Appendices
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Appendices for
Premed Pressure: Examining whether premed students experience more academic stress compared to non-premeds

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This document contains the following:

Copy of survey questions analyzed

(PASS)
Please respond to the following statements about your experiences, on average, in your college science courses.

Response scale:

1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree

1. I am confident that I will be a successful student.*
2. I am confident that I will be successful in my future career.*
3. I can make academic decisions easily.*
4. The time allocated to classes and academic work is enough.*
5. I have enough time to relax after my academic work.*
6. My instructors are critical of my academic performance.
7. I fear failing courses this year.
8. I think that my worry about examinations is a weakness of character.
9. Instructors have unrealistic expectations of me.
10. The workload is excessive.
11. I believe that the amount of work assignments is too much.
12. I am unable to catch up if I get behind on my academic work.
13. The unrealistic academic expectations of my parent(s)/guardian(s) stresses me out
14. Competition with my peers for grades is quite intense.
15. The exam questions are usually difficult.
16. Exam time is short to complete the answers.
17. Exam times are very stressful to me.
18. Even if I pass my exams, I am worried about getting a job.

**reverse coded (1 = strongly agree; 5 = strongly disagree)*

(Perception of premeds)
In your opinion, how do you think pre-med student stress compares to the stress of science students who are not pre-med?

When we say pre-med we mean students who intend to apply or have applied to medical school.

- Pre-med students have higher stress than non pre-med students
- Pre-med students have the same stress as non pre-med students
- Pre-med students have lower stress than non pre-med students

[Fill in based on previous answer]
Why do you think pre-med students have **[higher/the same/lower]** levels of stress regarding their major as other science undergraduate students? **[free response]**

Do you consider yourself to be a pre-med student meaning that you intend to apply or have applied to medical school?

- Yes
- Undecided at this time if I will apply to medical school
- No, not currently but I have in the past
- No, I have never considered myself to be pre-med

[If yes or undecided]

Which of the following aspects of the medical school application process have you started?

- Preparing for the MCAT
- Maintaining a competitive GPA
- Trying to secure letters of recommendation
- Beginning to write a competitive personal statement
- Trying to get involved in extracurricular activities such as undergraduate research, clinical experience

[Each option selected will show up below]

How much does (or did) each of the following aspects of the medical school application process cause you stress?

Response scale: Answer on a sliding scale from 0 (none), 1 (low), 2 (moderate), 3 (high), 4 (extremely high)

- Preparing for the MCAT
- Maintaining a competitive GPA
- Securing letters of recommendation
- Writing a competitive personal statement
- Getting involved in extracurricular activities such as undergraduate research, clinical experience
- Financing being a competitive pre-med student (paying for preparatory courses, volunteering your time)

On average, how much does (or did) each of the following cause you stress?
Response scale: Answer on a sliding scale from 0 (none), 1 (low), 2 (moderate), 3 (high), 4 (extremely high)

- Being judged negatively for choosing to go into medicine
- Being judged by others for not meeting a medical school related goal (e.g., scoring highly on the MCAT, getting into medical school)
- Worrying about not meeting a medical school related goal in the future (e.g., worrying about not getting a good grade in a science course)
- Failing to meet a medical school related goal (e.g., getting what you consider to be an unacceptable grade in a science course)
- Feeling guilty for spending time on pre-med related activities instead of with friends or family
- Experiencing personal guilt for not doing enough to become a competitive candidate
- Thinking I'm not competitive enough to be accepted to medical school

How can instructors help decrease the stress associated with being pre-med? Select your top three recommendations.

- Provide a supportive and motivational environment (e.g., ample office hours)
- Provide multiple attempts on assignments and assessments
- Provide extra credit opportunities
- Make course materials and the syllabus available to students preemptively
- Be flexible on exam times
- Express that the instructor cares that students are genuinely learning
- Other (please describe)

How can your institution help decrease the stress associated with being pre-med? Select your top three recommendations.

