RESEARCH

Resilience and First-Year Pharmacy Students' Academic Performance in a Pharmacy Math Course

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Objective. The purpose of this study was to examine the relationship between academic resilience and academic success in Doctor of Pharmacy (PharmD) students.

Methods. A cross-sectional survey using the Academic Pharmacy Resilience Scale (APRS-16) was conducted in two cohorts of first year pharmacy (P1) students (n = 374) during fall orientation in 2019 and 2020. The following data were also collected from student records: demographics, pre-pharmacy grade point average (GPA), Pharmacy Math outcome (passing or failing the course), and Pharmacy Math final numerical grade. Academic success was defined as achieving a passing grade in a Pharmacy Math course. Correlational, multiple logistic regression, and multiple linear regression analysis were conducted.

Results. The survey response rate was 98.1%, and approximately 95% of participants passed Pharmacy Math. No significant correlations were found between Pharmacy Math final pass/fail outcome or Pharmacy Math final numerical grade and APRS-16 overall and subscale scores. In multiple logistic regression, neither pre-pharmacy GPA nor APRS overall scale or subscale scores were significantly associated with final Pharmacy Math outcome (passing/failing). In multiple linear regression, pre-pharmacy GPA was significantly associated with Pharmacy Math final numerical grade, but APRS-16 overall score and subscale scores were not.

Conclusion. First-year pharmacy students' performance in Pharmacy Math was not influenced by academic resilience. Studies like this one examining the relationship between pharmacy students' resilience and academic performance are lacking. Future studies should assess whether academic resilience may affect performance in other courses as well as performance in the PharmD curriculum.

Keywords: academic performance, academic resilience, pharmacy math, pre-pharmacy grade point average

INTRODUCTION

Because of the high cost of pharmacy school and risk of graduation delay and/or attrition, a better understanding of factors promoting student success after academic adversity is needed. During their tenure in pharmacy school, students may be confronted with numerous personal and academic challenges that serve as barriers to success and may jeopardize completion of the Doctor of Pharmacy (PharmD) program. To combat such challenges, Tomlinson[1] identified resilience as a critical capability for the 21st century. Academic resilience is defined as the ability to overcome obstacles seen as major threats to students' educational goals.[2] According to Sanderson and Brewer,[3] contemporary researchers consider resilience "a dynamic process" that may be "developed or enhanced."[4,5] Resilience is built partially on adverse event(s) and one's ability to cope and is seen as beneficial, with the potential of maintaining or improving academic stamina and capacity.

The academic pharmacy literature concerning the relationship between resilience and academic performance among pharmacy students is virtually nonexistent. A systematic review conducted by Stoffel and Cain[6] focused on grit and resilience literature within health professions education and included 27 papers concerning resilience, which were a mix of research studies, review articles, guidelines, commentaries, and letters to the editor. All 27 articles involved either medical or nursing students but no pharmacy students. Among the studies included in Stoffel and Cain's[6] systematic review, relationships between resilience and academic outcomes were not consistent. For example, Elizondo-Omaña and colleagues[7] reported

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no significant correlations between resilience score and gross anatomy grades among 113 medical students. Likewise, Taylor and Reyes[8] did not find a significant relationship between resilience and test scores in multiple courses over a semester in a sample of 136 baccalaureate nursing students. In contrast, other studies such as Beauvais and colleagues[9] and Pitt and colleagues[10] among nursing students found higher resilience was associated with academic success (eg, higher grade point average [GPA]).

A comprehensive systematic review conducted by Chisholm-Burns and colleagues[11] also examined evidence of the relationships between select noncognitive factors, including resilience, and academic performance of health professions students. Like Stoffel and Cain,[6] Chisholm-Burns and colleagues[11] noted several previous studies demonstrated a positive and significant association between nursing and medical students' resilience and academic performance. However, no published studies involving pharmacy students were located that examined this potential relationship.[11] To minimize attrition and delayed graduation, and to better understand how resilience affects pharmacy students' academic performance, the purpose of this study was to take the first step and examine the relationship between academic resilience and academic success among first year pharmacy (P1) students (academic success was defined as achieving a passing grade in the Pharmacy Math course by the end of the P1 fall semester).

