RESEARCH

Admissions Criteria as Predictors of Academic Performance in a Three-Year Pharmacy Program at a Historically Black Institution

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Objective. To determine the ability of University of Maryland Eastern Shore School of Pharmacy's admissions criteria to predict students' academic performance in a 3-year pharmacy program and to analyze transferability to African-American students.

Methods. Statistical analyses were conducted on retrospective data for 174 students. Didactic and experiential scores were used as measures of academic performance.

Results. Pharmacy College Admission Test (PCAT), grade point average (GPA), interview, and observational scores combined with previous pharmacy experience and biochemistry coursework predicted the students' academic performance except second-year (P2) experiential performance. For African-American students, didactic performance positively correlated with PCAT writing subtests, while the experiential performance positively correlated with previous pharmacy experience and observational score. For nonAfrican-American students, didactic performance positively correlated with PCAT multiple-choice subtests, and experiential performance with interview score. The prerequisite GPA positively correlated with both of the student subgroups' didactic performance.

Conclusion. Both PCAT and GPA were predictors of didactic performance, especially in nonAfrican-Americans. Pharmacy experience and observational scores were predictors of experiential performance, especially in African-Americans.

Keywords: admissions criteria, academic performance, three-year pharmacy program, HBCU, African-American students

INTRODUCTION

Pharmacy colleges and schools use admissions criteria such as the standardized Pharmacy College Admissions Test (PCAT), prepharmacy grade point average (GPA), pharmacy work experience, prior degree, and communication skills as tools for identifying students potentially capable of succeeding in their programs. More than two-thirds of the pharmacy schools require or recommend applicants to submit PCAT results.[1] The PCAT measures the academic ability and scientific knowledge necessary for the commencement of pharmacy education.[2] Trinca et al stated that the PCAT was designed to predict success during the first professional year.[3] Other studies indicate the PCAT is a moderate to strong predictor of grades earned in pharmacy programs.[4-6] Other studies show that PCAT subtest scores are more predictive than the PCAT composite score of first-year GPA.[7-9]

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In addition to the PCAT, other predictors of academic success in the pharmacy programs are evaluated. With pharmacy practice moving from a medication-centered role to a more patient-centered one, increasing responsibility has been placed on pharmacists to be effective communicators. The Accreditation Council for Pharmacy Education (ACPE) recommends that communication skills be assessed as part of the admissions process.[10] Interviews often are used as a means of evaluating communications skills, as well as the general fit of an applicant for a particular program. Hardigan et al reported that faculty interview score was a significant predictor of first-year GPA, while Kidd et al reported that faculty interview score was not a predictor of first- through third-year GPA.[4,8] Other studies evaluating admissions criteria also have conflicting results, such as those evaluating the predictive ability of cumulative prepharmacy GPA,[4,6,8,11-15] and prior work experience.[16,17] Briceland and Hamilton reported that students with previous pharmacy work experience and higher first-year GPAs had higher third-year (P3) experiential GPAs.[18]

Valdez et al reported that previous pharmacy work experience has a significant correlation with the retention of knowledge.[17] In contrast, Mar et al reported that

previous pharmacy work experience had little impact on the students' overall academic or clinical performance in pharmacy school.[16] Additionally, several studies show that a prior 4-year college degree was positively correlated with academic success in pharmacy school.[12-14] In contrast, attainment of a 4-year college degree was not a significant predictor in the models studied by Thomas, et al.[9] Although several studies have correlated admissions criteria to academic success, most of these were in 4-year pharmacy programs, and results were inconsistent.[4-9,11-15,19]

Limited studies have been conducted in 3-year pharmacy programs. In 2009, the American Association of Colleges of Pharmacy (AACP) reported thirteen 3-year pharmacy programs enrolling students.[20] As the number of 3-year programs increases, it is imperative to identify admissions criteria that will predict success in these programs, as they often employ nontraditional learning models. In a study involving 22 schools of pharmacy, which included two 3-year pharmacy programs, Shauner et al reported the moderate validity of PCAT scores and prepharmacy GPAs in predicting students' success in the first year.[15] In Unni et al's study, conducted in a 3-year pharmacy program, the authors found that a high math/science prerequisite GPA is a good predictor of first-year and second-year academic performance.[21] However, none of the predictors—prerequisite GPAs, PCAT scores, or prior degrees—correlated with P3 capstone course performance.[21] Thus, the validity of these admissions criteria in predicting academic success in a 3-year pharmacy program remain to be explored.

