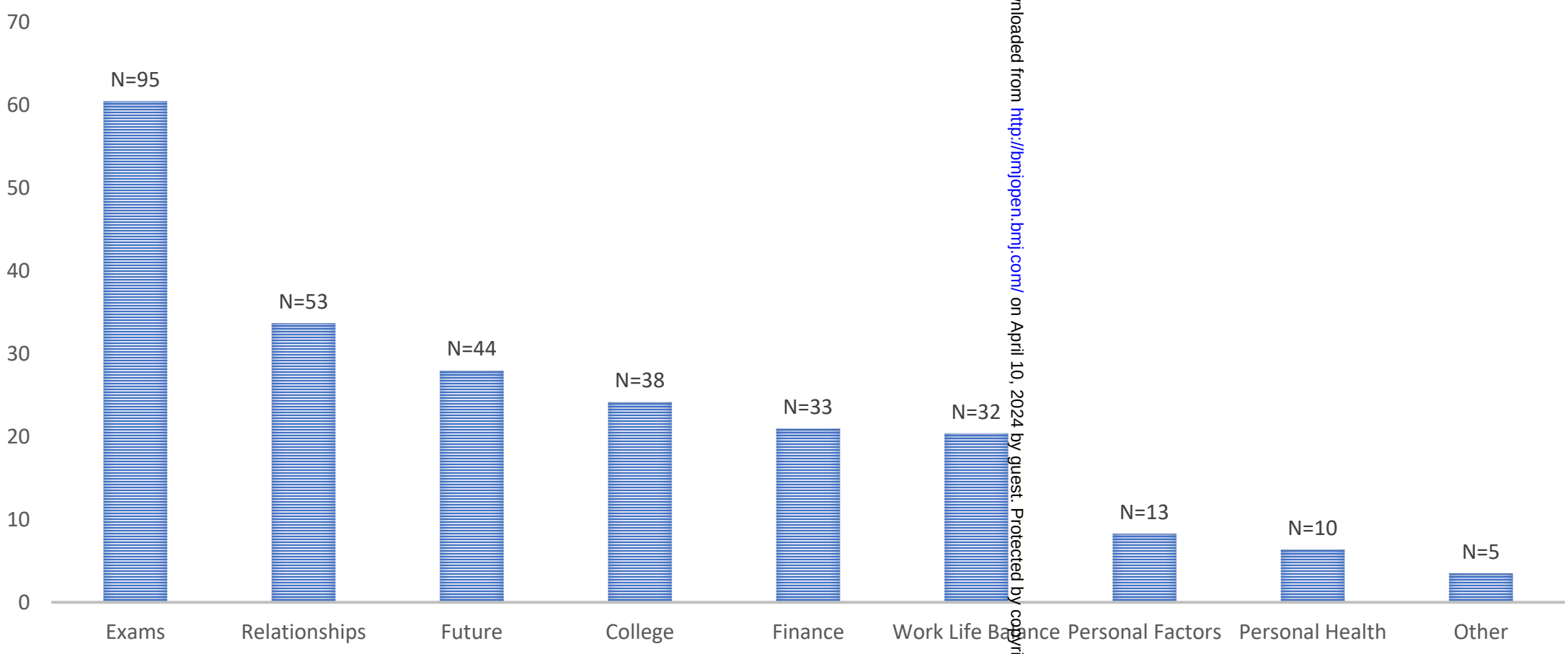


Figure 4: Emotional, Physical and Cognitive Impact of Stress

