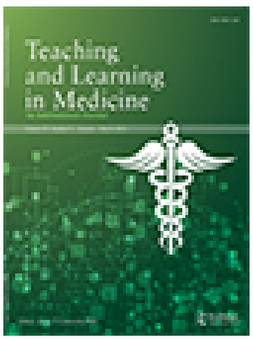

Routledge
Taylor & Francis Group

Teaching and Learning in Medicine
An International Journal

ISSN: 1040-1334 (Print) 1532-8015 (Online) Journal homepage: http://www.tandfonline.com/loi/htlm20

Do Medical Student Stress, Health, or Quality of Life Foretell Step 1 Scores? A Comparison of Students in Traditional and Revised Preclinical Curricula

Phebe Tucker, Haekyung Jeon-Slaughter, Ugur Sener, Megan Arvidson & Andrey Khalafian

To cite this article: Phebe Tucker, Haekyung Jeon-Slaughter, Ugur Sener, Megan Arvidson & Andrey Khalafian (2015) Do Medical Student Stress, Health, or Quality of Life Foretell Step 1 Scores? A Comparison of Students in Traditional and Revised Preclinical Curricula, Teaching and Learning in Medicine, 27:1, 63-70, DOI: 10.1080/10401334.2014.979178

To link to this article: http://dx.doi.org/10.1080/10401334.2014.979178

Teaching and Learning in Medicine, 27(1), 63–70

ISSN: 1040-1334 print / 1532-8015 online
DOI: 10.1080/10401334.2014.979178

Routledge
Taylor & Francis Group

INVESTIGATIONS

Do Medical Student Stress, Health, or Quality of Life Foretell Step 1 Scores? A Comparison of Students in Traditional and Revised Preclinical Curricula

Phebe Tucker
Department of Psychiatry at University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma, USA

Haekyung Jeon-Slaughter
Department of Psychiatry, UT Southwestern Medical Center, Dallas, Texas, USA

Ugur Sener and Megan Arvidson
College of Medicine, University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma, USA

Andrey Khalafian
Department of Psychiatry at University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma, USA

***Theory*: We explored the theory that measures of medical students' well-being and stress from different types of preclinical curricula are linked with performance on standardized assessment. *Hypotheses*: Self-reported stress and quality of life among sophomore medical students having different types of preclinical curricula will vary in their relationships to USMLE Step 1 scores. *Method*: Voluntary surveys in 2010 and 2011 compared self-reported stress, physical and mental health, and quality of life with Step 1 scores for beginning sophomore students in the final year of a traditional, discipline-based curriculum and the 1st year of a revised, systems-based curriculum with changed grading system. Wilcoxon rank sum tests and Spearman rank correlations were used to analyze data, significant at $p < .05$. *Results*: New curriculum students reported worse physical health, subjective feelings, leisure activities, social relationships and morale, and more depressive symptoms and life stress than traditional curriculum students. However, among curriculum-related stressors, few differences emerged; revised curriculum sophomores reported less stress working with real and standardized patients than traditional students. There were no class differences in respondents' Step 1 scores. Among emotional and physical health measures, only feelings of morale correlated negatively with Step 1 performance. Revised curriculum students' Step 1 scores correlated negatively with stress from difficulty of coursework. *Conclusions*: Although revised curriculum students reported worse quality of life, general stress, and health and less stress from patient interactions than traditional students, few measures were associated with performance differences on Step 1. Moreover, curriculum type did not appear to either hinder or help students' Step 1 performance. To identify and help students at risk for academic problems, future assessments of correlates of Step 1 performance should be repeated after the new curriculum is well established, relating them also to performance on other standardized assessments of communication skills, professionalism, and later clinical evaluations in clerkships or internships.**

Keywords USMLE Step 1, well-being, stress, health, medical curriculum

BACKGROUND

Many studies have examined stress related to personal characteristics, the medical school curriculum, and other aspects of training, both in the basic sciences and clinical years.[1–4] Studies include examinations of stress from excessive evaluative concerns[5] and workload or volume of material,[6] with a large survey reporting that up to 50% of students had burnout and 10% suicidal ideation.[7]

Recent changes in preclinical medical curriculum have led to increasing replacement of traditional discipline-based lectures with more self-directed, interactive methods based on organ systems with clinical correlations, such as case-based vignettes, team-based learning[8] and problem-based learning.[9] Studies have found mixed results as to effects on trainees' well-being, with reports of improved study conditions, social support, and attitudes,[10,11] and, on the other hand, stress from uncertainty about