METHODS

A cross-sectional survey was conducted in two cohorts of P1 students (entering classes of fall 2019 and fall 2020) at the University of Tennessee Health Science Center (UTHSC) College of Pharmacy. All P1 students entering the UTHSC College of Pharmacy in fall 2019 (n = 204) and fall 2020 (n = 177) were eligible to be included in the study. The surveys were conducted during first-year fall orientation in 2019 and 2020. The study was approved by the UTHSC Institutional Review Board.

Attrition and poor academic performance commonly occur early in the PharmD didactic curriculum, specifically in the first year of the program.[12-15] The Pharmacy Math course in the P1 fall semester has been identified as particularly challenging for students at our college because of the implementation of a new curriculum and greater focus on early application of skills and knowledge (failure rate of approximately 3% per year). Therefore, this study focused on academic success of P1 students in Pharmacy Math, a course ubiquitous across the curricula of PharmD programs in the United States.

The Pharmacy Math course at UTHSC College of Pharmacy is a one-credit course designed to teach fundamentals of performing pharmaceutical calculations, a required skill for the compounding and dispensing of prescriptions. A cooperative learning/flipped classroom approach was used wherein students were required to review assigned textbook chapters prior to class and class time was devoted to active-learning activities. Topics covered in the course included but were not limited to: interpretation of prescription and medication order, weighing and measuring, drug concentration expressions, dosage calculations, and enteral and parenteral nutrition. Examinations were timed, conducted using examination software, and primarily consisted of multiple-choice and short answer questions. To support student learning, help sessions (individualized or group tutoring) were available during class as of fall 2020 for students who needed extra assistance or were struggling academically. Final grades were calculated based on examination and quiz scores. To pass the course, students had to achieve a final grade of C (75%) or higher.

The Academic Pharmacy Resilience Scale (APRS-16) was used to measure academic resilience in P1 students. The APRS-16 is a reliable and validated scale and is the only published academic resilience scale designed specifically to measure this concept in pharmacy students.[16] In the APRS-16, students are asked to respond to 16 items based on a vignette describing an instance of academic adversity in which a student receives a failing grade on a pharmacy course examination following low grades on two previous examinations. As a result, the student is concerned about their academic standing. Response to each of the 16 items is assessed using a five-point Likert scale ranging from 1 = unlikely to 5 = likely. The scoring for seven negatively worded items is reversed so that higher scores indicate a more adaptive or resilient response, which is consistent with the direction of scoring for the nine remaining items. Possible total scores on the APRS-16 range from 16 to 80, with higher scores indicating greater academic resilience. The APRS-16 has four subscales (Table 1): Negative Affect and Emotional Response (five items), Reflecting and Adaptive Help-Seeking (five items), Adaptive Thought Processes (three items), and Perseverance (three items).[16] Total scores for the Negative Affect and Emotional Response subscale and Reflecting and Adaptative Help-Seeking subscale range from 5 to 25, and total scores for the Adaptive Thought Processes subscale and Perseverance subscale range from 3 to 15. In a previous study, Chisholm-Burns and colleagues[16] noted the Cronbach alpha for the APRS-16 was .84, and the Cronbach alphas for the subscales ranged from .61 to .82.

Table 1. Academic Pharmacy Resilience Scale Items and Subscales[16,a]

Subscale 1: Negative Affect and Emotional Response
1. I would begin to doubt my chances of success in the PharmD program[b]
2. I would probably get depressed[b]
3. I would be very disappointed[b]
4. I would begin to think my chances of getting the job or residency I want were poor[b]
5. I would feel like everything was ruined and going wrong[b]
Subscale 2: Reflecting and Adaptive Help-Seeking Score
6. I would try to think of new solutions.
7. I would use my past successes to help motivate myself.
8. I would set my own goals for achievements.
9. I would seek encouragement from my family and friends.
10. I would try to think about my strengths and weaknesses to help me work better.
Subscale 3: Adaptive Thought Processes
11. I would see the situation as a challenge.
12. I would do my best to stop thinking negative thoughts.
13. I would see the situation as temporary.
Subscale 4: Perseverance
14. I would just give up[b]
15. I would change my career plans[b]
16. I would not change my long-term goals and ambitions.

[a]Item scores range from 1 to 5, with higher score indicating greater resilience.
[b]Indicates reverse-scored items.