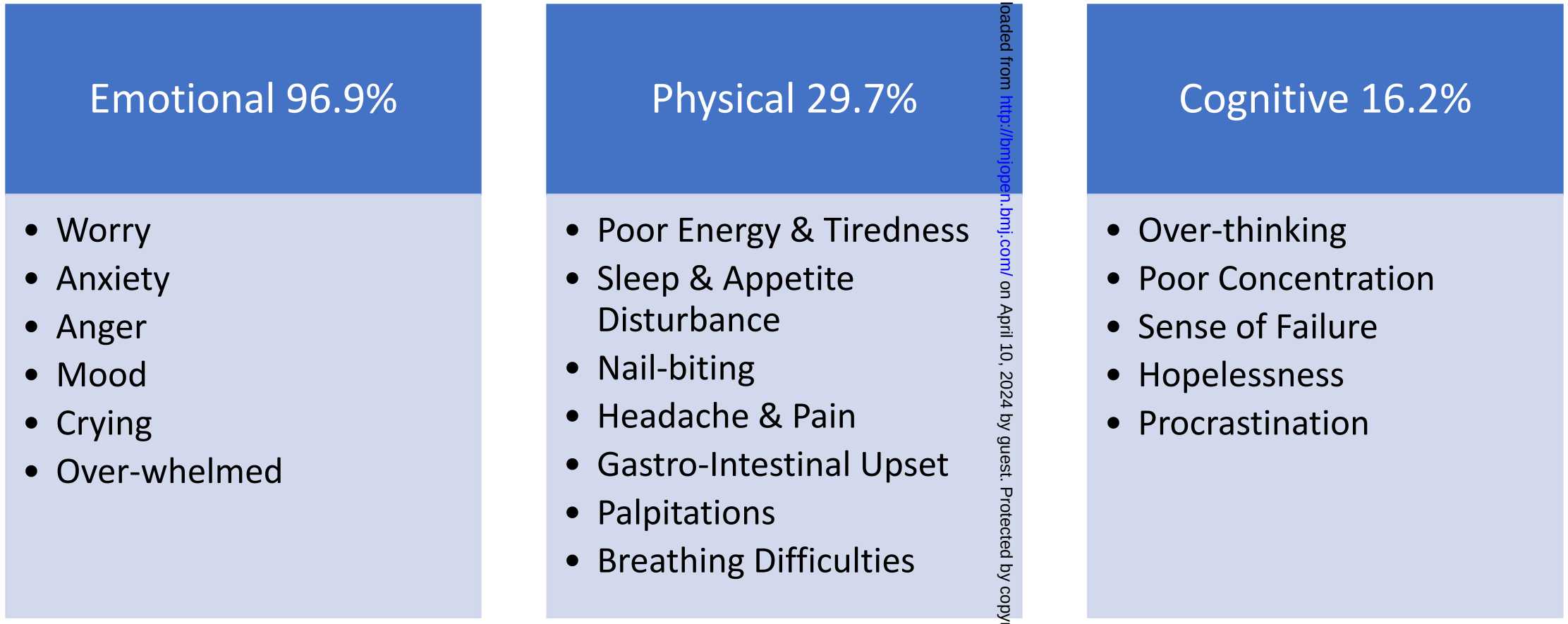
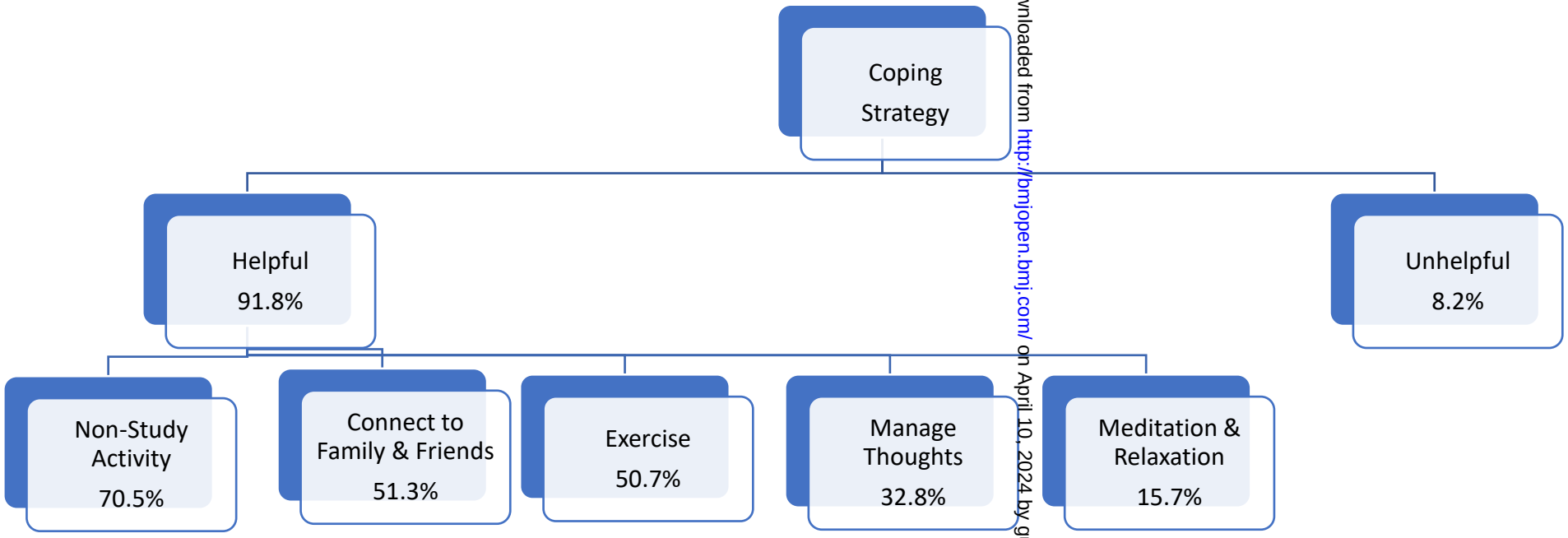