Correspondence may be sent to Phebe Tucker, Vice Chair of Education, Department of Psychiatry at University of Oklahoma Health Sciences Center, WP3440, P.O. Box 26901, Oklahoma City, OK 73109, USA. E-mail: Phebe-Tucker@ouhsc.edu

individual study and unclear expectations of faculty.[6,12] Some small studies show that curriculum reforms were associated with improved performance on USMLE Step 1.[13,14] However, a large longitudinal U.S. study found that curriculum type and educational policies accounted for little variation in Step 1 performance, whereas individual student differences accounted for most of between-school variations in scores.[15]

Another change in many medical schools has been replacement of five-interval grading systems with variations of pass–fail systems, in part to reduce stress and competition among students. Such a change has led to greater student satisfaction,[16,17] decreased perceived stress, and higher group cohesion at the end of the sophomore year, without changes in test anxiety, reductions in USMLE Step 1 scores[16,17] or later success in residency placement and clinical performance.[18,19] A large survey of seven U.S. medical schools noted lower stress and burnout in students in pass–fail grading systems compared students in schools with more grading categories.[20] However, not all studies support the benefits of eliminating traditional grading systems, such as one finding number grades to be more predictive of clinical competence beyond medical school than assessments in pass–fail.[21]

Although several studies have explored various effects of curriculum changes involving interactive, clinically oriented systems-based courses, and others have investigated effects of changes to grading systems with variations of pass–fail evaluations, none were identified that determined whether in-depth measures of stress, quality of life, and health and mental health in students enrolled in different types of curriculum and grading systems can predict performance on standardized assessments of clinical knowledge on USMLE Step 1.

To update its preclinical curriculum, in 2010 the College of Medicine (COM) at the University of Oklahoma (OU) began a major curriculum revision involving both course structure and grading system. A carefully planned, integrated, systems-based preclinical curriculum was initiated, consistent with national educational trends. The traditional structure of co-occurring discipline-based courses (human anatomy, biochemistry, etc.) was replaced with 10 successive interdisciplinary courses related to organ systems of the body, followed by a capstone course to further integrate basic sciences and clinical information with clinical correlations. Small-group sessions (team-based learning, problem-based learning, sessions with standardized patients and facilitated discussions) were increased in number to enhance communication, confidence with patients, self-directed learning, and group interaction. At the same time, the traditional five-interval grading system was replaced by an honors/pass–fail evaluation, with the goal of fostering teamwork and reducing stress related to excessive competition.

To better understand whether measures of stress, health, and well-being relative to these two types of curriculum and grading systems might relate to performance on standardized assessments of knowledge (USMLE Step 1), we undertook a 2-year assessment at the beginning of the sophomore year for two successive medical student classes—the last group taking the traditional, discipline-based discipline and the first group taking the curriculum with revised, systems-based courses and changed grading system. Although it could be argued that some stress is inevitable and even a motivating factor in medical training, excessive stress is counterproductive and can hamper learning and thus performance on assessments. Higher levels of anxiety and frustration have been associated with lower academic performance in medical students.[22] We tried to identify subjective characteristics (stress, perceived health, and quality of life) of students in different curricula that may be affected by their courses and may increase their risk for poor academic performance, so that they might be offered timely assistance. More objective predictors of Step 1 scores such as MCAT and undergraduate grades have been previously studied. However, as they predate students' medical studies, we did not focus on them, as they cannot be affected by students' responses to different curricula that may impact Step 1 performance.

Our hypotheses for the current study were as follows:

H1: Students in both curricula who report better physical and emotional health and quality of life would perform better on Step 1.

H2: Students in both traditional and revised curriculum who report higher stress would have lower performance on USMLE Step 1.

H3: Students in the revised curriculum would report less stress and better quality of life than those in the traditional curriculum.

METHOD

We measured self-reported physical and mental health, quality of life, group cohesion, and general and curriculum-related stress at the same time in the fall for both the last sophomore medical student class in the traditional curriculum—the Class of 2013—and the first sophomore medical student class in the new curriculum—the Class of 2014. Participants included 58 (34.3% of total in class) students from the class of 2013 and 50 (32.7% of class) students from the class of 2014. We made these subjective assessments of well-being at the start of the 2nd year, when students had a year of experience with their medical curriculum and before their assessments were confounded by stress from preclinical courses or studying for USMLE Step 1, which was generally taken 9 months after our survey. Stress related to Step 1 exams would be expected to intensify in the spring semester when students focus more on studying and taking practice exams. Also, we assessed students during the same season of the year, the fall, to eliminate confounding influences of seasonal variations, holidays, or other events. Thus, the timing of our measures was designed to capture emotionally based information at a time when students anticipated another year of the preclinical curriculum but were not yet stressed by individual courses or Step 1 preparations.