- Advertise opportunities for students to join research labs
- Connect students to opportunities to gain clinical experience
- Financial assistance on course materials (e.g., lab fees)
- Provide MCAT financial assistance
- Provide MCAT tutoring
- Encourage faculty to write letters of recommendation
- Provide students with mock interview opportunities
- Host career or medical school fairs
- Increase availability of pre-med advisors
- Offer classes that accommodate different schedules
- Create a community forum for tips and advice from current or previous medical students for current pre-meds
- Other (please describe)

[If No, not currently but I have in the past]

What factors influenced your decision to switch off of the pre-med track? Select all that apply.

- Poor performance in one or more courses
- Low GPA
- A different career track seemed less demanding
- Concern about the competitive academic environment
- Low acceptance rate of medical school
- Negative experiences working/volunteering in the healthcare system
- Lack of social support from friends and family
- Lack of social support from professors or your university
- Lack of access to medical-related research/internships/shadowing opportunities
- Future financial stress
- Current financial stress associated with being pre-med (e.g., MCAT prep, cost associated with taking voluntary internships)
- Mental health concerns (e.g. depression, anxiety, burnout)
- A different career track seemed more interesting

[All participants]

Demographics:

How long have you attended college while pursuing your undergraduate degree?

- 1 year or less
- 2 years
- 3 years
- 4 years
- 5 years or more
- I have graduated with my undergraduate degree
- Decline to state

Please select the major that is closest to yours. If you have more than one major, please choose all that apply.

- Biology
- Biochemistry
- Chemistry
- Physics
- Geosciences
- Engineering
- Math
- Computer science
- Business
- English
- Psychology
- Sociology
- Another STEM major, please specify
- Another major outside of science, technology, engineering, or math, please specify

What is your GPA (on a 4.0 scale)?

I most closely identify as

- Woman
- Man
- Gender-queer or non-binary
- An identity not listed, please specify
- Decline to state

I most closely identify as

- American Indian or Alaska Native
- Asian or Asian American
- Black or African American
- Hispanic, Latino/a/x, or of Spanish origin
- Pacific Islander
- White

- An identity not listed including multiracial, please describe
- Decline to state

What is your parent/guardian's highest completed level of education? If you have more than one parent/guardian with differing levels of education, choose the parent/guardian with the highest completion level.

- Did not complete high school
- High school diploma or GED
- Some college but no degree
- Associate degree (for example: AA, AS)
- Bachelor's degree (for example: BA, AB, BS)
- Master's degree (for example: MA, MS, MEng, MEd, MBA)
- Higher than a Master's (for example: MD, PhD, JD)
- Other, please describe
- Decline to state

During the time you have been enrolled in your undergraduate program, have you considered yourself financially stable (e.g., had enough money for necessities such as groceries and rent)?

- Yes
- Yes, but only sometimes
- No
- Decline to state

Do you identify as a member of the LGBTQ+ community? (e.g., lesbian, gay, bisexual, trans, queer/questioning, intersex, asexual/aromantic)

- Yes
- No
- Decline to state

Please indicate the language you spoke at home when growing up.

- English
- Spanish
- A language not listed, please specify
- Decline to state

How old are you?

[end of survey]

Table S1. Summary of participant demographics.

Demographic N = 551		n	%	Demographic N = 551		n	%
Gender	Man	159	28.9%	College career stage	Early (2nd year or less)	339	61.5%
	Woman	376	68.2%		Late (3rd year or more)	209	37.9%
	Non-binary (NB)	9	1.6%		Decline to state	3	0.5%
	Other	2	0.4%				
	Decline to state	5	0.9%	Premed	Currently	141	25.6%
					Previously	84	15.2%
Race/ ethnicity	American Native	9	1.6%		Undecided	66	12.0%
	Asian	87	15.8%		Never	260	47.2%
	Black	20	3.6%				
	Hispanic	105	19.1%	Major	STEM major	212	38.5%
	Multiracial	40	7.3%		Non-STEM major	339	61.5%
	Pacific Islander	6	1.1%				
	White	272	49.4%				
	Decline to state	12	2.2%	GPA	Mean ± std dev	3.55 ± 0.48	
College gen. status	Continuing	315	57.2%		Median	3.77	
	First-generation	117	21.2%		Range	(1.4-4.0)	
	Decline to state	119	21.6%				
Financially stable	Yes	247	44.8%				
	Sometimes	196	35.6%				
	No	81	14.7%				
	Decline to state	27	4.9%				