Figure 5: Strategies Used by Medical Students to Manage Stress



Helpful Strategies included: Talk to someone, Organise, prioritise and plan, Eat and sleep, Mindfulness / breathing techniques, TV and movies, Music, Study more, Read, Pray, Tea, Podcast, Shopping, Sun, Less coffee and Time with Pet.
Unhelpful Strategies included: Anger /outbursts or ignoring the problem, Alcohol, Social isolation, Don't eat or sleep, Cry, Procrastinate, Skin picking, Not well, Taking drugs and Smoking.

Appendix 1. Stress Questionnaire for Medical Students

We are very aware of the stress of medical student life and as a Teaching and Learning group are looking to address this by developing materials to help students to identify and manage stress. To do this we need to measure baseline stress among medical students prior to the introduction of any materials and ask that you take a few moments to complete these questionnaires as they will provide us with valuable information. All data is anonymous and confidential. Thank you for your time.

Date: 2017

Age_____ **Gender** (*Circle*): M F **GEM** (*Circle*): Yes No

How stressed have you been in the past month? Mark 'X' on this line where 0 is lowest and 10 is highest.

0_____**10**

0=Lowest **10=Highest**

What things in your life make you feel stressed?

1._____

2._____

3._____

How do you feel when you are stressed /how do you react?

1._____

2._____

3._____

How do you cope when you are stressed?

1._____

2._____

3._____

Any other comments?

_____

_____ **Thank You.**

PERCEIVED STRESS SCALE

The questions in this scale ask you about your feelings and thoughts during the last MONTH**. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.**

0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often

1. In the last month, how often have you been upset because of something that happened unexpectedly?
   0 1 2 3 4

2. In the last month, how often have you felt that you were unable to control the important things in your life?
   0 1 2 3 4

3. In the last month, how often have you felt nervous and "stressed"?
   0 1 2 3 4

4. In the last month, how often have you felt confident about your ability to handle your personal problems?
   0 1 2 3 4

5. In the last month, how often have you felt that things were going your way?
   0 1 2 3 4

6. In the last month, how often have you found that you could not cope with all the things that you had to do?
   0 1 2 3 4

7. In the last month, how often have you been able to control irritations in your life?
   0 1 2 3 4

8. In the last month, how often have you felt that you were on top of things?
   0 1 2 3 4

9. In the last month, how often have you been angered because of things that were outside of your control?
   0 1 2 3 4

10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?
    0 1 2 3 4

Appendix 2 Detailed List of Qualitative Comments:

What things make you stressed:

Answers to this question fell into 7 main categories or themes, and includes exams, relationships, future, college, finance and work-life balance/time management. Other less frequently reported themes included personal health and illness but in the context of falling behind and not having time to recover. Table 4a.

157 completed this section:

Exams:

Exams as a stress was reported by 95 out of 157 (60.5%) and this fell into two broad categories, stress related to demands of the exams and stress related to personal factors. The category of stress related to personal factors extended to students' approach to exams and to their thinking, including fear of failure or performing poorly. Comments were made about constant pressure both from the college and from the students thinking and personal and college expectations. Others included expected academic performance and deadlines, balancing college and exams and work and relationships, the relentless nature of the exams and the 'incessant nature' of the final year as well as a negative focus on what students did not know rather than what they knew. Comments included 'not enough hours in the day', 'hyper-competitive environment', 'constant college demands', 'exams close together', 'volume of work'. Many reported being stressed by 'being unprepared', 'fear of not performing at my best', 'falling behind', 'failing', 'not doing well', 'being left behind', 'expectation on myself versus the reality', 'comparing myself to others and their success', 'my thoughts', 'my reactions to things', 'over-whelmed' and 'procrastination'.

Relationships:

Relationships was reported as stressful by 53 out of 157 (33.7%) this included family, partner, friends and colleagues with concern about family members health, little time to spend with them and inter-personal conflict with family and friends.