We offered all rising 2nd-year students anonymous, voluntary participation in this study through e-mail and contact

with fellow students from a medical school psychiatry interest group. Participating students gave informed consent consistent with requirements of the University of Oklahoma Health Sciences Center Institutional Review Board, which gave full board approval of the study. We informed students that they could withdraw from the study at any time and that their data would be maintained in a confidential, deidentified way, aggregated for data analysis, and would not be accessed by administration.

After informed consent was obtained, each participating student completed several paper-and-pencil questionnaires in their study modules, at home or in other private places, and returned them in sealed envelopes to a student support office or to fellow medical students who were trained study personnel. All assessments were completed within a week after students received them, with e-mails or personal reminders made by medical student study personnel.

A brief questionnaire elicited gender, age, ethnicity, and other demographic information at the beginning of the 2nd year of medical school. Five scales measured different aspects of general life stress, stress related to the curriculum, group cohesion, perceived well-being, and depressive symptoms.

Students completed the Perceived Stress Scale (PSS-14),[23] a 14-item, self-reported unidimensional instrument developed to measure a perceived stress in response to situations in a person's life. Respondents report the prevalence of an item within the last month on a 5-point scale, ranging from *never* to *very often*. This tool was developed for a general, nonclinical population, with mean PSS score for U.S. 18- to 29-year-olds at 14.2 ($SD = 6.2$).[24]

The six-item Perceived Cohesion Scale assessed individual group members' perceptions of their cohesion to a particular group related to a sense of belonging (three items) and feelings of morale (three items). This scale was chosen to determine whether the revised curriculum's emphasis on small-group activities was associated with a greater sense of belonging and morale. A Likert scale ranged from 0 (*strongly disagree*) to 5 (*neutral*) to 10 (*strongly agree*).[25]

We measured perceived physical and mental health and quality of life through the Quality of Life Satisfaction Questionnaire–18 (Q-LES-Q-18), an 18-item shortened version of the Q-LES-Q.[26] The Q-LES-Q consists of four domains—physical health, subjective feelings, leisure and time activities, and social relationship—that examine quality of life in a variety of areas with responses on a 5-point Likert scale.[27] Q-LES-Q test–retest reliability is $r = .82$, and internal consistency is $\alpha = .92$.

The Beck Depression Inventory (BDI), a 21-item scale, measured self-reported symptoms of depression.[28] Each item was scored from 0 to 3, with 3 representing the most severe level of the symptom in question. BDI total scores range from 0 to 63. Total scores of 0 to 9 are considered not clinically significant, 10 to 17 indicate mild depression, 18 to 24 suggest moderate depression, and scores over 25 indicate severe depression.

We adapted a Curriculum Stress Questionnaire (CSQ) from a study of medical student stress[29] to be relevant to the two preclinical curricula. Eleven items rated their personal stress associated with specific aspects of the course and curriculum, such as the course content, small-group activities, formative assessments throughout the course, the final examination, interviewing patients, examining patients, working with standardized patients, relationships with peers, and relationships with administration on a 4-point scale: 0 (*no stress*), 1 (*mildly stressful*), 2 (*moderately stressful*), and 3 (*very stressful*).

Chi-square and Wilcoxon rank sum tests analyzed demographic variables, curriculum-related stress measures, and emotional and physical health measures for student groups. Spearman rank correlations compared respondents' stress and physical and emotional health measures with Step 1 scores. To test our study sample representativeness, the effect size (Cohen's d) was calculated to test group differences in MCAT and Step 1 scores, and age and chi-square statistics in sex and race between our study participants and nonparticipants in each class. The effect size of less than 0.50 indicates no significant group difference—no participation bias—and effect size of 0.80 and higher denotes a significant group difference, indicating a study participation bias.

RESULTS

Comparing demographics, respondents from both classes did not differ significantly in sex, race, or age (Table 1), demonstrating that participants from both classes were comparable.

To test study participation bias, we compared average scores of MCAT and Step 1 between our study participants and students who opted out, nonparticipants, within the classes. For both classes, there were no significant differences in average scores of MCAT (effect size = .17 for Class 2013 and .07 for Class 2014) and Step 1 (effect size = .00 for Class 2013 and .45 for Class 2014) between the study participants and nonparticipants. Table 1 shows demographic variables by class of study participants and nonparticipants; our study participants did not differ from nonparticipants in sex, race, and age.