Standardized test scores and prepharmacy GPA may be of limited use in predicting academic success in some populations.[22,23] Sedlacek et al suggested that college grades and Medical College Admissions Test (MCAT) scores have modest correlations with medical school grades for minority students.[23] In pharmacy school, however, limited admissions data exist regarding these factors. In particular, prediction studies of African-American students' academic success in pharmacy school are limited. The number of African-Americans or blacks enrolled in US schools of pharmacy is considerably lower than their representation in the general population.[24] The 2013-2014 AACP Argus Commission on Diversity and Inclusion in Pharmacy Education acknowledged that students feel more prepared to care for patients from diverse backgrounds when they graduate from schools with diverse student bodies. Although the student body at pharmacy schools has changed significantly, there is still much progress to be made in the area of diversity and inclusion.[25]

As more schools of pharmacy attempt to increase enrollment of African-Americans, they will need to identify factors most likely to predict success in this student population. Previous studies conducted in 4-year pharmacy programs at historically black colleges and universities (HBCU) institutions, have correlated prepharmacy variables with academic performance in the PharmD program.[26,27] Dutta et al reported that prepharmacy GPA, PCAT chemistry and quantitative scores, and prior degree were significant predictors of the students' academic success.[27] Similarly, Charupatanapong et al reported that prepharmacy GPA and PCAT quantitative scores were predictors of minority pharmacy students' cumulative GPA.[28] However, neither of these studies specifically analyzed African-American students.

A study by Bandalos et al, which specifically evaluated African-American students, indicated that prepharmacy GPAs and PCAT reading were the best predictors of first-year pharmacy GPA for African-Americans.[22] The ACPE accreditation standards mandate that pharmacy programs assess their admissions criteria.[29] While it is important to assess the effectiveness of the admissions criteria, more studies are needed to add to the limited number of performance prediction research conducted in 3-year pharmacy programs and in the African-American student population. This study was conducted at the University Of Maryland Eastern Shore School of Pharmacy (UMES-SOP), an HBCU institution that offers a concentrated 3-year pharmacy program.

The primary objective of this study was to determine whether UMES-SOP admissions criteria could predict student academic performance in its 3-year doctor of pharmacy (PharmD) program. The secondary objective was to determine which admissions criteria are predictive of the academic performance for African-American students.

METHODS

The study population comprised 174 students from the classes of 2013, 2014, and 2015 enrolled in the UMES-SOP program. The demographic data were acquired from student self-reporting on the Pharmacy College Application Service (PharmCAS) application. The didactic component of the curriculum occurs in the first two years (P1 and P2) of pharmacy school. The UMES-SOP program uses a mastery-learning model and a block system of curricular design. In this educational model, material is taught in one block (typically lasting two weeks), and the students' understanding is evaluated by a summative assessment before they progress to the next block. The summative assessments occur at the end of each block and are scheduled biweekly. In order to demonstrate mastery of the content, the students are required to achieve an 85% or better on the summative assessment.

The experiential component begins immediately in the P1 year, is distributed throughout the program, and culminates in the third year (P3) with advanced pharmacy practice experiences (APPEs), which consist of eight 5-week rotations. The students must score an average of 75% for all outcomes as designated on the preceptor's evaluation of the student in order to progress.

A retrospective data analysis was carried out using admissions and academic data. The specific measures of student academic performance used in the study were the students' biweekly didactic assessment scores in the P1 and P2 year and the current cumulative didactic assessment scores. The specific measures of student experiential performance were P1 experiential scores, P2 experiential scores, P3 experiential scores, and current cumulative experiential scores. The current cumulative score is defined as the mean of available didactic or experiential scores. Admissions data, didactic assessment data, and experiential data were obtained from the UMES-SOP Offices of Student Affairs, Academic Affairs, and Experiential Education, respectively.

Applicants to the UMES-SOP are evaluated for interview eligibility based on prerequisite GPA and PCAT scores. Eligible students are invited for a half-day, on-campus interview, which includes individual interviews by faculty members, staff, and/or preceptors, and involves an ethical dilemma presentation. For the ethical dilemma presentation, students are grouped into teams. The team then presents their proposed solution, with each member having a designated section to present, and is followed by a question-and-answer component.

