



Examining Change in Student Anxiety and Depression After the First Year of a Professional Program Secondary to Perceived Stress: A Cross-Sectional Descriptive Study

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Abstract

Background: Research has shown that students in the health sciences experience higher levels of anxiety and depression.

Objectives: In this study, we endeavor to investigate these results among first-year pharmacy and veterinary students at Auburn University and among first-year medical students at the Edward Via College of Osteopathic Medicine's (VCOM) Auburn Campus.

Methods: We surveyed students after their first year in their respective professional programs using a modified Hospital Anxiety and Depression scale (HADS) survey. The survey was modified to establish changes in depression and anxiety levels before and after the first year of coursework.

Results: Two hundred ninety-five students participated in the survey, 95 veterinary students, 127 pharmacy students, and 73 VCOM students. All programs showed a statistically significant increase in student-reported levels of depression and anxiety. Students from the Harrison School of Pharmacy showed the greatest increase in anxiety and depression, followed by students from VCOM and the College of Veterinary Medicine. Females in all programs entered their programs with higher levels of anxiety than males and also completed their first year with higher anxiety scores than males in the same programs.

Conclusions: Students in all three professional programs reported increased levels of anxiety and depression with the largest increase reported in pharmacy students. Efforts to identify the triggers, understand the consequences, and develop interventional methods to improve student wellbeing are recommended.

Keywords: Anxiety, Depression, Medical Students, Pharmacy Students, Veterinary Students

1. Background

Students in the health sciences experience higher levels of anxiety and depression, according to researchers (1). First-year students in medical school and pre-professional health sciences programs encounter significant changes and challenges. Many move from home or an established support system to another part of the country. They enter a new environment with new classmates, faculty, and staff while simultaneously getting to know and establish themselves in a new town. Their curriculum is often considerably more challenging than in prior academic settings, and they must learn at a much more rapid pace than in prior courses. According to Ford et al. (1), "[w]ithin the college environment, research indicates that students enrolled in advanced health professional programs, such as

in medicine, nursing, dental, and pharmacy, appear to be at greater risks for the negative consequences associated with stress".

Research indicates these adjustments health science students experience while achieving degrees can have an undesirable effect on academic performance, physical health and wellbeing, and lead to the development of anxiety, exhaustion, anger, decreased self-confidence, and depression. Extreme psychological stress can have severe consequences including psychological disorders and physical morbidities (1-4). Stress can also exacerbate mental illnesses and trigger more serious psychiatric disorders, such as schizophrenia, bipolar disorder, PTSD, and eventually increase the risk of Alzheimer's disease (5). When students are under these immense pressures, they may sleep less, eat poorly, exercise less, and drink alcohol more

(4). These behaviors can compromise immune and cardiovascular systems, potentially leading to cardiovascular disease, diabetes, metabolic syndrome, and neuropsychiatric disorders. For these reasons, stress-induced depression and anxiety in health sciences students are important topics for researchers (6, 7).

As issues of mental health and wellbeing are discussed more frequently in research and social media, the need for additional research has been recognized. Although many studies document elevated depression and anxiety levels among medical students and pre-professional health sciences students, few studies document the extent of the increase within the first year of these programs, and even fewer provide comparative data among programs (8-10). The objective of our study is to illustrate and compare the degree of increase in anxiety and depression among first year students in medical science programs including pharmacy, osteopathic medicine, and veterinary medicine. A significant increase in depression and anxiety secondary to perceived increases in stress levels within all studied populations is hypothesized, also that female students experience a higher increases in depression and anxiety as compared to male counterparts.

1.1. Literature Review

Researchers have confirmed the existence of depression and anxiety in medical students. In a recent meta-analysis, Rotenstein et al. (11) assert that medical students have high levels of depression but note that the prevalence varies by study. After examining 195 studies from 47 countries that involved over 100,000 students, they demonstrated that about 27% of the students indicated reported levels of depression. Similarly, Dyrbye et al. (12) conducted a systematic review of the literature and found that in all study types elevated rates of anxiety among medical and pharmacy students showed higher levels of distress than other graduate students and that stress levels significantly increased in the first year of medical school. The studies they examined showed inconsistent results when comparing female and male students' levels of depression and anxiety.