The following data were collected from student records: demographics (age, gender, and race/ethnicity; students were classified as either non-Hispanic White or minority if identified as a racial/ethnic group other than non-Hispanic White), pre-pharmacy GPA (calculated based on prepharmacy/prerequisite undergraduate coursework), Pharmacy Math outcome (passing grade/failing grade) at midterm, Pharmacy Math outcome (passing grade/failing grade) at the end of the course/semester, and Pharmacy Math final numerical grade (presented on GPA scale where A = 4.0, A- = 3.67, B+ = 3.33, B = 3.0, B- = 2.67, C+ = 2.33, C = 2.0, and F = 0). As a quality control measure, a cross-check for accuracy was conducted of a random sample of data entered in the study database and no errors were found. In recognition that past academic performance influences future academic performance, as demonstrated in several studies among pharmacy students, pre-pharmacy GPA was included as an independent variable to account for its contribution to academic success among P1 students.[14,17-21]

Statistical Analysis

Data analysis was performed using SPSS Statistics 26.0 (IBM). Descriptive statistics, with means, medians, and standard deviations for continuous variables and frequencies for categorical variables, were conducted. Because prior studies[13,14,19,20,22-24] found gender, age, and race/ethnicity associated with academic success among pharmacy students, relationships between demographic factors, APRS-16 total and subscale scores, Pharmacy Math outcome at the end of the course/semester, and Pharmacy Math final numerical grade were assessed. Specifically, Spearman rho and point biserial correlations were calculated to determine the strength of the relationships between age, APRS-16 total and subscale scores, pre-pharmacy GPA, Pharmacy Math pass/fail outcome, and Pharmacy Math final numerical grade. Cohen's[25] conventions were used to assess strength of correlations wherein .1 signifies a small effect, at least .3 is a medium effect, and at least .5 is a large effect.[26] Additionally, chi-square analyses and Mann-Whitney U tests were performed to determine if significant differences exist based on gender and race/ethnicity regarding pre-pharmacy GPA, APRS-16 total and subscale scores, Pharmacy Math pass/fail outcome, and Pharmacy Math final numerical grade. An a priori alpha level of .05 was used to determine significance of chi-square and correlational analyses. As a total of 16 Mann-Whitney U tests were performed, Bonferroni's adjustment was appropriate (.05 divided by 16), making the alpha level .003.

In the primary analysis, four multiple logistic regression analyses were conducted to determine the influence of pre-pharmacy GPA and academic resilience as measured by the APRS-16 on Pharmacy Math outcome (pass/fail) at the end of the course/semester. Separate models were conducted for APRS-16 total score and APRS-16 subscale scores to determine the potential influence of overall academic resilience score and the potential influence of the four different aspects of academic resilience reflected in the instrument's subscales. Based on guidelines provided by Bujang and colleagues[27] for calculating sample size for logistic regression in observational studies, an event per variable (EVP) of 50 was used, and sample size was determined using the formula $n = 100 + 50i$, where i represents the number of independent variables in the logistic regression analysis and 100 represents the minimal needed sample size.[28] The following target sample size was calculated:$100 + 50(5) = 350$. The first and

second logistic regression models were conducted using data from the total sample, with separate analyses performed using either the APRS-16 total score as an independent variable or the APRS subscale scores as independent variables. The third and fourth logistic regression analyses were conducted as a subset analysis using data from only those students who were failing Pharmacy Math at midterm, with separate analyses performed using either the APRS-16 total score as an independent variable or the APRS subscale scores as independent variables. These subset analyses were performed to examine the role of academic resilience in the final Pharmacy Math outcome among this subgroup of students who were faced with an identified threat (a failing grade at midterm) to their educational goal (ie, successful course outcome). The models, one which includes APRS-16 total score as an independent variable and the other which includes the APRS-16 subscale scores as independent variables, are explicated as follows:

(a) Pharmacy Math Outcome (Pass/Fail) = Constant + β(pre-pharmacy GPA) + β(APRS-16 total score)

(b) Pharmacy Math Outcome (Pass/Fail) = Constant + β(pre-pharmacy GPA) + β(Negative Affect and Emotional Response subscale score) + β(Reflecting and Adaptive Help-Seeking subscale score) + β(Adaptive Thought Processes subscale score) + β(Perseverance subscale score)

To reiterate, each model was performed on the entire population of students enrolled in Pharmacy Math and on the subgroup of students who were failing at midterm, making a total of four models. To conduct each regression analysis, independent variables were entered in one block simultaneously.