Table S2. Descriptives of perceived academic stress scale (PASS).

	n	mean	sd	median	min	max	range	skew	kurtosis	se
PASS	550	2.89	0.52	2.94	1.06	4.11	3.06	-0.48	0.24	0.02

Table S3. Academic stress multiple regression.

	Estimate	Standard error	T-value	Pr(>|t|)
(Intercept)	3.057231	0.184413	16.57815	2.41E-49
Premed	0.068194	0.052232	1.305603	0.192299
Woman or NB	0.219153	0.049609	4.417612	1.23E-05
Asian	0.115019	0.065503	1.755932	0.079723
PEER	0.127376	0.050676	2.51354	0.012272
Financially Unstable	0.167311	0.046417	3.604482	0.000345
Late College Career	-0.00039	0.046744	-0.00831	0.993371
GPA	-0.13838	0.049043	-2.82156	0.004973

Note. This is traditional OLS regression conducted with base R. We also ran exploratory analyses using more robust regression software (1), and re-ran this model with the more robust method. Although the coefficients are slightly different between base R and using robust standard errors provided by jtools (1), the overall interpretation in both versions of the model are identical. We report these analyses in the manuscript for simplicity of interpretation. See “Original Model” column in Table S3-2 for robust output.

Table S3-2. Academic stress multiple regression w/ moderation.

	Original Model	Alternative Exploratory Model
(Intercept)	2.57 ***	2.56 ***
	(0.06)	(0.06)
Premed	0.07	0.06
	(0.06)	(0.16)
GPA	-0.06 **	-0.08 ***
	(0.02)	(0.02)
Woman or NB	0.22 ***	0.22 ***
	(0.05)	(0.06)
Asian	0.12	0.13
	(0.07)	(0.08)
PEER	0.13 *	0.19 **
	(0.05)	(0.06)
Financially Unstable	0.17 ***	0.15 **
	(0.05)	(0.05)
Late College Career	-0.00	-0.02
	(0.05)	(0.06)
Premed : GPA		0.10
		(0.06)
Premed : Woman or NB		0.05
		(0.14)
Premed : Asian		-0.09
		(0.15)
Premed : PEER		-0.25
		(0.12)
Premed : Financially Unstable		0.04
		(0.12)
Premed : Late College Career		0.09
		(0.11)
N	499	499
R2	0.11	0.12

Coefficients reported first, standard errors reported in parenthesis below coefficient. All continuous predictors are mean-centered and scaled by 1 standard deviation. The outcome variable is in its original units. Standard errors are heteroskedasticity robust. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Table S3-3. Likelihood ratio test of academic stress multiple regression models.

Model 1: academic stress ~ premed (yes/no) + GPA (continuous) + gender (women and non-binary/men) + race (PEER/Asian/White) + financial stability (yes/no) + college career stage (early/late)

Model 2: academic stress ~ premed + GPA + premed:GPA + gender + premed:gender + race + premed:race + financial stability + premed:financial stability + college career stage + premed:college career stage

Res.Df	RSS	Df	Sum of Sq	F	Pr(>F)
491	121.93				
485	119.72	6	2.093	1.4916	0.179

Note for interpretation. This test suggests that the more complicated model with interactions does not provide statistically significant model fit compared to the simpler, original model.

Table S4. Premed logistic regression.

	Estimate	**Standard error**	**T-value**	**Pr(>|z|)**
(Intercept)	3.237166	1.267568	2.55384	0.010654
Woman or NB	0.578656	0.359306	1.610485	0.107292
Asian	0.137232	0.413776	0.331659	0.740147
PEER	-0.16208	0.336703	-0.48137	0.630251
Financially Unstable	-0.51144	0.31304	-1.6338	0.1023
Late College Career	-0.16665	0.305625	-0.54528	0.585558
GPA	-1.05665	0.334356	-3.16026	0.001576

Table S5. Most common ways to decrease premed stress selected by participants.

