

Psychometric Properties of a New Self-Report Measure of Medical Student Stress using Classic and Modern Test Theory Approaches

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Abstract

Background.

Medical students face significant stressors related to the intense rigors of their training and education. Accurate measurement of their stress is important to quickly identify, characterize and ameliorate these challenges. Existing measures have limitations that modern measurement approaches, such as item response theory (IRT), are able to address. This study presents the calibration and validation of a new IRT-based measure called the Medical Student Stress Scale (MSSS).

Methods.

Following rigorous measurement development procedures described elsewhere, the authors created and tested a pool of 35 items with 348 1st – 4th year medical students along with demographic and external validity measures. Psychometric analysis included exploratory and confirmatory factor analyses, IRT modeling, and correlations with legacy measures.

Results.

Of the original 35 items, 22 were retained based on their ability to discriminate, provide meaningful information, and perform well against legacy measures. The MSSS differentiated stress scores between male and female students, as well as between year in school.

Conclusion.

Developed with input from medical students, the MSSS represents a student-centered measurement tool that provides precise, relevant information about stress and holds potential for screening and outcomes-related applications.

Background

It is widely understood that medical school can be a very stressful experience that is different from other forms of life stress. This includes exposure to death and human suffering, ethical conflicts, adjustment to the medical school environment, student abuse, personal life events, and educational debt (1). Recent research suggests that source of stress may be subject to change depending on the year of medical school (2). Not only is medical student stress uniquely challenging but it is also disrupting and potentially harmful. Heightened stress contributes to roughly 25% of medical students considering dropping out. There is also a strong association between high levels of stress, depression, and anxiety (3, 4). Depression is reported to be experienced by some 27% of medical students, with the overall prevalence of suicidal ideation as 11% (5). Anxiety is reported by some 43.1% of medical students, with nearly 60% who

report abusing substances such as coffee, tea, or cigarettes (4). What's more is that only roughly 16% of medical students who screened positive for depression actually sought psychiatric treatment (5).

It is important to recognize that some degree of stress in a medical student's life is normal and, frankly, unavoidable. Medical school is challenging and stress can play an adaptive role in providing that extra motivation and "push" in times of intense study. However, if left unidentified or unmanaged, stress may manifest in hazardous forms such as impaired sleep, altered appetite, depression, clinical anxiety, and at worst, suicide. This may result in downstream consequences such as poor academic performance, cynicism, academic dishonesty, and/or substance abuse. During medical residency, the harmful aspects of unmanaged stress appear to intensify in severity. Studies have shown that major medical errors are strongly related to a physician's degree of burnout and stress (6). Today, more than 50% of US physicians report burnout which creates a greater risk of verbal abuse to colleagues and harm to patients (7). Programs, such as one at the University of California San Diego, have been effective in helping suicide prevention with a 40% increase in medical students reaching out for help. However, proper testing metrics are needed to identify students at higher risk (8). In order to create sustainable interventions to promote self-care skills, it is crucial to measure stress levels in the most precise way possible.