For this study, the prerequisite cumulative GPA (0-4) was used. The PCAT is divided into six content areas: biology, chemistry, reading, verbal, quantitative ability, and writing subtests. The PCAT writing subtest responses are judged in terms of problem-solving skills and the effective use of the conventions of language (essay). For this study, percentile rank (1-99) was used for PCAT scores for biology, chemistry, reading, quantitative, and verbal. Earned scores (1-6 points) were used for the convention of language (essay) and problem-solving components.[30]

Based on the interview scoring rubric, the student's average normalized interview score (0-25 points) was used. Based on the ethical dilemma scoring rubric, the observational score (1-5 points) was used. The interview scoring rubric is a 10-item questionnaire that assesses the applicant's communication, leadership and interpersonal skills, and traits necessary to be a successful pharmacist, such as motivation and professionalism. The ethical dilemma scoring rubric is a 3-item questionnaire that assesses the applicant's presentation/communication, problem-solving and team-interaction skills, and overall professionalism.

Although they are not specifically a requirement for admission, previous pharmacy technician experience and biochemistry are factors that might be considered during the UMES-SOP admissions process. These are often viewed favorably by UMES-SOP interviewers in the overall assessment of an applicant during the on-campus interview. Data on previous biochemistry coursework (with or without) and pharmacy technician experience (in years) were obtained from the Office of Student Affairs.

Students' weighted scores (0-100%) of the biweekly assessments in P1 and P2 years were used in the calculation of the P1 and P2 didactic scores, respectively. Scores were weighted based on the number of semester credit hours associated with that assessment block. For the experiential component, students were evaluated by preceptors using an electronic experiential evaluation form for each rotation. The experiential evaluation form contains several criteria and uses a 4-point scale associated with numerical values. The score for each rotation was calculated by taking the mean of all numerical values awarded and was presented as a percentage. For this study, the students' P1 and P2 experiential scores (0-100%) were calculated based on the P1 and P2 evaluation scores, respectively. The students' final P3 experiential score (0-100%) was calculated by taking the mean of the eight APPE evaluation scores.

All data were de-identified prior to statistical analysis. Character data were numerically encoded when needed. The characteristics of study participants were presented using descriptive statistics (eg, means, standard deviations, percentages). The study was nonexperimental, and a multiple regression analysis was conducted (95% confidence interval). The independent variables for this study were prerequisite cumulative GPA, PCAT scores (biology, chemistry, reading, verbal, quantitative, essay, and problem solving), interview scores, and observational scores. Prior biochemistry coursework and pharmacy technician experience also were assessed as independent variables. The didactic assessment mean scores and experiential evaluation mean scores were used as dependent variables in the multiple regression iterations. A bivariate correlation analysis (Pearson's correlation, r) was used to investigate the relationship between the admissions criteria and academic performance (didactic and experiential). All quantitative data analyses were conducted in SPSS for Windows, v21 (IBM Corp., Armonk, NY). A power analysis indicated that a sample size of at least 51 students was required to provide 100% power at a significance level of 5%, using t test and

Pearson's correlations. The study received approval from the UMES Institutional Review Board.

RESULTS

Of the 174 students, 81 (47%) were African-American, and 93 (53%) were nonAfrican-American (Table1). African-American refers to individuals having origins in any black racial groups of Africa. Additionally, the African-American group included immigrant and first-generation African-Americans, US permanent residents, and international students. The nonAfrican-American group included whites, American Indians, Asians, and Hispanics. Fifty-one percent of the students had a prior biochemistry course; 47% had previous pharmacy technician experience, with a mean of 1.6 years of work experience (Table 2). The prerequisite cumulative GPA was 3.35 (SD=0.29, Table 2). Sixty-one percent of the study population completed their prerequisites from a 4-year university or college (Table 2). However, based on independent sample *t* test for means, comparison between students who had completed their prerequisites from a 4-year university vs non 4-year school (community college or combination) did not show any significant difference in either didactic or experiential academic performance.

For the PCAT multiple-choice subtest scores, the means ranged from 43 (23) to 67 (19) (Table 2). For the writing subtest, the PCAT essay mean score was 3 (0.4), and the problem-solving mean score was 3 (0.4). The on-campus interview mean score was 20 (2), and the observation mean score during the ethical dilemma activity was 4 (0.6). The two groups of students (ie, African-American students and nonAfrican-American students) were not statistically equivalent, as the test for homogeneity, using a *t* test for equality of means, failed. Thus, descriptive statistics were reported for each group. Of the African-American students, 54% had completed a biochemistry course prior to pharmacy school, compared with 47% of the nonAfrican-American students.

There was no difference in the means of the prerequisite cumulative GPAs of the African-American and nonAfrican-American students. However, the PCAT biology, reading, verbal, and quantitative scores of the African-American students were lower than nonAfrican-American students. Only the PCAT chemistry score was higher in African-American students compared with that of nonAfrican-American students. The PCAT scores used were the highest score received for each subtest from among all attempts by the student.