On measures of emotional and physical health and well-being (Table 2), the 2014 class scored higher than 2013 class in depression scores (higher BDI scores) and perceived life stress (PSS), and lower in life satisfaction scores (Q-LES-Q) in all four domains. On ratings of perceived group cohesion (Perceived Cohesion Scale), class differences emerged only for feelings of morale, with the Class of 2014 reporting lower morale.

Table 3 shows comparisons of data from rating scales examining stress related to the curriculum (CSQ). Results showed significant differences between classes only on measures of stress relating to working with patients. Students from the revised curriculum (Class of 2014) reported significantly less stress than traditional curriculum students (Class of 2013) at the beginning of the year both interviewing (CSQ Item 7: $M = .63$ vs. $M = 1.14$, $p < .01$) and examining (CSQ Item 8: $M = 0.78$ vs.

TABLE 1
Demographic variables by class of study participants and nonparticipants

	Study Participants			Nonparticipants	
Variables	Class 2013[a] *N* (%)	Class 2014[b] *N* (%)	Analysis	Class 2013[c] *N* (%)	Class 2014[d] *N* (%)
Sex					
Male	33 (56.90)	29 (58.00)	$\chi^2(1, 108) = 0.01, p = .9079$	58 (60.42)	56 (55.45)
Female	25 (43.10)	21 (42.00)		38 (39.58)	45 (44.55)
Race					
Caucasian	50 (86.21)	41 (82.00)	$\chi^2(3, 108) = 0.63, p = .89$	64 (66.67)	72 (71.29)
African American	1 (1.72)	1 (2.00)		0 (.00)	0 (.00)
Native American	1 (1.72)	2 (4.00)		5 (5.21)	1 (1.00)
Asian	6 (10.34)	6 (12.00)		17 (17.71)	16 (15.84)
	M (SD)	M (SD)	Analysis[e]	M[f]	M[g]
Age					
Years	24.64 (2.66)	25.02 (2.80)	$p = .29$	23.61	24.97

[a]$N = 58$.
[b]$N = 50$.
[c]$N = 96$.
[d]$N = 101$.
[e]Analysis presents two-sided Wilcoxon rank sum test results.
[f]Standard deviation was not calculated because individual student age data were not available.
[g]There was no statistically significant difference in (a) sex, $\chi^2(1, 154) = .19$, $p = .67$ for Class 2013; $\chi^2(1, 155) = .00$, $p = .77$ for Class 2014; (b) race, $\chi^2(3, 154) = 5.41$, $p = .14$, for Class 2013; $\chi^2(3, 155) = 3.73$, $p = .30$ for Class 2014; (c) age (effect size = 0.50) between study participants and nonparticipants.

$M = 1.16$, $p = .01$) patients and less stress working with standardized patients (CSQ Item 9: $M = .48$ vs. $M = .95$, $p < .01$). Class of 2014 reported significantly fewer hours of sleep the night before completing the scale than class of 2013.

Among all measures of emotional and physical health and well-being, only feelings of morale for all students correlated negatively with Step 1 scores (Table 4). Among curriculum-related stress (CSQ) items, only Class of 2014's reported

TABLE 2
Emotional and physical health measured in the beginning of the course by class

	Classes		
Scales	2013 (Traditional)[a] *M* (*SD*)	2014 (Revised)[b] *M* (*SD*)	Analysis[c]
BDI	3.09 (3.79)	6.78 (5.32)	$p < .01$
Q-LES-Q			
Physical health	16.97 (2.60)	15.04 (3.80)	$p = .01$
Subjective feelings	23.09 (2.06)	21.68 (3.19)	$p = .02$
Leisure-time activities	12.43 (1.99)	10.86 (2.86)	$p < .01$
Social relationship	22.00 (3.20)	19.94 (3.38)	$p < .01$
PSS	28.25 (6.13)	32.70 (8.42)	$p = .01$
PCS			
Sense of belonging	23.81 (4.49)	21.40 (6.40)	$p = .01$
Feelings of morale	23.50 (4.00)	20.40 (7.17)	$p = .03$

Note: BDI = Beck Depression Inventory; Q-LES-Q = Quality of Life Satisfaction Questionnaire–18; PSS = Perceived Stress Scale; PCS = Perceived Cohesion Scale.
[a]$N = 58$.
[b]$N = 50$.
[c]Analysis presents two-sided Wilcoxon rank sum test results.