Secondary analyses were also conducted to explore the relationships between Pharmacy Math final numerical grade, pre-pharmacy GPA, and the APRS-16. Multiple linear regression analyses were conducted using Pharmacy Math final numerical grade as the dependent variable, explicated as follows:

(a) Pharmacy Math Final Numerical Grade = Constant + β(pre-pharmacy GPA) + β(APRS-16 total score)

(b) Pharmacy Math Final Numerical Grade = Constant + β(pre-pharmacy GPA) + β(Negative Affect and Emotional Response subscale score) + β(Reflecting and Adaptive Help-Seeking subscale score) + β(Adaptive Thought Processes subscale score) + β(Perseverance subscale score)

As in the primary analyses, each model was performed on the entire student population in Pharmacy Math and on the subgroup of students who were failing at midterm, making a total of four models. To conduct each regression analysis, independent variables were entered in one block simultaneously.

Alternate analyses, in which pre-pharmacy GPA was replaced by pre-pharmacy math/science GPA (calculated based only on prerequisite math and science courses, rather than all prerequisite courses), were also conducted. In these alternate analyses, the previously described multiple logistic regression and multiple linear regression analyses in the total sample and subgroup who were failing at midterm were repeated using pre-pharmacy math/science GPA rather than overall pre-pharmacy GPA. An a priori alpha level of .05 was used to determine statistical significance of the multiple logistic regression and multiple linear regression analyses.

RESULTS

Among 381 total students in the entering classes of 2019 and 2020, seven students (four in 2019 and three in 2020) withdrew from the college prior to the end of the P1 fall semester and were excluded from the study. Among the 374 remaining students, 367, or 98.1%, participated in the study. Mean age of participants was 23.3 years (SD = 3.7), and most participants were female (n = 238, or 64.9%) and non-Hispanic White (n = 214, or 58.3%). Mean pre-pharmacy GPA was 3.37 (SD = 0.4) and mean Pharmacy Math final numerical grade was 3.35 (SD = 1.0) (Table 2). Mean and median APRS-16 overall scale and subscale scores and Cronbach alphas are presented in Table 2. Among 367 participants, 49 students (13.4%) were failing Pharmacy Math at the midterm and 19 students (5.2%) ultimately failed Pharmacy Math. Of 49 students failing Pharmacy Math at the midterm, 31 passed and 18 failed Pharmacy Math at the end of the course, while one student who was passing at midterm ultimately failed. Mean and median APRS-16 overall and subscale scores for students who passed and failed the course within the total sample and the subgroup failing Pharmacy Math at midterm are presented in Table 3.

In Mann-Whitney U analysis, no significant differences based on gender were found in pre-pharmacy GPA, Pharmacy Math final numerical grade, or APRS-16 scores. Significant differences ($p < .001$) were found between non-Hispanic White students and minority students in pre-pharmacy GPA (M = 3.42, SD = 0.4, Median = 3.46 vs M = 3.29, SD = 0.4, Median = 3.29, respectively) and Pharmacy Math final numerical grade (M = 3.49, SD = 0.8, Median = 4.0 vs M = 3.13, SD = 1.1, Median = 3.67, respectively). No significant differences in APRS-16 overall scale and subscale scores were found based on race/ethnicity. In chi-square analysis, there was no significant difference ($p = .08$) in the proportion of students failing Pharmacy Math based on gender. In the total sample, a significantly greater proportion of minority students

Table 2. Summary of Demographics, Pre-pharmacy GPA, Academic Pharmacy Resilience Scale-16 (APRS-16) Overall and Subscale Scores, and Pharmacy Math Outcomes (Pass/Fail) and Final Numerical Grades of Participants in the Entering Classes of 2019 and 2020