While global measurement tools exist to assess stress or burnout, such as the Perceived Stress Scale (PSS), Maslach Burnout Inventory (MBI), these are less tailored and personal, and therefore may not be as sensitive to population-specific needs. While three different measures have been created specifically for medical student stress - Perceived Medical Student Stress (PMSS) Instrument (9), Medical Student Stress Profile [MSSP] (10), and Medical Student Stressor Questionnaire [MSSQ] (11) – each has its own limitations. The PMSS is a 13-item measure that contains several items that can be considered double-barreled (e.g., they actually measure two or more different things), such as "Medical school is cold, impersonal and needlessly bureaucratic." Several items are also negatively phrased (e.g., "I am concerned that I will not be able to..." or "I do not know what..."), which can be cognitively complex to understand in the context of response scales where double negatives occur. Finally, it includes certain colloquialisms (e.g., "baptism by fire") that may not be fully understood by all respondents. The MSSP is a 52-item measure, which, despite its relative length (and associated response burden) also instructs respondents to rate each item twice; once to measure how true the item is, and then to measure how stressful it is. This can create cognitive load and actually requires a respondent to answer 102 items. Further, the measure contains colloquialisms from British English (e.g., "You do not get on with your fellow students") and also contains negatively phrased items (e.g., "Your supervisors do not support you"). Finally, the MSSQ is either a 20 or 40 British English item measure that contains a list of possible stressors, versus items that are written in a more common question or statement form (e.g., "heavy workload", "large amount of content to be learnt", "falling behind in reading schedule"). A list of issues is not necessarily a limitation in and of itself, however, given the nature of medical student stress, a respondent may more easily and quickly identify with an item's content and meaning when it is written in a more personal way. For example, the difference between the MSSQ item "Tests/Examinations" compared with an item such as "I feel unsure of my abilities as a student" or "I am fearful of failing."

Given these limitations, the purpose of this current study was to use established measurement development methodologies based on the Patient Reported Outcomes Measurement Information System® (PROMIS) (12) to develop and test a new measure of medical student stress.

Methods

Overview

This study was approved by the participating institution's internal review board. The development and testing of this new measure drew from a widely accepted multi-step, multi-phase measurement development methodology based on PROMIS, which included the following: PHASE I: 1) A literature search of existing measures, concepts, and items; 2) Development of a guiding conceptual framework; 3) Medical student group discussions to elucidate and confirm important concepts and issues related to medical student stress; 4) Creation of an initial pool of medical student stress items; 5) Refinement of items via expert review; 6) Cognitive interviews with medical students; and 7) Final expert item review; PHASE II: The final item pool was administered to a sample of actively enrolled medical students attending a large, private Midwestern university, with an average class size of 160 students (total number of enrolled students was roughly 640 students). Given that PHASE I activities have been previously reported (13) this report will focus exclusively on PHASE II activities.

Calibration Testing Procedures

Eligible participants were current medical students (1st – 4th year also know as “M1-M4”) at the participating institution. Following informed consent, the authors administered a 10–15 minute online survey via Research Electronic Data Capture (REDCap), which is a secure web-based data collection application. Participation was voluntary and responses were kept anonymous. Secure invitations were sent via an encrypted email service, and survey participants were notified that taking part in the survey would have no bearing on academic standing whatsoever.

Measures

In addition to new items of medical student stress, the authors also administered a socio-demographic form and the following legacy measures to establish preliminary convergent validity evidence: 1) *Demographic Form*: This included year in medical school, gender, race (either Caucasian or non-Caucasian), and religious belief; 2) *Health and Lifestyle Behaviors*. The authors asked participants about their sleep and exercise patterns, including questions on frequency and total amounts; 3) *Burnout*. To measure burnout, the authors administered the 10-item Burnout Measure Short Version (14); 4) *Perceived Stress*. To gauge stress levels, the authors used the Perceived Stress Scale-4 (PSS-4) (15); 5) *Anxiety*. To assess anxiety, the authors used the 4-item PROMIS Anxiety Short Form, which was drawn from a 29-item bank (16); 6) *Visual Analog Scale (VAS)*. To assess current stress levels, the authors used a VAS in the form of a single question which asked participants to rate their perceived stress levels on a 10-point Likert-type scale ranging from no stress at all (1) to worst stress imaginable (10).

Analysis

Following data cleaning, the authors first conducted a series of exploratory factor analyses (EFAs), including unidimensional, 2- and 3-Factor Target, and 3-Factor Quartimax solutions. Targeted EFA rotations allowed the authors to explore theoretical models of stress and burnout (e.g. reasons, reactions, and responses to stress). Together with the Quartimax rotation, these EFAs allowed the authors to consider the optimal structure of the MSSS.