TABLE 3
Curriculum-related stress measured by CSQ and hours of sleep by class

Scales Academic Performance	Classes and Curriculum 2013 (Traditional) *M* (*SD*)	 2014 (Revised) *M* (*SD*)	Analysis[a]
USMLE Step 1[b]	219.30 (30.80) $N = 56$	224.50 (23.21) $N = 48$	$p = .53$
CSQ			
Total score	12.79 (5.08) $N = 58$	12.04 (4.19) $N = 50$	$p = .38$
CSQ-Q1 (Content of the course/Difficulty of material)	1.53 (0.71) $N = 58$	1.50 (0.93) $N = 50$	$p = .97$
CSQ-Q2 (Quantity of information learned/Workload)	1.81 (0.71) $N = 58$	1.92 (0.70) $N = 50$	$p = .49$
CSQ-Q3 (Effects of studying on personal or family life)	1.34 (0.87) $N = 58$	1.44 (0.88) $N = 50$	$p = .72$
CSQ-Q4 (Small-group activities)	0.81 (0.71) $N = 58$	0.72 (0.73) $N = 50$	$p = .46$
CSQ-Q5 (Mini-exams, graded exercises)	1.19 (0.78) $N = 58$	1.30 (0.79) $N = 50$	$p = .58$
CSQ-Q6 (Formal examinations)	2.24 (0.88) $N = 58$	2.46 (0.81) $N = 50$	$p = .15$
CSQ-Q7 (Interviewing points)	1.14 (0.76) $N = 58$	0.62 (0.60) $N = 54$	$p < .01$
CSQ-Q8 (Examining points)	1.16 (0.79) $N = 58$	0.78 (0.71) $N = 50$	$p = .01$
CSQ-Q9 (Working with standardized points)	0.95 (0.76) $N = 58$	0.48 (0.58) $N = 50$	$p < .01$
CSQ-Q10 (Relationships with peers)	0.40 (0.62) $N = 58$	0.40 (0.57) $N = 50$	$p = .83$
CSQ-Q11 (Relationships with administration)	0.22 (0.42) $N = 58$	0.42 (0.76) $N = 50$	$p = .28$
Hours of Sleep	7.27 (1.28) $N = 58$	6.70 (1.70) $N = 50$	$p = .04$

Note: CSQ = Curriculum Stress Questionnaire.
[a]Analysis presents two sided Wilcoxon rank test results.
[b]Sample sizes are different due to missing data on Step 1 score.

TABLE 4
Correlation between emotional and physical health measured in the beginning of the 2nd year and Step 1 score in the end of the 2nd year

	USMLE Step 1		
	Correlation Coefficient[a] (*p*)		
	All $N = 104$[b]	2013 Class (Traditional)	2014 Class (Revised)
BDI			
Total	$-.10(p = .30)$	$-.18(p = .19)$	$-.04(p = .76)$
Q-LES-Q			
Physical health	$-.07(p = .51)$	$-.11(p = .40)$	$.02(p = .91)$
Subjective feelings	$-.01(p = .88)$	$-.03(p = .82)$	$.07(p = .63)$
Leisure-time activities	$-.09(p = .35)$	$-.19(p = .17)$	$.05(p = .74)$
Social relationship	$-.02(p = .83)$	$-.05(p = .71)$	$.09(p = .53)$
PSS			
Total	$-.15(p = .13$	$-.13(p = .35)$	$-.15(p = .30)$
PCS			
Sense of belonging	$-.02(p = .80)$	$-.10(p = .46)$	$.06(p = .68)$
Feelings of morale	$-.25(p = .01)$	$-.22(p = .11)$	$-.25(p = .08)$

Note: BDI = Beck Depression Inventory; Q-LES-Q = Quality of Life Satisfaction Questionnaire−18; PSS = Perceived Stress Scale; PCS = Perceived Cohesion Scale.
[a]Spearman rank correlation (ρ) was used for analysis.
[b]Two students from class 2013 and 2 students from class 2014 with missing data on USMLE Step 1 scores.

TABLE 5
Correlation between curriculum-related stress in the beginning of the 2nd year and USMLE Step 1 score in the end of 2nd year