Between the African-American and nonAfrican-American students, there was no difference in interview and observational scores when a *t* test for equality of means was conducted. Table 2 provides the didactic assessment and experiential scores by year. The mean P1 year didactic assessment score was 87 (5), and the mean P2 year didactic assessment score was 84 (7). The mean experiential scores in the P1 and P2 year were 91 (7) and 92 (12), respectively. In the P3 year, the mean experiential score was 93 (5). The P2 didactic performance and all experiential performance of the African-American students were lower compared with the score of the non-African-American students.

The results of multiple-regression analyses for the students and the degree to which combined independent variables (ie, PCAT scores, prerequisite cumulative GPAs, interview and observational scores, previous pharmacy technician experience, and biochemistry coursework) predicted didactic and experiential performance are shown in Table 3. Holding all other variables constant, the combined independent variables significantly ($p<0.05$) predicted the students' academic performance, except the P2 experiential performance (model 5). The prerequisite cumulative GPA made significant positive contributions in the didactic models with standardized beta coefficients (β) of 0.27, 0.33, and 0.34 in models 1, 2, and 3, respectively. Additionally, PCAT problem solving (β=0.20) made a significant positive contribution in model 1. Previous pharmacy technician experience made a significant positive contribution in models 4 (β=0.20) and 7 (β=0.24). Prerequisite cumulative GPA made significant contribution (β=0.20) in model 6.

Table 1. Demographic Characteristics of the Pharmacy Students

Variable	All Students (N=174)	African-American (n=81)	NonAfrican-Americans (n=93)
Age, Mean (SD)	24.7 (4.9)	25.7 (4.9)	23.9 (4.7)
Female, n (%)	99 (57)	53 (65)	46 (49)
Ethnicity, n (%)			
Black or African-American	81 (47)		
White or Caucasian	54 (31)		
Asian or Pacific Islander	32 (18)		
Hispanic or Latino	6 (3)		
American Indian	1 (1)		

Table 2. Descriptive Statistics of Study Variables

Variable	All Students (n=174)	African-Americans (n=81)	NonAfrican-Americans (n=93)
Prior Biochemistry, n (%)			
Yes	88 (51)	44 (54)	44 (47)
No	86 (49)	37 (46)	49 (53)
Pharm Tech, n (%)			
Yes	82 (47)	36 (44)	46 (49)
No	92 (53)	45 (56)	47 (51)
Years of Pharm Tech, Mean (SD)	1.6 (2.3)	1.4 (2.4)	1.6 (2.3)
Prereq completed in 4 year university/college	107 (61)	47 (58)	60 (64)
Prereq cum GPA, Mean (SD)	3.35 (0.29)	3.39 (0.29)	3.33 (0.29)
PCAT, Mean (SD)			
Biology[a]	67 (19)	65 (18)	68 (19)
Chemistry[a]	64 (19)	66 (19)	63 (19)
Reading[a]	43 (23)	36 (22)	49 (22)
Verbal[a]	55 (23)	52 (23)	58 (23)
Quantitative[a]	50 (22)	47 (19)	53 (23)
Essay[b]	3 (0.4)	3 (0.5)	3 (0.4)
Problem Solving[b]	3 (0.5)	3 (0.5)	3 (0.4)
Campus Interview, Mean (SD)			
Interview Scores	20 (2)	20 (2)	20 (1)
Observational Scores	4 (0.6)	4 (0.6)	4 (0.5)
Raw Score, Mean (SD)			
P1 Didactic	87 (5)	86 (5)	87 (5)
P2 Didactic	84 (7)	82 (8)	85 (5)
Cum Didactic	85 (5)	84 (6)	86 (5)
P1 Experiential	91 (7)	89 (8)	92 (5)
P2 Experiential	92 (12) (n=166)	91 (13) (n=76)	93 (11) (n=90)
P3 Experiential	93 (5) (n=112)[c]	92 (5) (n=51)[c]	94 (4) (n=61)[c]
Cum Experiential	92 (6) (n=174)	90 (6) (n=81)	93 (5) (n=93)

A/H/P=Applied, Health, or Physical Science; P1=first year; P2=second year; P3=third year; n=sample size; Pharm Tech=Pharmacy Technician Experience; cum=cumulative; prereq=prerequisite

[a]Percentile rank;

[b]Earned scores;

[c]Does not include third cohort who were still in APPEs at the time of study

A subanalysis of the African-American students indicated that the combined independent variables significantly ($p<0.05$) predicted the P2 and cumulative didactic performance (models 9 and 10, respectively). Prerequisite cumulative GPA made significant positive contributions in models 9 ($\beta=0.32$) and 10 ($\beta=0.34$). The PCAT reading score made significant contributions in models 9 ($\beta=0.23$) and 10 ($\beta=0.20$). For nonAfrican-Americans, these independent variables significantly ($p<0.05$) predicted P1, P2, and cumulative didactic performance (models 15, 16, and 17) and the P3 experiential performance (model 20). Prerequisite cumulative GPA had made significant positive contributions with β of 0.26 in both models 16 and 17.