	Participants (n=367)
Age, Mean (SD)	23.3 (3.7)
Gender	
Female, n (%)	238 (64.9)
Male, n (%)	126 (34.3)
Other	3 (0.8)
Race/ethnicity	
Non-Hispanic White, n (%)	214 (58.3)
Minority, n (%)	151 (41.1)
Missing	2 (0.5)
Pre-pharmacy GPA	
Mean (SD)	3.37 (0.4)
Median (IQR)	3.37 (0.6)
APRS-16 overall score[a]	
Mean (SD)	61.3 (8.3)
Median (IQR)	62 (11)
Cronbach alpha	0.8
APRS-16 subscale 1: Negative Affect and Emotional Response Score[a]	
Mean (SD)	13.8 (4.4)
Median (IQR)	13 (6)
Cronbach's alpha	0.8
APRS-16 subscale 2: Reflecting and Adaptive Help-Seeking Score[a]	
Mean (SD)	22.2 (2.8)
Median (IQR)	23 (5)
Cronbach alpha	0.7
APRS-16 subscale 3: Adaptive Thought Processes Score[a]	
Mean (SD)	12.2 (2.1)
Median (IQR)	12 (3)
Cronbach's alpha	0.6
APRS-16 subscale 4: Perseverance Score[a]	
Mean (SD)	13.1 (2.2)
Median (IQR)	14 (3)
Cronbach alpha	0.7
Pharmacy math outcome at midterm, n (%)	
Pass	318 (86.6)
Fail	49 (13.4)
Pharmacy math outcome at end of semester/course, n (%)	
Pass	348 (94.8)
Fail	19 (5.2)
Pharmacy math final numerical grade[b]	
Mean (SD)	3.35 (1)
Median (IQR)	3.67 (1)

Abbreviations: GPA=grade point average; IQR=interquartile range.
[a]Possible total scores of the APRS-16 range from 16 to 80, with higher scores indicating greater academic resilience. Total scores for the *Negative Affect and Emotional Response* subscale and *Reflecting and Adaptative Help-Seeking* subscale range from 5 to 25, and total scores for the *Adaptive Thought Processes* subscale and *Perseverance* subscale range from 3 to 15.
[b]Pharmacy Math Final Numerical Grade presented on GPA scale where A=4.0, A-=3.67, B+=3.33, B=3.0, B-=2.67, C+=2.33, C=2.0, and F=0.

(7.9%) failed Pharmacy Math compared to non-Hispanic White students (3.3%) ($p = .05$). In the subgroup failing Pharmacy Math at midterm, there was no significant difference ($p>.05$) between minority and non-Hispanic Whites students in the proportion who failed Pharmacy Math at the end of the course.

Pre-pharmacy GPA was moderately correlated with Pharmacy Math final numerical grade (Spearman rho = .34, $p < .001$). No other significant correlations were found between Pharmacy Math final pass/fail outcome or Pharmacy Math final numerical grade and the following variables: age, pre-pharmacy GPA, and APRS-16 overall and subscale scores.

In the primary multiple logistic regression analyses, neither pre-pharmacy GPA nor APRS-16 overall scale score were significantly associated with final Pharmacy Math outcome (passing/failing) in the total sample or in the subgroup of students who were failing Pharmacy Math at the midterm ($p>.05$). Likewise, neither pre-pharmacy GPA nor APRS-16 subscale scores were significantly associated with final Pharmacy Math outcome (passing/failing) in the total sample or in the subgroup of students who were failing Pharmacy Math at the midterm ($p>.05$). The alternate multiple logistic regressions analyses, in which pre-pharmacy GPA was replaced by pre-pharmacy math/science GPA, were also not significant ($p>.05$).

In the secondary multiple linear regression analyses, pre-pharmacy GPA was significantly associated ($p < .001$) with Pharmacy Math final numerical grade in the total sample, but APRS-16 overall score and APRS-16 subscale scores were not (Models 1 and 2, respectively, in Table 4). The final model that included only pre-pharmacy GPA explained 6.6% (adjusted $R^2 = 0.066$) of the total variance in Pharmacy Math final numerical grade. In the alternate analyses, pre-pharmacy math/science GPA was likewise significantly associated ($p < .001$) with Pharmacy Math final numerical grade in the total sample, while APRS-16 overall score and APRS-16 subscale scores were not; this final model explained 4.9% (adjusted $R^2 = 0.049$) of the total variance in Pharmacy Math final numerical grade. In the subgroup of students who were failing Pharmacy Math at the midterm, neither pre-pharmacy GPA (or, alternately, pre-pharmacy math/science GPA) nor APRS-16 overall scale or subscale scores were significantly associated with Pharmacy Math final numerical grade ($p>.05$).