	USMLE Step 1 Correlation Coefficient[a] (p)		
CSQ	All $N = 104$[b]	2013 Class (Traditional)	2014 Class (Revised)
Total Score (CSQ)	.04($p = .6717$)	−.02($p = .8968$)	.10($p = .5186$)
CSQ-Q1 (Content of the course/Difficulty of material)	−.17($p = .0728$)	−.01($p = .9291$)	−.36($p = .0129$)
CSQ-Q2 (Quantity of information learned/Workload)	−.04($p = .7085$)	−.07($p = .5959$)	.01($p = .9205$)
CSQ-Q3 (Effects of studying on personal or family life)	.03($p = .7839$)	.04($p = .7855$)	.02($p = .9870$)
CSQ-Q4 (Small-group activities)	.07($p = .4672$)	.12($p = .3874$)	−.01($p = .9356$)
CSQ-Q5 (Mini-exams, graded exercises)	−.11($p = .2765$)	−.14($p = .2906$)	−.09($p = .5243$)
CSQ-Q6 (Formal examinations)	−.12($p = .2403$)	−.06($p = .6720$)	−.21($p = .1505$)
CSQ-Q7 (Interviewing points)	.06($p = .5364$)	.15($p = .2686$)	−.03($p = .8588$)
CSQ-Q8 (Examining points)	.07($p = .4962$)	.11($p = .4373$)	.02($p = .8699$)
CSQ-Q9 (Working with standardized points)	−.0004($p = .7050$)	.02($p = .8740$)	−.10($p = .8778$)
CSQ-Q10 (Relationships with peers)	.02($p = .8750$)	−.03($p = .8254$)	.08($p = .6039$)
CSQ-Q11 (Relationships with administration)	−.06($p = .5269$)	−.13($p = .3512$)	.02($p = .8757$)
Hours of Sleep	.11($p = .2503$)	.06($p = .6499$)	.19($p = .2018$)

Note: CSQ = Curriculum Stress Questionnaire.
[a]Spearman rank correlation (ρ) was used for analysis.
[b]One hundred four observations due to two students from Class 2013 and two students from Class 2014 with missing data on USMLE Step 1 scores.

difficulty of course content correlated negatively with Step 1 scores (Table 5).

DISCUSSION

Contrary to our hypotheses that students who reported better physical and emotional health and quality of life would perform better on USMLE Step 1, among all measures assessed in these areas, only feelings of morale among all participants correlated negatively with performance. Thus, unexpectedly, students reporting lower morale scored higher on this high-stakes examination; it is possible that higher performing students may have benefited from internalized academic pressure or dysphoria from a perfectionistic drive,[5] or, on the other hand, lower performing students may have lacked a degree of tension that can motivate intensive study. As other student self-assessments of depressive symptoms (BDI); of physical health, subjective feelings, leisure activities, and social relationships on Q-LES-Q; and of perceived life stress (PSS) did not correlate with Step 1 scores, students' test performance did not appear to reflect these measures of well-being. It is possible that relationships of these factors with exam performance are complex and vary among individuals, or that a larger sample size would have yielded differences.

Also contrary to original hypothesis, students' reported stress from most specific aspects of the curriculum examined did not correlate with performance on USMLE Step 1. Thus, stress from quantity of course information, effects of studying on relationships with others, small-group activities, and graded exercises and examinations were not associated with either worse or better performance on USMLE. Only stress from perceived difficulty of course material correlated negatively with Step 1 performance, so that more stress in this area predicted lower performance, which could be expected if students accurately perceived that they were having difficulty with subjects.

Comparisons of Classes of 2013 and 2014 for emotional and physical health measures and general stress had results exactly opposite to what was expected. Revised curriculum students had more depression symptoms and higher levels of perceived life stress than traditional students. New curriculum students also reported lower self-assessed physical health, subjective feelings of well-being, leisure time activities and social relationships, and lower feelings of morale. Class of 2014 students also reported fewer hours of sleep than Class of 2013, perhaps reflecting their greater stress in many areas or longer hours of studying.

There may be several reasons for this disparity in classes' health and well-being, including the fact that Class of 2014 may have had concerns about participating in a novel curriculum.

Indeed, in focus groups with students, new curriculum students reported that they sometimes felt like "guinea pigs" in initiating an untried curriculum. Other factors may have contributed to the class's stress, including class or course leadership, administration, less structured expectations from self-directed learning activities, or other unknown issues.

Also contrary to expectations, curriculum-related stress was for the most part not lessened in new curriculum students. Class of 2014 did not have less stress than Class of 2013 related to difficulty or quantity of course material, grades, or formal exams or relationships with family, peers, or administration. Related to course content and exams, new curriculum students said that their instructors sometimes acknowledged that their lectures and test questions were new and undergoing modification; students said they weren't always prepared to solve many of the clinical problems they encountered in USMLE-type exam questions. Some also said that they felt that they needed more time to grasp concepts. Thus true integration of basic sciences and relevant clinical information into a new curriculum may take some time for both faculty to develop and students to master, so that stress differences may emerge over time. In considering the revised curriculum's failure to improve specific stress related to grades and examinations, the new curriculum replaced a traditional five-interval grading system with a more "relaxed" three-interval grading system. However, research has shown that only grading intervals having less than three categories have been associated with less stress compared to those with more intervals.[20,30]

Of note, responding students in the revised curriculum reported more confidence in several aspects of patient interaction—interviewing and examining patients, and working with standardized patients. These important skills are consistent with ACGME core competencies related to patient care, interpersonal and communication skills, and professionalism.[31] The new curriculum's emphasis on clinically relevant activities increased individual and small-group activities, giving preclinical students earlier clinical experience with real and standardized patients. However, although the revised curriculum's small-group and patient care activities may have boosted students' confidence in patient care, this was not associated with performance on Step 1, which does not test these skills.