According to Marshall, Allison et al. (13), there are fewer studies confirming the stress levels of pharmacy students or comparing those stress levels to those of medical and nursing students. Marshall, et al. studied perceived stress levels among pharmacy students at one university and discovered that they had elevated stress levels and lower quality of life. They also found that female students had significantly higher stress levels and lower quality of life than male students.

Veterinary students have a demanding academic schedule as well. In a study by Hafen et al., a cohort of

veterinary students at Kansas State University presented with scores at the middle to upper range for anxiety and depression during all four years of study, which was further confirmed in studies by Hafen et al. (14, 15) and Strand et al. (16). Hafen et al. (14) reported clinical levels of depression and elevated anxiety among first-year veterinary medicine students at Kansas State University. Strand et al. (16) also reported significantly higher levels of perceived stress among the surveyed female students compared to male students.

2. Methods

Using a survey method, a cross-sectional design was implemented to examine if students in the health science areas of osteopathic medicine, pharmacy and veterinary medicine experience anxiety and depression after completion of the first year of each program.

Following VCOM and Auburn University Institutional Review Board approval, a modified version of the Hospital Anxiety and Depression scale (HADS) questionnaire was created in Qualtrics. Ethical issues considered were that the interpersonal information of anxiety and depression that could reflect negative connotations upon the professional programs; therefore, participation was voluntary, and results were anonymized.

Participants were introduced to the study via email, which outlined the purpose of the research, the voluntary and anonymous nature of responses, and advised of consent. Consent was implied by completion and submission of the survey. Following the initial email, a follow-up email was sent with the survey link, along with an in-person visit by administration to solicit participation.

Participants in the study consisted of 295 students from a major southeastern university and an osteopathic medical school. There were 217 females and 78 males. All respondents had completed their first year of a professional program in osteopathic medicine, pharmacy, or veterinary medicine.

2.1. Instrumentation

A modified version of the Hospital Anxiety and Depression scale (HADS) was used to assess depression and anxiety. Demographic data regarding sex and age were collected. The HADS is a brief, self-report questionnaire used to assess levels of anxiety and depression among patients in hospitals and clinics as well as in the general population (17, 18). HADS provides researchers insight into the levels of anxiety and depression at the time of testing; but for this study the questionnaire was modified to address the goal of analyzing the change in anxiety and depression levels of students during the first year of their programs. For

example, the addition of, “Prior to my program, ...,” and “After the first year of my program, ...,” to each statement resulted in 28-questions total. Questions were rated with a Likert-type scale with higher scores indicating higher levels of anxiety and depression. Because the questionnaire is a self-rating instrument, the scale allowed us to draw conclusions on cases of anxiety and depression within our tested sample population. The specific scale does not allow us to diagnose these occurrences as medical disorders, but only to demonstrate change within the first year of a professional program.

2.2. Analysis

Each question in the HADS survey scores on a scale of 0 - 3, with some reverse coded. Anxiety and depression total scores are divided into three categories; normal scores were from 0 - 7; borderline abnormal scores ranged from 8 - 10; and abnormal scores were 11 - 21.

First, descriptive statistics on age, sex, and school frequencies were all calculated to determine the overall demographics. Total score values for anxiety and depression were normally distributed. Second, we performed paired-sample *t*-test to determine the mean difference in anxiety and depression scores between pre-school and post-first year of professional school. Third, we ran an analysis of variance (ANOVA) to assess anxiety and depression scores between the three school programs (Veterinary, Pharmacy, and VCOM). A Bonferroni post-hoc analysis assessed pairwise comparisons between schools. Last, a post-analysis using a paired-sample *t*-test by sex for both anxiety and depression was calculated.

3. Results

The study sample (Table 1) shows two hundred ninety-five volunteers participated: 95 veterinary students, 127 pharmacy students, and 73 osteopathic medical students. Of the 295 participants, 217 were female and 78 were male. When dividing the sample size into different age groups, the younger group of 22 - 25 year olds had the largest number of participants, being 250, with the smallest group of one in 42 - 45 year olds. There is also a category of “other” outside of the range of 22 - 45 year olds, which consisted of 4 subjects.