DISCUSSION

The purpose of this study was to examine the influence of academic resilience on P1 student outcomes in

Table 3. Comparison of Course Grades and Academic Pharmacy Resilience Scale-16 Scores in First-Year Pharmacy Students Enrolled in a Required Pharmacy Math Course[a]

	Total Sample[b] (n=376)	Subgroup[b] (n=49)
APRS-16 Overall Score		
Passed Pharmacy Math		
Mean (SD)	61.3 (8.4)	60.9 (8.3)
Median (IQR)	62 (11)	61 (15)
Failed Pharmacy Math		
Mean (SD)	61.1 (8)	61.3 (7.6)
Median (IQR)	61 (14)	60 (12)
APRS-16 Subscale 1: Negative Affect and Emotional Response Score		
Passed Pharmacy Math		
Mean (SD)	13.7 (4.4)	14.2 (4.6)
Median (IQR)	13 (6)	15 (8)
Failed Pharmacy Math		
Mean (SD)	14 (4.5)	13.7 (4.6)
Median (IQR)	14 (7)	13 (6)
APRS-16 Subscale 2: Reflecting and Adaptive Help-Seeking Score		
Passed Pharmacy Math		
Mean (SD)	21.9 (2.8)	22.4 (2.7)
Median (IQR)	23 (5)	23 (5)
Failed Pharmacy Math		
Mean (SD)	22.3 (2.8)	22.1 (3)
Median (IQR)	23 (5)	23 (5)
APRS-16 Subscale 3: Adaptive Thought Processes Score		
Passed Pharmacy Math		
Mean (SD)	12.2 (2.1)	11.7 (1.9)
Median (IQR)	13 (3)	11 (3)
Failed Pharmacy Math		
Mean (SD)	11.8 (2)	12.1 (2.1)
Median (IQR)	12 (4)	13 (4)
APRS-16 Subscale 4: Perseverance Score		
Passed Pharmacy Math		
Mean (SD)	13.2 (2.2)	12.7 (2.6)
Median (IQR)	14 (3)	14 (5)
Failed Pharmacy Math		
Mean (SD)	12.9 (2.4)	13.3 (2)
Median (IQR)	14 (4)	13 (3)

Abbreviations: IQR=interquartile range.

[a]Possible total scores of the APRS-16 range from 16 to 80, with higher scores indicating greater academic resilience. Total scores for the Negative Affect and Emotional Response subscale and Reflecting and Adaptative Help-Seeking subscale range from 5 to 25, and total scores for the Adaptive Thought Processes subscale and Perseverance subscale range from 3 to 15.

[b]There were no significant differences ($p>.05$) in APRS-16 overall or subscale scores between the passed and failed Pharmacy Math groups in either the total sample or the subgroup who were failing Pharmacy Math at the midterm.

Pharmacy Math. Some previous studies of the relationship between resilience and academic performance in health professions students found higher resilience was associated with academic success.[9,10,29-31] To enhance resilience, the American Psychological Association[32] recommends several strategies, such as building relationships (eg, joining support groups); focusing on physical and emotional wellness through physical activity, good nutrition,

Table 4. Linear Regression Models to Determine Predictors of Pharmacy Math Final Numerical Grade of Participants in the Entering Classes of 2019 and 2020 (n=367)

	B	Standard Error	Standardized Beta	*t*	*p* value	Zero-order Correlation	Partial Correlation	Part Correlation	Tolerance[a]	VIF[a]
Model 1										
Constant	0.777	0.56		1.35	.2					
Pre-pharmacy GPA	0.672	0.13	0.26	5.21	<.001	0.263	0.264	0.263	1	1
APRS-16 Overall Score	0.005	0.01	0.04	0.83	.4	0.038	0.044	0.042	1	1
Model 2										
Constant	0.598	0.61		0.98	.3					
Pre-pharmacy GPA	0.661	0.13	0.26	5.06	<.001	0.263	0.258	0.257	0.98	1.02
APRS-16-NAER Score	−0.01	0.01	−0.03	−0.48	.6	−0.014	−0.025	−0.024	0.79	1.27
APRS-16-RAH Score	0.008	0.02	0.02	0.39	.7	0.069	0.02	0.02	0.76	1.31
APRS-16-ATP Score	0.023	0.03	0.05	0.82	.4	0.054	0.043	0.041	0.74	1.36
APRS-16-P Score	0.011	0.03	0.03	0.44	.7	0.033	0.023	0.022	0.78	1.29