The optimal model was then fit using a confirmatory item factor analysis (CFA), and used for reliability and validity evaluations. Cronbach's alpha was used to index internal consistency reliability, and correlation coefficients with external measures were used to index validity. T-scores derived from the optimal model were also used in known group's discriminant validity t-test evaluations. The authors hypothesized that the optimal model for the MSSS will exhibit high internal consistency ($\alpha > 0.80$), and correlate well with validity measures ($r > 0.50$) (17). The authors also hypothesized that there would be at least a small difference ($d > 0.20$) between known groups.

Results

Following all item development activities, the authors arrived at a field testing-ready item pool of 35 items. The item context for all items is "Since starting medical school" with response options: Never, Rarely, Sometimes, Often, and Always.

Calibration Testing Results

In total, 348 medical students completed the survey (M1 = 144 (41%), M2 = 145 (42%), M3 = 26 (7%), M4 = 33 (9%)), of which 175 (50%) were male and 173 (50%) were female. In terms of ethnicity, 197 (57%) responded white/Caucasian, 155 (45%) responded non-Caucasian, and 2 (1%) did not respond.

The best fitting EFA model was a 3-factor solution (Akaike Information Criterion = 29125; Bayesian Information Criterion = 30053), which the authors labeled: Factor 1: Social Challenges, Factor 2: High Activation, and Factor 3: Low Activation. The Social Challenges factor represented items such as difficulty asking for help, feeling unsupported by faculty and peers, feeling taken advantage of by faculty, and feeling pressure to get good grades. The High Activation factor represented items such as feeling anxious, being unable to relax, being overly self-critical, and feeling overwhelmed. Finally, the Low Activation factor represented items such as feeling hopeless, depressed, having difficulty motivating oneself, and feeling like dropout out of school. See Table 1 below for item coefficients by factor. Note that generally, item coefficients $> .30$ characterize each respective factor, however in the case of cross-loadings (due to conceptual overlap), the higher coefficient is to be used.

Table 1
Exploratory Factor Analysis Item Coefficients

Item ID	Item (each begins with "Since starting medical school")	Social Challenges	High Activation	Low Activation	Items Removed
msss1	I notice fluctuations in appetite.	0.08	0.03	0.46	
msss2	I have difficulty asking for help.	0.45	0.21	0.2	
msss3	I have trouble falling/staying asleep.	-0.02	0.24	0.38	x
msss4	I receive less satisfaction from learning.	0.11	-0.04	0.65	
msss5	I am unable to relax.	-0.05	0.69	0.23	
msss6	I feel anxious.	-0.08	0.69	0.27	
msss7	I am unable to enjoy activities outside of classes/rotations.	0.01	0.49	0.29	
msss8	I feel pressure extracurricular activities (student groups, research, etc.).	0.2	0.37	-0.11	x
msss9	I notice that I drink alcohol in excess.	0.02	-0.08	0.33	x
msss10	I use drugs in excess (prescription and/or non-prescription).	-0.01	-0.04	0.47	x
msss11	I feel hopeless that I will ever get my degree.	0.08	0.25	0.59	
msss12	I feel depressed.	0	0.32	0.61	
msss13	I am stressed about finances.	0.17	0.07	0.28	x
msss14	I have a hard time motivating myself to study.	0.18	-0.06	0.62	
msss15	I feel emotionally exhausted.	0.11	0.46	0.38	
msss16	I feel bothered by the amount of exposure to death and human suffering.	0.3	0.06	0.17	x
msss17	I am fearful of failing.	0.13	0.52	0.28	
msss18	I exercise less.	0.18	0.18	0.15	x
msss19	I feel unsupported by my peers.	0.54	0.18	0.09	