Participants were compared by school and by the respective values of “abnormal, borderline, and normal” (Appendixes 1 and 2 in Supplementary File). The Auburn College of Veterinary Medicine and VCOM students did not report any “pre-abnormal depression” prior to starting their professional programs; however, both reported abnormal “post-depression” following completion of their first year.

Table 1. Frequencies by School, Sex, and Age

	No. (%)
School	
AU College of Veterinary Medicine	95 (32.2)
Harrison School of Pharmacy	127 (43.1)
VCOM-Auburn	73 (24.7)
Total	295 (100.0)
Gender	
Female	217 (73.6)
Male	78 (26.4)
Total	295 (100)
Age	
22 - 25	250 (84.4)
26 - 29	27 (9.2)
30 - 33	8 (2.7)
34 - 37	4 (1.4)
38 - 41	1 (0.3)
42 - 45	1 (0.3)
Other	4 (1.4)
Total	295 (100.0)

Also, note that in all schools, “normal” levels decreased after completion of their first year of the professional program.

Paired sample *t*-test (Table 2) compared participants by school and by their respective anxiety values of “abnormal, borderline, and normal”. Within this category all three professional schools started with at least some abnormal values, unlike the depression category. Similarly, for every school the rates of anxiety and depression normal values decreased while abnormal values increased. For overall pre- and post-anxiety, the paired sample *t*-test (Table 2) showed a mean difference of 4.45 (95% CI: 3.90 - 4.99), which is a statistically significant increase in anxiety ($P < 0.01$). The same method of data interpretation was used for the depression section of the survey. For pre- and post-depression the paired sample *t*-test showed a mean difference of 3.14 (95% CI: 2.64 - 3.65), which is a statistically significant increase in depression ($P < 0.01$).

Paired sample *t*-test (Appendix 3 in Supplementary File) for Auburn College of Veterinary Medicine showed a mean difference of 2.29 (95% CI: 1.46 - 3.13) with a statistically significant increase in anxiety, ($P < 0.01$) were seen when pre- and post-anxiety were analyzed for the Auburn College of Veterinary Medicine data. AU CVM data also showed a statistically significant increase in depression ($P = 0.013$) but with a mean difference of 0.85 (95% CI: 0.18 -

Table 2. Paired Sample *t*-test Overall Means Differences

	Mean	SD	SE	95% CI	t	df	Sig.
Post-anxiety, pre-anxiety	4.45	4.75	0.28	3.90 - 4.99	16.09	294	< 0.01
Post-depression, pre-depression	3.14	4.39	0.26	2.64 - 3.65	12.29	294	< 0.01

1.52), which is a non-significant confidence interval.

Paired sample *t*-test (Appendix 4 in Supplementary File) for the Harrison School of Pharmacy data showed a mean difference in pre- and post-anxiety of 6.12 (95% CI: 5.29 - 6.95), and a statistically significant increase in anxiety ($P < 0.001$). There was a change in the pharmacy school's pre- and post-depression as well. The mean difference in depression level was 4.89 (95% CI: 4.09 - 5.70), representing a significant increase ($P < 0.001$).

Paired sample *t*-test (Appendix 5 in Supplementary File) for Edward Via College of Osteopathic Medicine: VCOM-Auburn had the fewest responses at 73, but also showed an increase in both anxiety and depression. For pre- and post-anxiety, the paired sample *t*-test had a mean difference of 4.34 (95% CI: 3.31 - 5.37), with a statistically significant increase in anxiety ($P < 0.001$). For pre- and post-depression scores, the paired sample *t*-test had a mean difference of 3.07 (95% CI: 2.15 - 3.99), indicating a statistically significant increase in depression scoring over time ($P < 0.001$).

An analysis of variance (Table 3) by schools determined whether there was a significant difference in anxiety (pre, post) and depression (pre, post) between the school programs. Results indicate that pre- and post-anxiety scores were statistically different between the schools (pre-first year) $F(2, 292) = 15.51, P < 0.001$; (post-first year) $F(2, 292) = 6.59, P = 0.002$. Pre-first year depression scores were not statistically different between the schools $F(2, 292) = 1.90, P = 0.151$, but were different for depression post-first year of school $F(2, 292) = 19.83, P < 0.001$.