Abbreviations: ATP=Adaptive Thought Processes, GPA=grade point average, NAER=Negative Affect and Emotional Response, P=Perseverance, RAH=Reflective and Adaptive Help-seeking, VIF=variance inflation factor.
[a]Tolerance less than 0.1 and VIF greater than 10 indicate multicollinearity.

adequate rest, practicing mindfulness, "embracing healthy thoughts" (eg, being hopeful, accepting change) rather than dwelling on the negative; and finding a purpose or goal-setting (eg, performing charitable work). However, other studies did not find a significant relationship between resilience and academic outcomes among health professions students.[7,8,33] Consistent with these latter studies, our findings indicate academic resilience was not significantly associated with final pass/fail outcome in Pharmacy Math or with Pharmacy Math final numerical grade in either the total sample or the subgroup that was failing Pharmacy Math at midterm.

One potential explanation of our findings is that failing Pharmacy Math (a one-credit course), although a prerequisite for other courses in the curriculum, may not represent a major adversity to students considering the intensity of the transition into pharmacy school and the P1 fall course load. Another potential explanation of the study's results is that the APRS-16 is not sensitive enough to detect the influence of resilience on academic outcomes in Pharmacy Math, particularly as approximately 95% of students passed the course. Future studies are needed to further evaluate the following: what constitutes a major adversity in the academic life of a pharmacy student; the role of academic resilience in overcoming that adversity and facilitating academic success; the subsequent potential role of resilience-enhancing interventions, such as the aforementioned strategies recommended by the American Psychological Association;[32] and the most appropriate use of the APRS-16 as a measure of academic resilience (whether it be in an individual course or in larger portions of the curriculum, such as a semester or academic year).

Similar to the APRS-16 overall and subscale scores, pre-pharmacy GPA was not associated with final pass/fail outcome in Pharmacy Math. However, pre-pharmacy GPA was associated with Pharmacy Math final numerical grade, explaining 6.6% of the variance in final grade. This is consistent with prior studies of the relationship between pre-pharmacy performance and pharmacy school performance.[14,17-21] Yet, the limited amount of variance explained by pre-pharmacy performance suggests other factors not considered in this study may explain Pharmacy Math performance. To develop strategies to facilitate student success in Pharmacy Math, future studies should further explore possible additional factors, including but not limited to self-efficacy, study habits, and tutoring, that may affect performance in this course.

There were no significant differences based on gender in pre-pharmacy GPA, APRS-16 overall or subscale scores, Pharmacy Math outcome (pass/fail) at the end of the course, or Pharmacy Math final numerical grade. Although there were no significant differences between the performance of minority students and non-Hispanic White students on the APRS-16, minority students had significantly lower pre-pharmacy GPAs and Pharmacy Math final numerical grades and a greater proportion failed Pharmacy Math. Given these findings and the lack of consistency in prior studies regarding the relationship between race/ethnicity, pre-pharmacy GPA, and pharmacy school performance, additional inquiries should consider factors that may affect the performance of minority students in Pharmacy Math as well as potential interventions to support and promote academic success among students who face challenges in this course.[22,23]

Additionally, statistical differences in pre-pharmacy GPA and Pharmacy Math final numerical grade may not translate to practical academic differences.

This study had some limitations. Students may have selected what they perceived to be socially desirable responses, a form of response bias, when completing the APRS-16. To reduce response bias, students were informed their survey responses would be confidential. Additionally, the APRS-16 included several reverse-scored items to prompt greater attention to these items and interrupt socially desirable response patterns. Another limitation is that this study was specifically designed to examine the relationship between academic resilience and academic performance in the context of a Pharmacy Math course. Although Pharmacy Math is a particularly challenging course, there are several other courses across the first year of the PharmD curriculum that are also demanding and may require greater student resilience. Therefore, a broader future inquiry involving other courses may reveal a more significant role for academic resilience than what was noted in the findings with this course.

CONCLUSION

First-year pharmacy students' performance in Pharmacy Math was not influenced by academic resilience, though final numerical grade was associated with pre-pharmacy GPA. Although the evidence did not suggest a role for academic resilience in students' success in Pharmacy Math, future studies should assess whether resilience may affect academic performance in other individual courses, semesters, academic years, and/or the curriculum as a whole.

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Conflicts of Interest: Marie Chisholm-Burns serves on the board of directors for the Accreditation Council for Pharmacy Education (ACPE). This manuscript does not represent ACPE or the boards' opinions or views.

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