Item ID	Item (each begins with "Since starting medical school")	Social Challenges	High Activation	Low Activation	Items Removed
msss20	I feel competition from my peers.	0.54	0.29	-0.19	
msss21	I feel unsupported by faculty.	0.8	-0.09	0.16	
msss22	I feel taken advantage of by faculty (i.e. research mentors, professors, and/or school administrators).	0.68	-0.1	0.02	
msss23	It is challenging to maintain relationships with others outside of school.	0.08	0.34	0.19	x
msss24	I feel pressure from others (parents, professors, mentors, etc) to get good grades.	0.39	0.23	0.06	
msss25	I feel unmotivated to attend class.	0.18	-0.06	0.41	x
msss26	I feel pressure from myself to get good grades.	0.1	0.71	-0.38	x
msss27	I am overly self-critical.	-0.01	0.85	-0.03	
msss28	I feel need to be perfect.	0.2	0.77	-0.29	x
msss29	I am unsure of abilities as student.	0.07	0.49	0.36	
msss30	I hardly have enough time to get things done.	-0.04	0.41	0.32	
msss31	I feel overwhelmed by everything there is to do.	0.01	0.53	0.43	
msss32	I struggle maintaining a healthy school-life balance.	0.15	0.59	0.16	
msss33	It is challenging to start or maintain romantic relationships.	0.12	0.31	0.19	x
msss34	I think about dropping out of school.	0.09	0	0.79	
msss35	I question my decision to enter medical school.	0.15	-0.05	0.76	x

Note: coefficients in bold characterize respective factors; correlations between factors High Activation and Social Challenges = .42; correlation between factors Low Activation and Social Challenges = .36; Correlation between factors Low Activation and High Activation = .31. Due to conceptual and psychometric misfit (e.g., model explained less variance/greater error in ratings) we removed items found in the "Items Removed" column. As before, each item stem has the same contextual qualifier – "Since starting medical school".

The authors removed two items that did not load well on any factor (e.g., stress about finances and exercising less), as well as two items with negative cross loadings (e.g., pressure to get good grades and need to be perfect). The authors retained other items with cross-loadings if they were conceptually/clinically relevant for content validity. It is important to note that while there are plausible 3-factors, they are not necessarily conceptually “separate” and one scale could still give a precise score that encompasses all three factors.

[INSERT Table 1 HERE]

The authors proceeded with testing a 3-factor solution in a restricted, hierarchical CFA model, allowing cross-loading items to co-load between High and Low Activation. The High and Low Activation factors came to represent locally dependent doublets or triplets (e.g., alcohol & drugs: msss9 & msss10; pressure: msss26, msss27, & msss28; dropping out: msss4, msss34, & msss35; and feeling unmotivated: msss14 & msss25), rather than two distinct factors. The authors decided to remove one item in locally dependent pairs and 1–2 items in locally dependent triplets, and remove items with poor remaining relationships, based on content relevance and available item information. The optimal final model was a bi-factor model with a general factor representing stress/burnout and a specific factor with six items (msss2, msss19, msss20, msss21, msss22, msss24) representing both general stress/burnout and social challenges.

Item Calibration Using Item-Response Theory Modeling

The retained 22 items underwent item response theory (IRT) bi-factor calibration, which provides specific information about each item’s discriminability and performance along a severity continuum from mild to severe. Marginalizing the social challenges factor to emphasize the stress/burnout, the primary factor provided item slopes (e.g., how discriminating each item is), item thresholds (e.g., how difficulty each item is in order for a person to endorse a specific response category), item characteristic curves (e.g., a visual depiction of each item’s discrimination between response categories and how informative an item is across a continuum), and a test information function (e.g., how informative and precise the entire set of items is across the continuum of the latent trait) (18). See Table 2 below for IRT calibration information.