Among limitations of our study is the relatively low response rate in both classes. Response rates tend to be lower among voluntary surveys completed during medical students' personal time[12,16,20,29] compared to those that are conducted during scheduled medical student activities or through other persuasive means.[7,11] A web-based survey with reminders may have improved response rates. Students in the current study may have been concerned about confidentiality despite reassurances, or they may have been too busy studying to participate, or uninterested. A previous study assessing medical students' attitudes and depression noted that students had concerns about confidentiality that affected their willingness to self-disclose problems.[32] We acknowledge that our study's participating students may have differed in some ways from the general class population. However, our analyses showed that participants did not differ from nonparticipants in Step 1 or MCAT scores or demographic variables, arguing against a selection bias. It is possible that students who were more (or less) stressed opted to participate. In addition, we had no control over the type or intensity of students' preparation for Step 1. Moreover, it may take several years to fine-tune the revised curriculum to the point that students (and faculty) are more confident that changes can accomplish desired objectives as the curriculum is more established. Finally, our study was conducted at only one medical school, which limits its generalizability. A future study could benefit from replicating the investigation in other medical schools making curriculum changes, and from combining data.

CONCLUSIONS

Although our study documented worse general stress, perceived health and quality of life, less sleep, and more confidence in patient interactions among revised curriculum students compared to their traditional course counterparts, few measures correlated with Step 1 performance. In later follow-up we hope to assess whether students' stress and well-being change over time as the revised curriculum matures, and whether these or other subjective or objective measures are associated with Step 1 performance. Targeting students at risk for academic problems for timely academic or personal support is important. We should also compare curriculum-related stress, health, and well-being with other standardized measures of communication skills (such as OSCEs), clinical knowledge (scores on USMLE Step 2 CK), clinical performance in clerkships and later residency programs, and aspects of professionalism, for both traditional and revised OU COM curricula.

ACKNOWLEDGMENTS

The authors thank Betty Pfefferbaum, M.D., J.D., and Britta Thompson, Ph.D., for their support of this study.

FUNDING

The Arnold and Bess Ungerman Endowed Chair in Psychiatry provided some financial support of this study.

REFERENCES

1. Firth-Cozens J. Medical student stress (Commentary). *Medical Education* 2001;35:6–7.
2. Morrison J, Moffat K. More on medical student stress (Commentary). *Medical Education* 2001;35:617–8.
3. Guthrie E, Radcliffe C, Lester H. Perceived stress during undergraduate medical training: A qualitative study. *Medical Education* 2003;37:32–8.
4. Spiegel DA, Smolen RC, Hopfensperger KA. Medical student stress and clerkship performance. *Journal of Medical Education* 1986;61:929–31.
5. Enns MW, Cox BJ, Sareen J, Freeman P. Adaptive and maladaptive perfectionism in medical students: A longitudinal investigation. *Medical Education* 2001;35:1034–42.