Additionally, PCAT reading scores made a significant positive contribution in models 16 ($\beta=0.42$) and 17 ($\beta=0.37$). For model 15, only prerequisite cumulative GPA made a significant positive contribution ($\beta=0.22$). For experiential, both prerequisite cumulative GPA ($\beta=0.26$) and interview scores ($\beta=0.28$) made significant positive contributions in model 20. Furthermore, the effect size was determined using a Cohen's f^2 (Table 3). There were two models with a small effect size (models 4 and 5), 12 models with a medium effect size (models 1-3,6-8,11,12,14,18,19,21) and seven models with a large effect size (models 9,10,13,15-17,20).

Table 4 shows correlations between independent variables (PCAT scores and prerequisite cumulative GPAs) and academic performance. The P2 experiential performance was excluded from Table 4 because it did not result in any significant positive correlations. The positive correlations between didactic performance and PCAT scores ranged from 0.17 to 0.25. For didactic performance and prerequisite cumulative GPA, positive correlations

Table 3. Multiple Regression of All Admissions Criteria on Didactic and Experiential Performance

Model	Academic Performance	R^2	Cohen's f^2	F	*p* value
All Students					
1	P1 Didactic (n=174)	0.19	0.23	3.16	<0.01[b]
2	P2 Didactic (n=174)	0.22	0.28	3.64	<0.01[b]
3	Cum Didactic (n=174)	0.23	0.30	3.94	<0.01[b]
4	P1 Experiential (n=174)	0.12	0.14	1.86	0.04[a]
5	P2 Experiential (n=166)	0.09	0.10	1.33	0.21
6	P3 Experiential (n=112)[c]	0.18	0.22	1.92	0.04[a]
7	Cum Experiential (n=174)	0.17	0.20	2.81	<0.01[b]
African-American					
8	P1 Didactic (n=81)	0.22	0.28	1.62	0.19
9	P2 Didactic (n=81)	0.22	0.39	2.18	0.02[a]
10	Cum Didactic (n=81)	0.27	0.37	2.11	0.02[a]
11	P1 Experiential (n=81)	0.14	0.16	0.92	0.54
12	P2 Experiential (n=76)	0.15	0.18	0.93	0.53
13	P3 Experiential (n=51)[c]	0.29	0.41	1.41	0.19
14	Cum Experiential (n=81)	0.22	0.28	1.53	0.14
NonAfrican-American					
15	P1 Didactic (n=93)	0.28	0.39	2.69	<0.01[b]
16	P2 Didactic (n=93)	0.27	0.37	2.46	<0.01[b]
17	Cum Didactic (n=93)	0.31	0.45	2.99	<0.01[b]
18	P1 Experiential (n=93)	0.22	0.28	1.83	0.06
19	P2 Experiential (n=90)	0.18	0.22	1.48	0.15
20	P3 Experiential (n=61)[c]	0.34	0.52	2.04	0.04[a]
21	Cum Experiential (n=93)	0.18	0.22	1.53	0.13

P1=first year; P2=second year; P3=third year; cum= cumulative; n=sample size
[a]Significant at $p<0.05$
[b]Significant at $p<0.01$
[c]Does not include third cohort who were still in APPEs at the time of study

ranged from 0.25 to 0.29. For African-American students, significant positive correlations ranged from 0.22 to 0.26 for didactic performance and prerequisite cumulative GPA, while significant positive correlations ranged from 0.24 to 0.28 for didactic performance and PCAT essay and problem solving.

For nonAfrican-American students, significant positive correlations ranged from 0.34 to 0.37 for didactic performance and prerequisite cumulative GPA while significant positive correlations ranged from 0.22 to 0.35 for didactic performance and PCAT chemistry, reading, and quantitative scores. There were no significant positive correlations between prior biochemistry coursework, interview, or observational scores and didactic performance, except for pharmacy technician experience, which had a negative effect on the P1 didactic performance of all students and the P1 didactic performance of nonAfrican-American students.