Table 2
Item Calibration Information in Order of "Least Likely" to "Most Likely" to Endorse

Item ID	Slope	CB1	CB2	CB3	CB4	Average Threshold (Difficulty)
MSSS30	1.238	-4.5	-2.19	-0.5	1.22	-1.476
MSSS27	1.543	-3.5	-1.62	0	1.15	-0.991
MSSS31	2.23	-3	-1.62	-0.3	1.12	-0.945
MSSS6	1.96	-3	-1.46	0.12	1.87	-0.63
MSSS32	1.72	-2.9	-1.27	0.26	1.67	-0.565
MSSS29	1.87	-2.3	-1.04	0.35	1.56	-0.351
MSSS15	1.907	-2.2	-0.92	0.47	1.87	-0.185
MSSS14	1.077	-3.1	-1.35	0.97	3.05	-0.116
MSSS5	1.917	-2.2	-0.72	0.73	2.18	0.002
MSSS17	1.964	-1.6	-0.52	0.65	1.92	0.121
MSSS20	0.723	-4.3	-0.91	1.7	4.57	0.258
MSSS1	1.137	-2.1	-0.67	0.97	3.61	0.449
MSSS4	1.064	-2.4	-0.22	1.65	3.54	0.64
MSSS24	0.847	-2	-0.14	1.44	3.32	0.644
MSSS2	1.244	-2.3	-0.22	1.9	3.79	0.801
MSSS12	1.871	-1.2	0.073	1.53	2.79	0.809
MSSS7	1.445	-1.5	0.279	1.48	3.38	0.922
MSSS21	0.944	-2.1	0.368	2.32	4.94	1.38
MSSS19	1.053	-1.4	0.651	2.88	4.42	1.64
MSSS11	1.824	0.04	1.244	2.23	3.54	1.76
MSSS34	1.379	0.06	1.199	2.24	3.92	1.85
MSSS22	0.537	-0.3	2.808	5.55	7.71	3.94

NOTE: The "Average Threshold" column represents the average of the four thresholds, CB1-CB4, and ordered from lowest to highest. This is a way to view each item's comparative difficulty along the severity continuum of medical student stress from low to high and indicates which items are relatively "easier" to endorse, and which ones are more "difficult", e.g., a person needs to be at a high level of the trait in order to endorse it.

[INSERT Table 2 HERE]

Figure 1 below illustrates how well the MSSS estimates a respondents' latent trait of medical student stress over the whole range of scores. Since test information function will be much higher than any single item information function, a test measures ability more precisely than does a single item. The MSSS is a reliable scale (Cronbach's $\alpha = 0.89$), covers a wide range of medical student stress, and only declines in precision (i.e. reliability) towards the very extremes of stress.

[INSERT FIGURE 1 HERE]

Administering and Scoring the MSSS-22

See Fig. 2 for MSSS-22 instructions and recall period, response options, and items.

[INSERT FIGURE 2 HERE]

Items from the MSSS-22 may be summed into a total score and converted into a T Score with a mean of 50 and standard deviation of 10 by using the conversion table in Table 3 below.

Table 3
Item Response Theory-Derived T-Score
Conversion Table

MSSS Total Raw Score	T-Score	Standard Deviation
0	10.37	4.72
1	12.66	4.41
2	14.69	4.19
3	16.53	4.03
4	18.20	3.90
5	19.74	3.80
6	21.17	3.71
7	22.50	3.65
8	23.76	3.59
9	24.94	3.54
10	26.07	3.50
11	27.15	3.46
12	28.19	3.43
13	29.19	3.41
14	30.15	3.38
15	31.10	3.37
16	32.01	3.35
17	32.91	3.34
18	33.79	3.32
19	34.65	3.32
20	35.49	3.31
21	36.32	3.30
22	37.14	3.30
23	37.95	3.29
24	38.74	3.29

MSSS Total Raw Score	T-Score	Standard Deviation
25	39.53	3.29
26	40.30	3.28
27	41.07	3.28
28	41.83	3.28
29	42.58	3.28
30	43.32	3.28
31	44.06	3.28
32	44.79	3.28
33	45.51	3.28
34	46.23	3.28
35	46.95	3.28
36	47.66	3.28
37	48.37	3.28
38	49.08	3.28
39	49.78	3.28
40	50.48	3.28
41	51.18	3.28
42	51.87	3.28
43	52.57	3.29
44	53.26	3.29
45	53.95	3.29
46	54.64	3.30
47	55.33	3.30
48	56.01	3.30
49	56.70	3.31
50	57.39	3.32
51	58.08	3.32