6. Thompson BM, Schneider VF, Haidet P, McMahon K, Levine R, Perkowski L, et al. Team learning at ten medical schools: Two years later. *Medical Education* 2007;41:250–7.
7. Moffat KJ, McConnachie A, Ross S, Morrison JM. First year medical student stress and coping in a problem-based learning medical curriculum. *Medical Education* 2004;38:482–91.
8. Dyrbye LN, Thomas MR, Massie FS, Power DV, Eacker A, Harper W, et al. Burnout and suicidal ideation among U.S. Medical Students. *Annals of Internal Medicine* 2008; 149:334–41.
9. Swanson DB, Case SM. Assessment in basic science instruction: Directions for practice and research. *Advances in Health Sciences Education* 1997;2:71–84.
10. Kiessling C, Schubert B, Scheffner D, Burger W. First year medical students' perceptions of stress and support: a comparison between reformed and traditional track curricula. *Medical Education* 2004;38:504–9.
11. Schwartz PL, Loten EG. Effects of a revised preclinical curriculum on students' perceptions of their cognitive behaviors, attitudes to social issues in medicine, and the learning environment. *Teaching and Learning in Medicine* 2003;15:76–83.
12. Lewis AD, Braganza Menezes D, McDermott HE, Hibbert LJ, Brennan S-L, Ross EE, et al. A comparison of course-related stressors in undergraduate problem-based learning (PBL) versus non-PBL medical programmes. *BMC Medical Education* 2009;9;1:60. http://www.biomedcentral.com/1472-6920/9/60. Accessed April 15, 2012.
13. Wilkerson L, Wimmers P, Doyle LH, Uijtdehaage S. Two perspectives on the effects of a curriculum change: student experience and the United States Medical Licensing Examination, Step 1. *Academic Medicine* 2007;82(Suppl.):S117–20.
14. Hoffman k, Hosokawa M, Blake R, Headrick L, Johnson G. Problem-based learning outcomes: Ten years of experience at the University of Missouri-Columbia School of Medicine. *Academic Medicine* 2006;81: 617–25.
15. Hecker K, Violato C. How much do differences in medical schools influence student performance? A longitudinal study employing hierarchical linear modeling. *Teaching and Learning in Medicine* 2008;20:104–13.
16. Bloodgood RA, Short JG, Jackson JM, Martindale JR. A change to pass/fail grading in the first two years at one medical school results in improved psychological well-being. *Academic Medicine* 2009;84:655–62.
17. Rohe DE, Barrier PA, Clark MM, Cook DA, Vickers KS, Decker PA. The benefits of pass-fail grading on stress, mood, and group cohesion in medical students. *Mayo Clinic Proceedings* 2006;81:1443–8.
18. Provan JL, Cuttress L. Preferences of program directors for evaluation of candidates for postgraduate training. *Canadian Medical Association Journal* 1995;153:919–23.
19. Vosti KL, Jacobs CD. Outcome measurement in postgraduate year one of graduates from a medical school with a pass/fail grading system. *Academic Medicine* 1999;74:547–9.
20. Reed DA, Shanafelt TD, Satele DW, Power DV, Eacker A, Harper W, et al. Relationship of pass/fail grading and curriculum structure with well-being among preclinical medical students: A multi-institutional study. *Academic Medicine* 2011;86:1367–73.
21. Gonnella JS, Erdmann JB, Hojat M. An empirical study of the predictive validity of number grades in medical school using 3 decades of longitudinal data: implications for a grading system. *Medical Education* 2004;38:425–34.
22. Artino AR, Hemmer PA, Durning SJ. Using self-regulated learning theory to understand the beliefs, emotions, and behaviors of struggling medical students. *Academic Medicine* 2011;86(Suppl. 10):S35–8.
23. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *Journal of Health and Social Behavior* 1983;24:385–96.
24. Cohen S, Williamson GM. Perceived stress in a probability sample of the United States. In S Spacapan & S Oskamp (Eds.), *The social psychology of health* (pp. 31–67). Newbury Park, CA: Sage, 1988.
25. Bollen KA, Hoyle RH. Perceived cohesion: A conceptual and empirical examination. *Social Forces* 1990;69:479–504.
26. Endicott J, Nee J, Harrison W, Blumenthal R. Quality of Life Enjoyment and Satisfaction Questionnaire: A new measure. *Psychopharmacology Bulletin* 1993;29:321–6.
27. Ritsner M, Kurs R, Gibel A, Ratner Y, Endicott J. Validity of an abbreviated quality of life enjoyment and satisfaction questionnaire (Q-LES-Q-18) for schizophrenia, schizoaffective, and mood disorder patients. *Quality of Life Research* 2005;14:1693–703.
28. Beck AT, Ward CH, Mendelson M, Mock J, Erbaugh J. An inventory for measuring depression. *Archives of General Psychiatry* 1961;4:561–71.
29. Guthrie E, Black D, Bagalkote H, Shaw C, Campbell M, Creed F. Psychological stress and burnout in medical students: A five-year prospective longitudinal study. *Journal of the Royal Society of Medicine* 1998;91: 237–43.
30. Robins LS, Fantone JC, Oh MS, Alexander GL, Shlafer M, Davis WK. The effect of pass/fail grading and weekly quizzes on first-year students' performances and satisfaction. *Academic Medicine* 1995;70: 327–29.
31. Stewart MG. Core competencies. Accreditation Council for Graduate Medical Education. 2001. https://dconnect.acgme.org/acWebsite/RRC_280/280_coreComp.asp. Accessed September 11, 2014.
32. Levine RE, Breitkopf CR, Sierles FS, Camp G. Complications associated with surveying medical student depression: the importance of anonymity. *Academic Psychiatry* 2003;27:12–8.