For students' experiential performance, none of the PCAT scores, prerequisite cumulative GPA, or prior biochemistry coursework showed significant positive correlations. However, significant positive correlations were observed between pharmacy technician experience, interview, and observational scores, with experiential performance ranging from 0.22 to 0.26. For African-American students, significant positive correlations ranged from 0.30 to 0.31 for experiential performance and observational score and previous pharmacy technician experience. For nonAfrican-American students, significant positive correlations ranged from 0.21 to 0.30 for experiential performance and previous biochemistry coursework, pharmacy technician experience, interview, and observational scores.

DISCUSSION

The model results from the regression analyses indicated that combining PCAT, GPA, interview, and observational scores, previous pharmacy technician experience, and biochemistry coursework were successful in predicting students' didactic performance and the P1, P3, and cumulative experiential performance (models 1-4, 6, and 7). The combined variables had a medium effect on didactic performance and on P3 and cumulative experiential performance. The data suggest that the

Table 4. Correlations between Admissions Criteria and Academic Performance for the African-American (AA) Students and NonAfrican-American (NAA) Students in the P1, P2 and P3 Years (values shown are Pearson's correlation, r)

	Didactic (All Students)			Didactic (AA Students)			Didactic (NAA Students)			Experiential (All Students)			Experiential (AA Students)			Experiential (NAA Students)		
	P1	(n) P2	Cum	P1	(n) P2	Cum	P1	(n) P2	Cum	P1	(n) P3[c]	Cum	P1	(n) P3[c]	Cum	P1	(n) P3[c]	Cum
	(174)	(174)	(174)	(81)	(81)	(81)	(93)	(93)	(93)	(174)	(112)	(174)	(81)	(51)	(81)	(93)	(61)	(93)
Cum GPA	0.27[b]	0.25[b]	0.29[b]	0.23[a]	0.22[a]	0.26[a]	0.34[b]	0.35[b]	0.37[b]	*	*	*	*	*	*	*	*	*
Bio	0.17[a]	*	*	*	*	*	*	*	*	-0.15[a]	*	-0.15[a]	*	-0.31[a]	*	*	*	-0.23[a]
Chem	0.18[a]	*	*	*	*	*	0.26[a]	*	0.23[a]	-0.23[b]	-0.19[a]	-0.23[b]	*	-0.27[a]	-0.24[a]	*	*	*
Reading	*	0.22[b]	0.21[b]	*	*	*	0.31[b]	0.33[b]	0.35[b]	*	*	*	*	*	*	*	*	*
Verbal	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Quant	0.23[b]	0.22[b]	0.25[b]	*	*	*	0.30[b]	0.22[a]	0.27[b]	*	*	*	*	*	*	*	*	*
Essay	*	0.18[a]	*	*	0.24[a]	*	*	*	*	*	*	*	*	*	*	*	*	*
Prob Solv	0.18[a]	0.17[a]	0.19[b]	0.28[a]	*	0.27[a]	*	*	*	*	*	*	*	*	*	*	*	*
Interview	*	*	*	*	*	*	*	*	*	0.22[b]	*	0.22[b]	*	*	*	0.28[b]	0.30[a]	*
Obs	*	*	*	*	*	*	*	*	*	*	0.24[a]	*	*	0.31[a]	*	0.24[a]	*	*
Bio-Chem	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0.21[a]	*	*
Pharm Tech	-0.17[a]	*	*	*	*	*	-0.28 [b]	*	-0.26 [a]	0.26[b]	*	0.26[b]	0.30[b]	*	0.31[b]	0.22[a]	*	0.22[a]

P1=first year; P2=second year; P3=third year; Cum=cumulative; Exp=Experiential; BioChem=previous biochemistry course; Obs=Observational Score; PharmTech=Pharmacy Technician Experience; Cum GPA=prerequisite cumulative GPA; PCAT Bio=PCAT biology score; PCAT Chem=PCAT chemistry score; PCAT Prob Solv=PCAT problem solving score; PCAT Quant=PCAT quantitative score; n=sample size

*Not significant at $p<0.05$

[a]Significant $p<0.05$

[b]Significant $p<0.01$

[c]Does not include third cohort who were still in advanced pharmacy practice experiences at the time of study

combined admissions criteria have more predictive value on the cumulative didactic performance, with a Cohen's f^2 value of 0.30 (model 3). However, this combination was unsuccessful in predicting the students' P2 experiential performance (model 5).