MSSS Total Raw Score	T-Score	Standard Deviation
52	58.78	3.33
53	59.47	3.34
54	60.17	3.35
55	60.86	3.36
56	61.57	3.38
57	62.27	3.39
58	62.99	3.41
59	63.70	3.42
60	64.42	3.44
61	65.15	3.47
62	65.89	3.49
63	66.63	3.52
64	67.38	3.55
65	68.14	3.58
66	68.90	3.62
67	69.68	3.65
68	70.47	3.69
69	71.26	3.74
70	72.07	3.78
71	72.89	3.83
72	73.72	3.88
73	74.56	3.94
74	75.42	4.00
75	76.30	4.06
76	77.19	4.12
77	78.11	4.18
78	79.04	4.25

MSSS Total Raw Score	T-Score	Standard Deviation
79	80.01	4.31
80	81.02	4.37
81	82.06	4.44
82	83.16	4.49
83	84.32	4.55
84	85.57	4.60
85	86.92	4.65
86	88.42	4.70
87	90.11	4.77
88	92.13	4.90

[INSERT Table 3 HERE]

Validity Evidence with External Validity Measures.

Convergent validity was established with moderately high associations with the Burnout Scale Short Version ($r = 0.800, p < .01$), PROMIS Anxiety ($r = 0.672, p < .01$), PSS-4 ($r = 0.739, p < .01$), and a stress visual analog scale ($r = 0.641, p < .01$) (see Table 4). Criterion-related validity was established with small inverse associations with self-reported regularity of exercise ($r = -0.261, p < .01$) and hours of sleep on average ($r = -0.237, p < .01$).

Table 4
Associations between MSSS & Validity Measures

	MSSS
Burnout Measure	.800*
PROMIS Anxiety-4	.672**
Perceived Stress-4	.739**
Visual Analog Scale (current stress)	.641**
Regularity of Exercise	-.261**
Hours of Sleep on Average	-.237**
** . Correlation is significant at the 0.01 level (2-tailed).	

[INSERT Table 4 HERE]

Known Groups validity was established with statistically significant differences in the MSSS scores between M1s and M2s, and also between male and female medical students (Table 5). Other validity measures, such as the burnout measure short version and PSS-4, were unable to significantly differentiate difference between M1s and M2s; however, the Burnout Measure was also able to demonstrate a significant difference between male and female students (Table 5).

Table 5
Known-Groups Validity

	Medical Student Year			Gender		
	M1 (n = 144)	M2 (n = 145)		Male (n = 174)	Female (n = 173)	
	Mean	Mean	Sig (p)	Mean	Mean	Sig (p)
MSSS	50.95	48.53	0.03	47	52.5	< 0.01
Burnout Measure	32.5	30.9	0.151	2.9	3.4	< 0.01
PSS-4	10.5	10.8	0.196	10.6	10.6	0.96

[INSERT Table 5 HERE]

Discussion

The purpose of this current study was to gather psychometric evidence for a new measure of medical student stress. The items comprising the MSSS are a distinctive mix of targeted and generic content that encapsulates the experience of stress in the medical school environment. The MSSS was developed using a rigorous, student-centered methodology that involved medical students, faculty, and experts in medical education, clinical psychology, and measurement development. Field-testing of the final item pool and external validity measures was conducted during required class time, so as not to burden the students' busy schedules.