A post-hoc multiple comparisons test (Table 4) determined which of the schools had the greatest differences. Pairwise comparisons analysis showed a significant mean difference in pre-anxiety measures between Auburn College of Veterinary Medicine and the Harrison School of Pharmacy, 2.23 (95% CI: 1.08 - 3.38), $P < 0.001$. In addition, there was significant difference in means scores between the Auburn College of Veterinary Medicine and VCOM-Auburn, 2.73 (95% CI: 1.41 - 4.05), $P < 0.001$. A multiple comparison of post-first year depression determined that there was a mean difference between the Harrison School of Pharmacy and Auburn College of Veterinary Medicine of 3.48, (95% CI: 2.15 - 4.81), $P < 0.001$.

An independent sample test by sex (Table 5) demonstrated that female mean pre-school and post-school anx-

ety scores are significantly different from males. Females' anxiety pre-school mean scores (8.04 ± 3.48) were higher than males (5.26 ± 3.53), a statistically significant difference of 2.78 (95% CI: 1.87-3.69), $t(293) = 6.02, P < 0.01$. In addition, the females mean post-school anxiety score was higher (12.44 ± 4.34) than males (9.83 ± 5.09), a statistically significant difference of 2.60 (95% CI: 1.42 - 3.79), $t(293) = 4.34, P < 0.01$.

4. Discussion

All programs showed a statistically significant increase in both anxiety and depression, confirming previous research; however, there was a greater increase in anxiety than there was in depression. Harrison School of Pharmacy students showed the largest increase in both anxiety and depression, followed by VCOM, and then AU College of Veterinary Medicine students, respectively. Overall, females began their respective programs with higher average depression and anxiety levels and had a higher increase in these levels than males.

One reason proposed as to why pharmacy students may be at a higher risk for significant changes in self-assessed anxiety and depression scores is their relatively younger age at admission to the pharmacy professional program. Pharmacy students at Auburn University may enter the program after their junior year of undergraduate college; these younger students may have a different level of emotional maturity as compared to the other two colleges.

Interestingly, veterinary students also may enter following their junior year of undergraduate, but significantly fewer veterinary students were in this age group. Another reason may be related to relative academic maturity (years of college completed) of the study populations. More research is warranted about this topic, but possible reasons for this disparity include: veterinary students may be better emotionally and academically prepared for the challenging curriculum ahead; and the first year of study in the VCOM and pharmacy curricula may be more challenging. Additional research and pre-matriculation screening in these areas could identify students in need of additional emotional support before the need arises.

Because pre-scores compared to post-scores were statistically significant for each of the schools based on

Table 3. Analysis of Variance

Analysis of Variance by Schools	Sum of Squares	df	Mean Square	F	Sig.
Total pre-anxiety	386.39	2.00	193.20	15.51	< 0.001
Total post-anxiety	278.26	2.00	139.13	6.59	0.002
Total pre-depression	17.77	2.00	8.89	1.90	0.151
Total post-depression	657.56	2.00	328.78	19.83	0.001

Table 4. Post-Hoc Multiple Comparisons

Dependent Variable	Multiple Comparisons				
	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound Upper Bound	
Total pre-anxiety					
AU College of Veterinary Medicine					
Harrison School of Pharmacy	2.22818 ^a	0.47878	0.000	1.0753 3.3810	
VCOM-Auburn	2.73136 ^a	0.54936	0.000	1.4086 4.0541	
Total post-anxiety					
AU College of Veterinary Medicine					
Harrison School of Pharmacy	-1.59519 ^a	0.62340	0.033	-3.0962 -0.0941	
VCOM-Auburn	0.68363	0.71529	1.000	-1.0387 2.4060	
Total pre-depression					
AU College of Veterinary Medicine					
Harrison School of Pharmacy	0.56975	0.29335	0.159	-0.1366 1.2761	
VCOM-Auburn	0.37505	0.33659	0.798	-0.4354 1.1855	
Total post-depression					
Harrison School of Pharmacy					
AU College of Veterinary Medicine	3.47526 ^a	0.55238	0.000	2.1452 4.8053	
VCOM-Auburn	1.63445 ^a	0.59810	0.020	0.1943 3.0746	

^aThe mean difference is significant at the 0.05 level and a significant confidence interval. Adjustment for multiple comparisons: Bonferroni.