The correlation results shown in Table 4 indicate that the prerequisite cumulative GPA, and PCAT quantitative and problem solving scores were the only admissions criteria that showed significant positive correlations throughout the didactic curriculum. The prerequisite cumulative GPA predicted the P1, P2, and cumulative didactic performance, which is consistent with its significant contributions in models 1, 2, and 3. This was in contrast to the findings of Unni et al, whose study was also conducted at a 3-year pharmacy program, in that the prerequisite cumulative GPA was not a predictor of P1 or P2 academic performance.[21] However, our results were consistent with those of Unni et al in that the prerequisite cumulative GPA was not a predictor of P3 experiential performance. Because the type of institution where students in this study received their prerequisite GPA was not a significant factor, a high prerequisite cumulative GPA seems to have prepared students well for the concentrated nature of the UMES-SOP curriculum.

The PCAT quantitative and problem-solving scores were the only PCAT variables that showed significant positive correlations with P1, P2, and cumulative didactic performance. This result highlights the significance of the PCAT quantitative variable because the school's curriculum includes pharmaceutics and pharmacy calculations in the P1 and P2 years. These courses require a strong math background. For the P1 year, the significant positive correlations of the PCAT biology and chemistry scores are consistent with the science-based nature of the P1 year curriculum at the school. The significant positive correlation of PCAT reading with the P2 and cumulative didactic performance suggests the importance of reading skills.

The student's reading level becomes significantly more important in the P2 year of an accelerated 3-year pharmacy program where they are expected to read and comprehend the pharmacotherapy course material in a shorter amount of time. Thus, students who have difficulty reading and understanding required reading assignments may perform poorly during assessments, which are mostly case-based questions. A study in a 4-year pharmacy program has shown there is a disparity between P3 pharmacy students' (equivalent to a P2 student in a 3-year program) mean reading level and that of the pharmacy reading materials assessed.[31] Additionally, PCAT essay showed a significant positive correlation with P2 didactic performance.

This study suggests that although PCAT writing scores (problem solving and essay) were not significant factors in predicting first-year didactic performance, they serve as useful indicators of the students' language and communication skills. These skills become significantly more important in the P2 year. There was no significant positive correlation between PCAT verbal and didactic performance. This result is consistent with the findings of Meagher et al, who found no significant effect of PCAT verbal on first-year to fourth-year GPAs of pharmacy students.[6]

In contrast, the prerequisite cumulative GPA and PCAT scores showed no significant positive correlations with the experiential performance. However, based on the regression analysis, previous pharmacy technician experience made significant contributions in models 4 and 7 (ie, P1 and cumulative experiential performance) respectively. In their study conducted at a 4-year pharmacy program, Kidd and Latif found that PCAT composite score did not predict fourth-year experiential performance.[4]

Our results suggest that additional admissions measures for experiential success are needed in order to ensure the students' overall academic success. In a 3-year pharmacy program, this is critical because the practice experiences occur concurrently with the didactic courses. Students are expected to be able to transition from the classroom to the practice environment seamlessly while successfully passing the didactic modules in a concentrated pharmacy program. This may pose a challenge to some students. The interview and observational assessments serve this purpose. The observational score showed a positive correlation with P3 experiential performance, while the interview score showed positive correlations with P1 and cumulative experiential performance.

In addition to assessing students' motivation, professionalism, communication skills, interpersonal skills, and leadership skills, the interview and observational questions also assessed applicants' ability to meet UMES-SOP technical standards. This set of skills was evaluated during students' practice experiences. Those results implied that a tool with a high potential for subjectivity may be used to determine students who will likely be successful in the experiential component of the curriculum, which is similar to the findings of Hardigan et al.[8] Additionally, those results emphasized the importance of the interview process and the need for faculty engagement in and training for that process. A piece of information not readily available to the UMES-SOP faculty interviewers, unless mentioned by the applicant, was the applicant's previous pharmacy technician experience. Generally, an applicant with previous pharmacy technician experience was better able to answer situation-based interview

questions by using relevant pharmacy examples. Consequently, applicants who have previous pharmacy technician experience could potentially be viewed more favorably and may have received higher evaluation scores during the interview process.

Our results show a positive correlation between previous pharmacy technician experience and P1 and cumulative experiential performance, and a negative correlation with the P1 didactic performance. Based on feedback from students in the program, prior biochemistry coursework helped them perform better in first-year courses. This could be because courses offered early in the fall semester of the P1 year incorporate principles of biochemistry, cell biology, and enzymology. However, our results showed no significant positive correlation between prior biochemistry experience and didactic performance.