The MSSS is a flexible and precise measure of the different types and levels of stress commonly experienced by medical students. While the MSSS can discriminate very well between those who are experiencing medical student-related stress at varying levels of severity, some precision may decline among individuals experiencing very little stress, as well as for those at extreme levels. Additionally, the MSSS is able to detect statistically significant differences in stress levels between male and female medical students, as well as between first and second year medical students. In some situations, such as medical student year, the MSSS detected differences where other commonly used measures did not. Further, the MSSS demonstrated convergent validity evidence through high, significant associations with the existing measures of burnout, anxiety, and stress.

Our study was not without limitations. The sample was drawn from just one institution, with relatively fewer M3 and M4 students, who are known to experience comparatively higher levels of stress compared with M1s and M2s. Over 80% of participants were M1s and M2s, a discrepancy largely due to increased workload and minimal required group class time during third and fourth years to administer the survey. Additionally, given that the survey was optional for all participants, there is the possibility of a selection bias, with the extremes (either most or least stressed) students opting in or out. These factors may have implications on the generalizability of findings.

Future studies will benefit from evaluating the scale's sensitivity to change over time. This is especially important considering possible uses of the MSSS include continuous screening and stress monitoring, as well as to evaluate the effectiveness of wellness interventions to reduce and manage stress in medical school. Since at this time no cut-points have been established to determine thresholds for mild, moderate, and severe levels of stress, future studies should also engage in standard setting activities to facilitate the clinical utility of this tool (19).

Conclusion

The 22 items comprising the MSSS are an appropriate blend of specific and generic content relevant to medical student daily life and are supported by a high internal consistency and convergent /concurrent validity. The MSSS can provide accurate, precise, and relevant measurement of stress and burnout for the 21st century medical student. Future applications include use as an outcome measure in comparative effectiveness research or as a screening tool in an academic or clinical program.

Practice Points

- Medical students face unique and significant stressors
- Brief and precise measurement of medical student stress is paramount to identifying and ameliorating challenges
- Existing measures have limitations
- The MSSS-22 is a brief, IRT-derived measure with high relevance and precision
- The MSSS-22 performs as expected with legacy measures and discriminates well between specific groups

List Of Abbreviations

- IRT- Item response theory
- MSSS- Medical Student Stress Scale
- PSS- Perceived Stress Scale
- MBI- Maslach Burnout Inventory
- PMSS-Perceived Medical Student Stress
- MSSP- Medical Student Stress Profile
- MSSQ-Student Stressor Questionnaire
- PROMIS-Patient Reported Outcomes Measurement Information System[®]
- VAS-Visual Analog Scale
- EFA- Exploratory factor analysis
- CFA- Confirmatory item factor analysis
- REDCap- Research Electronic Data Capture

Declarations

Ethical approval:

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Approval for project involving human subjects granted on 8/19/2014 by Northwestern University's Institutional Review Board Office, IRB project number-STU00092019, review type-exempt (human subjects involved only in surveys, tests, interviews, or observations), protocol sites-Northwestern University (NU) Chicago medical campus.

Informed consent: Informed consent was obtained from all individual participants included in the study, including consent for publication.

Competing Interests

The authors declare that they have no competing interests.

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None.

Authors Contributions

MM assisted in scale development, administered focus groups, administered surveys, and led organization of manuscript. DV led scale development, assisted with organization of manuscript, and oversaw data analysis and synthesis of final scale creation. AK analyzed and interpreted the data and led statistical analyses. MR and GA assisted with item development for stress scale, provided expert feedback on study methodology, and assisted with synthesis of final manuscript. SG assisted with amalgamation of final manuscript.