Future:

Future was reported as a source of pressure by 44 out of 157 (28%). Concern was expressed about immediate issues such as obtaining electives or residency's and the application process involved with specific mention of the pressure experienced by North American students 'trying to balance school with all the extra training, exams and applications that North Americans have'. Further comment implied a lack of support from the College through this process. Comments about future

following graduation and further career path 'deciding what type of medicine /surgery to enter' and the pressure of doing well in medicine as a career choice were prominent along with particular and frequent mention of future employment uncertainty 'unsure of my position next year – what job will I have?'. One commented that their stress was increased from the 'combination of present responsibilities along with planning for the future' as well as 'worrying about putting in work now for applications in the future (audits, research and electives) and a fear that they did not have the time (because of daily college and exam pressures) to do well in these applications and that this would affect future choices. Others mentioned worry and comparing themselves to peers who had chosen careers other than medicine and who were perceived as being more successful and further along their career path. One commented that they felt 'pressure to complete and start working when everyone in peer group has holidays to go on. Seems like other career choice would've been worth it as we are a clever bunch and could've done other things to be successful'.

College:

38 out of 157 (24.2%) commented that 'College' was stressful. Most did not elaborate further but those that did included issues with the organisation of the course (medicine) in general and their perception of lack of support, poor structure and communication deficits as well as academic and financial demands. On commented that 'constant College' created stress for them.

Finance:

33 out of 157 (21%) reported financial stress. Most did not comment further than 'money' and 'finances' but those that did reported financial difficulty due to loans, pressure to pay fees 'bank loans not being approved to pay fees', 'exam results being delayed because of bank loan not being approved for fees' and 'trying to keep on top of money issues'. Those that commented on 'having no money' added that this was in comparison to peers in other professions or 'comparing myself to others and their success'.

Work Life Balance:

Work life balance was reported as being stressful by 32 out of 157 (20.4%) and comments fell into two broad categories, excessive demands and poor time management. Comments included having few social outlets 'letting normal life go', lack of social life, lack of time with friends, limited work-life balance, lack of time to play sport or engage in activity outside college, inability to maintain balanced life-style. Students' were aware of their limited work-life balance and of 'letting other interests and

commitments slip' and of 'not seeing people outside medicine'. Others commented on their poor time management when trying to manage activities as well as study.

Other Themes:

"Personal factors" were cited by 13 (8.3%) as being the source of stress. Personal health and illness were reported as a stress by 10 out of 157 (6.4%) and comments included 'being sick' and 'falling behind' when they needed time out to recover. Others reported feeling 'lonely', 'hospital food unhealthy', 'crime in the area', 'finding housing'. One student reported 'not much at all' to the question 'what things make you stressed'.

How do you feel when you are stressed /how do you react:

148 completed this section and responses were divided into three categories representing the Emotional (anxiety, anger, mood), Cognitive or Thinking and Physical manifestations of stress. Table 4b.

Emotional:

58 out of 148 (39.2%) reported anxiety and this included excessive worry, agitation and panic. A further 48 out of 148 (32.4%) reported being irritable, angry, hostile, grumpy and argumentative and 24 out of 148 (16.2%) felt low mood, depressed and sad. Eight out of 148 reported crying and tears. When combined, the emotional response of anxiety, irritability and low mood was reported 87.8% of students. Thirteen out of 148 (8.8%) reported being 'over-whelmed'.

Cognitive:

Thinking problems and cognitive effects were reported by 24 out of 148 (16.2%) and these included overthinking, poor concentration, sense of failure, hopelessness and procrastination.

Physical:

The physical manifestations of stress, such as poor energy, tiredness, sleep disturbance, appetite disturbance, nail biting, headache, abdominal pain, gastro-intestinal upset, palpitations and breathing difficulties were reported by 44 out of 148 (29.7%).

Sixteen out of 148 (10.8%) reported purely positive impacts of stress that helped them increase productivity and get things done. These students reported that stress made them talk to people, exercise, sleep, read, approach the task in a different way and take a break or focus on hobbies. Twenty out of 148 (13.5%) reported a mixed response to stress where they reported negative, emotional and physical impact but also positive outcomes that increased their focus and productivity. Taken together this means that for 36 students out of 148 (24.3%) their reaction to stress was either totally or partially helpful.

How do you cope when you are stressed?

Of the 162 students 146 (90.1%) completed this section. Of those twelve (8.2%) felt that they did not cope well with stress while the remaining 134 (91.8%) reported they used positive strategies to cope with stress. Students were asked to include three coping strategies and most included more. Table 4c.

Helpful Strategies:

The top ten positive strategies in order included: Exercise (50.7%), Talk to someone (30.8%), Organise, prioritise and plan (23.3%), Time with friends (20.5%), Activity other than study (19.2%), Eat and sleep (17.1%), Meditation, mindfulness, breathing techniques (13%), TV and movies (10.9%), Music (6.8%), Study more (6.8%). Other strategies included Reading (4.8%), Prayer (3.4%), thought management and self-reassurance, relaxation, taking timeout all 2.7%, with Tea, Podcast, Shopping all 1.4% and Sun, Less coffee and Time with Pet all at 0.7%.