ANOVA (Table 3), we can conclude that students are experiencing differences in their lived anxiety and depression secondary to stress. Overall, this study demonstrates that there is a common experience of a significant increase in self-reported anxiety and depression levels over the first-year curriculum for pharmacy, osteopathic medicine, and veterinary medicine students. Our findings suggest that these three categories of professional students are at increased risk for the negative consequences of stress associated with high levels of anxiety and depression including

physical and psychiatric illnesses. Noteworthy, our results are similar to findings in other medical and professional student populations reported by Rotenstein et al. (11) and by Dyrbye et al. (12). Rotenstein et al. (11) demonstrated that about 27% of the students indicated reported levels of depression after examining 195 studies from 47 countries that involved over 100,000 students. Likewise, Dyrbye et al. (12) conducted a systematic review of the literature and found that in all study types elevated rates of anxiety among medical and pharmacy students showed higher

Table 5. t-test of Groups by Sex

Equal Variances Assumed	Independent Samples Test								
	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-Tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Pre-school anxiety	0.75	0.39	6.02	293.00	0.00	2.78	0.46	1.87	3.69
Post-school anxiety	3.42	0.07	4.34	293.00	0.00	2.60	0.60	1.42	3.79
Pre-school depression	0.00	0.98	0.21	293.00	0.84	0.06	0.29	-0.51	0.62
Post-school depression	3.39	0.07	0.20	293.00	0.84	0.11	0.57	-1.01	1.24

levels of distress than other graduate students and that stress levels significantly increased in the first year of medical school.

5.1. Conclusions

There were several limitations to this study. (1) Anxiety and depression scores are a snapshot of their academic experience; (2) the study was administered after completion of the first year in these programs; (3) this case control study allowed the students to self-report on changes in their perceived amount of anxiety and depression throughout the first year in these respective programs; (4) although this survey demonstrates a timely sample of these three populations, the method of administration is subject to recall bias. Assessing the same cohort at the beginning and end of their first academic year may provide different results; (5) although the HADS survey is a validated instrument, the modified version is not. Further study needs to be done to validate this modified instrument.

To expand this research, future studies will need to collect additional subject-specific information such as previous undergraduate/graduate work, college GPA, first in their family to attend college/professional school, and risk factors such as social and financial stressors, part-time work, emotional support, food insecurity, drug and alcohol use, and other environmental factors such as degree of access to supportive family, friends, and faith communities. Other variables that may contribute are the required number of courses in each program for the first year, extracurricular activities, and personal matters, particularly major life events. The HADS survey could be re-administered to the same groups after completion of their second or third years to determine whether the levels of anxiety and depression predictably peak during a certain year in the program.

Further studies could be done to assess the levels of access and use of mental health, exercise, and social or faith-based communities and services by the students in

each program. Research could also compare schools with minimal mental health resources to schools that consider mental health and diversity acceptance a priority, proactively offering on-site counseling, peer groups, exercise/yoga/wellness programs, and other support. These follow-up studies could shed light on ways to decrease the risks of anxiety and depression associated with students in these professional programs. The results could establish a foundation across medical professions on the Auburn University campus to consider mental health, wellness, and diversity support a priority to model and for supporting these professional students as they progress throughout their career. We have a responsibility to shed light on the presence and prevalence of significant levels of self-reported anxiety and depression in students enrolled in health professional training programs across Auburn University campus.

The results of this study of Auburn University (Colleges of Pharmacy and Veterinary Medicine) and VCOM students indicates a need for further study within these populations and expansion of this study to other professional and graduate programs. Targeted intervention programs focused on the recognition and management anxiety and depression secondary to stress should be developed to provide students with in-house access to needed support services and to equip students with the additional skills to persevere through the academic challenges they face. As educational institutions become more aware of the impact anxiety and depression have on student success, they will recognize how to address student needs, provide resources, and encourage students to cope with these emotions and practical challenges, improving students' quality of life so they can go forward and improve the lives of others.

Supplementary Material

Supplementary material(s) is available [here](#) [To read supplementary materials, please refer to the journal website and open PDF/HTML].

Footnotes

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