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Consent for Publication

Informed consent for publication was obtained from all individual participants included in the study prior to administration of survey.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Figures

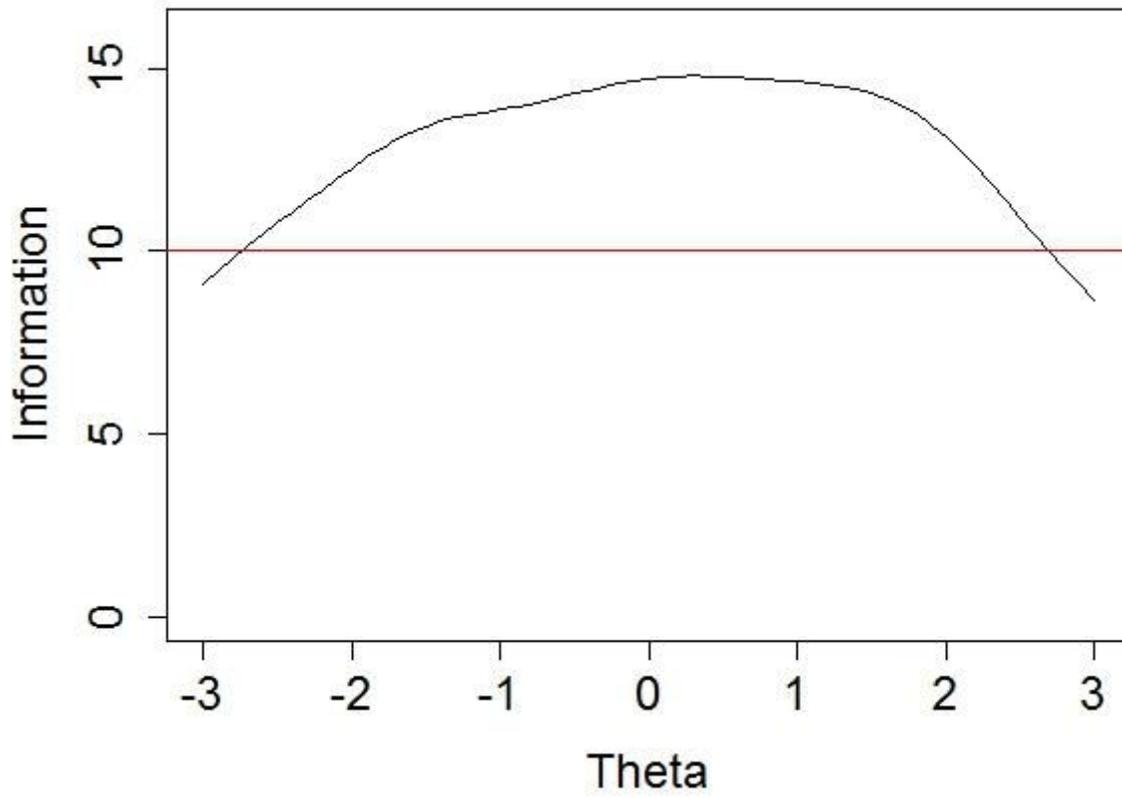


Figure 1

MSSS Test Information Function

Instructions & Recall Period:	The questions in this scale ask about your well-being since starting medical school. In each case, please indicate your response.
Response Options:	Never, Rarely, Sometimes, Often, Always
Items:	Since starting medical school, <ol style="list-style-type: none">1. I notice fluctuations in my appetite.2. I have difficulty asking for help.3. I receive less satisfaction from learning new material.4. I am unable to relax.5. I feel anxious.6. I am unable to enjoy activities outside of classes/rotations.7. I feel hopeless that I'll ever get my degree.8. I feel depressed.9. I have a hard time motivating myself to study10. I feel emotionally exhausted.11. I am fearful of failing.12. I feel unsupported by my peers.13. I feel competition from my peers.14. I feel unsupported by faculty.15. I feel taken advantage of by faculty (i.e. research mentors, professors, and/or school administrators).16. I feel pressure from <u>others</u> (i.e. parents, professors, mentors, etc.) to get good grades.17. I am overly self-critical.18. I feel unsure of my abilities as a student.19. I hardly have enough time to get things done.20. I feel overwhelmed by everything there is to do.21. I struggle maintaining a healthy school-life balance.22. I think about dropping out of school.

Figure 2

MSSS Scale Instructions, Recall Period, Items, and Response Options