N (premed) =141	**Ways to decrease premed stress**	% of premeds	n
Instructor-level	Extra credit opportunities	83.7	118
	Multiple attempts on assignments	78.7	111
	Provide a supportive environment	34.0	48
	Course materials available early	31.9	45
	Flexible exam times	27.0	38
Institution-level	Connect students to clinical experience	56.7	80
	MCAT tutoring	44.0	62
	Advertise research labs to join	36.9	52
	Encourage letters of rec	29.8	42
	Financial assistance for course materials	24.8	35

S6. Reliability of items asked to premed students (n = 140) related to specific premed experiences.

Cronbach's alpha = 0.85 when all of the following items are considered together:

How much does (or did) each of the following aspects of the medical school application process cause you stress?

Response scale: Answer on a sliding scale from 0 (none), 1 (low), 2 (moderate), 3 (high), 4 (extremely high)

- Preparing for the MCAT
- Maintaining a competitive GPA
- Securing letters of recommendation
- Writing a competitive personal statement
- Getting involved in extracurricular activities such as undergraduate research, clinical experience
- Financing being a competitive pre-med student (paying for preparatory courses, volunteering your time)

On average, how much does (or did) each of the following cause you stress?
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- Being judged negatively for choosing to go into medicine
- Being judged by others for not meeting a medical school related goal (e.g., scoring highly on the MCAT, getting into medical school)
- Worrying about not meeting a medical school related goal in the future (e.g., worrying about not getting a good grade in a science course)
- Failing to meet a medical school related goal (e.g., getting what you consider to be an unacceptable grade in a science course)
- Feeling guilty for spending time on pre-med related activities instead of with friends or family
- Experiencing personal guilt for not doing enough to become a competitive candidate
- Thinking I'm not competitive enough to be accepted to medical school

S7. Item-by-item citations for selected questions

How can faculty or instructors help decrease the stress associated with being pre-med? Select all that apply.

- Make course materials available to students well in advance (2)
- Flexibility for tests times (3)
- Provide a supportive and motivational environment e.g. ample office hours (2, 4, 5)
- Adhere to accommodations for students who have disabilities (exploratory)
- Express that the instructor cares that students are genuinely learning (exploratory)
- Provide multiple attempts on assignments and assessments (exploratory)
- Provide extra credit opportunities (exploratory)
- Other, please describe

How can your institution help decrease the stress associated with being pre-med? Select all that apply.

- Financial assistance on course materials (6)
- Provide MCAT tutoring (7)
- Provide students with mock interview opportunities (8)
- Host career or school fairs (8)
- Increase availability of advisors/ peer support. (9)
- Offer classes that could accommodate different schedules (10)
- Create a community forum for tips/advice/questions from current/previous med students (11)
- Advertise opportunities for students to join research labs (exploratory)
- Connect students to opportunities gain clinical experience (exploratory)
- Provide MCAT financial assistance (exploratory)
- Encourage faculty to write letters of recommendation (exploratory)
- Other, please describe

What factors influenced your decision to switch off of the pre-med track? Select all that apply.

- Poor performance in one course or more courses (12)
- Low GPA (13)
- Concern about the competitive environment (14)
- A different career track seemed more interesting (4, 8)
- Lack of social support from friends and family (13, 15)
- Future financial stress (13)
- Mental health e.g. depression, anxiety, burnout (4, 11, 15)
- Lack of access to resources for research/internship opportunities (8, 13)
- Financial cost of being premed i.e. MCAT®, prep, opportunity cost associated with taking internships/shadow/lab opportunities rather than employment (exploratory)
- Lack of social support from professors or your university (exploratory)
- Low acceptance rate of medical school (exploratory)
- A different career track seemed less demanding (exploratory)
- Negative experiences working/volunteering in the healthcare system (exploratory)

S8. Appendices citations

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