Overall, students reported they used five main positive strategies to cope with stress and these were activities other than study (70.5%), connecting with friends and family (51.3%) and exercise (50.7%), followed by Organisation and Planning (32.8%) and Meditation /Relaxation techniques (15.7%). Considerable numbers reported using all categories but interestingly there was not one mention of using support services, trainers, college resources or professional help.

Many used positive self-talk and mentioned that they try to look at 'the bigger picture' and try to 'keep perspective' and while acknowledging that exam results are important that there is a 'broader scheme of things' and that 'it is all manageable'. There was specific mention of reminding themselves of 'all the good things in my life' and that 'it is worth it' and this may account for students high use of activity other than study and family and friends to cope. Many specifically mentioned linking with non-medical friends as supports. A number mentioned the positive benefit of

stress that helps them work harder, focus and perform but the difficulty and negative impact of what they termed 'incessant pressure'.

A significant group (n=14; 9.45%) report that they ignore the signs of stress and comments included: 'put a smile on when I don't feel like it', 'usually takes a day or two to realise I'm stressed', 'don't think about it', 'try to work through it', 'start to avoid situations', 'work more hours', 'am compelled to work faster', 'a lot of time I hide away from my stresses' and 'I talk myself out of it – why I don't have to be stressed'.

Unhelpful strategies:

Twelve students (8.2%) reported that they did not deal with stress well. The strategies they used were as follows: Anger /outbursts or ignoring the problem (n=10; 6.8%), Alcohol (n=6;4.1%), Social isolation (n=5; 3.4%), Don't eat or sleep (n=3; 2%), Cry (n=3; 2%), Procrastinate (n=2; 1.4%), Skin picking (n=1; 0.7%) and not well (n=1; 0.7%). Taking drugs was reported by one respondent and one student reported smoking in order to cope.

Other Comments:

In the free text 'Other Comments' section 22 students chose to make an additional comment. A number of students thanked us for undertaking this work which was regarded as 'worthwhile' with the comment that 'guidance and direction on coping should be done more often through the college course' and that it 'would be a useful exercise to complete throughout the course'. One suggested that 'medical students can cope best when stress when plans/direction and guidance is given' and another that 'students tend to be incredibly stressed in Res (Final Year) year and that can be an over-whelming time'.

Some reported being less stressed during the past month as 'I'm very relaxed compared to my friends /peers (that is, those doing the other modules)' and 'psychiatry was a more enjoyable and organised module than medicine and surgery'. Another commented that they 'thoroughly enjoyed the module (psychiatry)'.

Students suggested possible inputs that included a 'student hotline' and the 'time to talk'. Comments included the student's tendency to self 'diagnose' and others commented that in their experience the counselling service was slow to respond and that the time of appointments

competed with course work or college commitments. Further comments suggested that 'stress was high' due to the 'intensity of the course, exams' and 'intense competition at every stage of the path' along with 'the intensity of this very difficult year' and that 'I know what I should do but time is the biggest issue'.

Others reported that 'not doing well upsets me', 'being perfectionist' and a number reported 'feeling worthless' because of constant focus on what we don't know that has negatively impacted self-esteem'. A number reported feeling a 'lack of support' and 'little positive feedback' along with 'lack of support /encouragement from staff' with a 'focus on what we don't know' as being stressful and something they felt needed to be addressed.

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross sectionalreporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1

Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	#3	State specific objectives, including any prespecified hypotheses	4-5
Methods			
Study design	#4	Present key elements of study design early in the paper	5-6
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	5-6
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	N/A Observational study of a whole class student population
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment	5-7

		(measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	
Bias	#9	Describe any efforts to address potential sources of bias	6
Study size	#10	Explain how the study size was arrived at	5
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	5-7
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	6
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	7-8
Statistical methods	#12c	Explain how missing data were addressed	7
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy	N/A Observational study of a whole class student population
Statistical methods	#12e	Describe any sensitivity analyses	N/A Observational study

Results

Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	7-12
Participants	#13b	Give reasons for non-participation at each stage	N/A
Participants	#13c	Consider use of a flow diagram	N/A
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	5
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	5-7
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	N/A Observational study of a whole class student population
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which	N/A Observational study of a whole class student population

		confounders were adjusted for and why they were included	
Main results	#16b	Report category boundaries when continuous variables were categorized	8
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A Observational study of a whole class student population
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	7-8
Discussion			
Key results	#18	Summarise key results with reference to study objectives	12-13
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	12-15
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	13-15

Generalisability	#21	Discuss the generalisability (external validity) of the study results	13
Other Information			
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20