The PCAT multiple-choice subtests scores (ie, biology, reading, verbal, and quantitative) were lower for African-American students compared with the scores of nonAfrican-American students, except for PCAT chemistry (Table 2). However, our results suggest that the P1 and cumulative didactic performance of African-American students were similar to nonAfrican-American students despite the lower baseline admission criteria. This is similar to the study by Caroll et al, which found that African-American students scored lower on PCAT verbal and reading than nonAfrican-American students, and that these differences did not translate to differences in student success as measured by their final grade. The study by Caroll, et al, however, had a smaller population of African-Americans students (27% of 147).[32]

In contrast, 47% of the total 174 students included in our study were African-American. Studies of medical students also have shown that standardized admissions test results may not adequately predict the academic performance of African-American students. White et al showed that MCAT scores did not predict the performance of minority students in the first year of medical school but did predict performance of majority students.[33]

Additionally, Davis et al's comprehensive review of the MCAT showed that black examinees had lower average MCAT scores than white examinees.[34] This mirrored differences on other admissions standardized tests.[35-37] However, the black examinees subsequently performed adequately on selected medical school performance indicators.[34] This suggested that medical students were selected on the basis of a combination of attributes and competencies rather than on MCAT scores alone.

A national survey found that health professions schools reported an overall positive impact from the use of holistic admissions review.[38] The majority of these schools reported an increase in diversity, while measures of student success were largely unchanged or, in many cases, improved. The schools' approach not only included traditional measures of academic achievement such as the applicant's grades and test scores but also assessed an applicant's unique experiences and attributes.[38]

The regression analyses (Table 3) indicate that combining PCAT, GPA, interview and observational scores, previous pharmacy technician experience, and biochemistry coursework was successful in predicting the nonAfrican-American students' P1, P2, and cumulative didactic performance (models 15-17). However, it was only successful in predicting the African-American students' P2 and cumulative didactic performance (models 9 and 10). The combined variables had a large effect on the didactic performance for both subgroups.

For the experiential performance of the subgroups, this combination was only successful in predicting the P3 experiential performance of the nonAfrican-American students. The prerequisite cumulative GPA was the only admissions variable that positively correlated with both of the subgroups' didactic performance. This is consistent with the significant positive contribution made by prerequisite cumulative GPA in models 9 and 10 for African-American students and models 15-17 for nonAfrican-American students. However, the prerequisite cumulative GPA had relatively stronger positive correlations with the nonAfrican-American students' didactic performance (r values ranged from 0.34 to 0.37) compared with African-American students (*r* values ranged from 0.22 to 0.26) (Table 4). Of the PCAT subtests, only the PCAT written subtests (ie, essay and problem solving) showed significant positive correlations with the African-American students' didactic performance.

The PCAT problem solving correlated with P1 and cumulative didactic performance, while PCAT essay correlated with P2 didactic performance of African-American students. However, PCAT multiple-choice subtests (ie, biology, chemistry, reading, verbal, and quantitative) did not correlate with the African-American students' didactic performance (Table 4). These results were not consistent with previous studies conducted in 4-year programs where PCAT reading, chemistry, and quantitative scores were found to be predictors of academic success for minority students.[22,27,28] Although African-Americans made up a large percentage of those study populations, other minorities (eg, Hispanic, Asian, and Native American) also were included. Additionally, in those studies, academic success was defined either in terms of first-year GPA only,[22,27] or using the students'

current cumulative GPA.[28] In our study, PCAT reading positively correlated with the nonAfrican-American students' P2 and cumulative didactic performance, which is consistent with the significant positive contributions made by PCAT reading in models 16 and 17.

None of the GPA and PCAT scores showed positive correlations with experiential performance. The only significant predictors of the two subgroups' experiential performance were previous pharmacy technician experience, interview, and observational scores. A positive correlation was shown with previous pharmacy technician experience with P1 and cumulative experiential performance of African-American students. The observational score, which may be affected by the students' pharmacy experience, showed a positive correlation with P3 experiential performance of African-American students. Based on these results, previous pharmacy technician experience may be considered as an admissions criteria, as this experience provides students with the basic dispensing skills, drug knowledge, interpersonal, and critical-thinking skills, all of which are critical during practice experiences.

Pharmacy technician experience was more important for African-American students than nonAfrican-American students. For the nonAfrican-American students, a positive correlation was observed between interview score and P3 experiential performance and between pharmacy technician experience and cumulative experiential performance. However, for nonAfrican-American students, the P1 experiential performance showed significant positive correlations with the interview and observations scores, biochemistry coursework, and pharmacy technician experience. Based on these data, changes to the admissions criteria at UMES-SOP will be considered to allow greater weighting of factors shown to correlate with academic performance.

This study had several limitations. The difference between US born and nonUS born, citizen, permanent-resident, and student-visa black students with regard to their command of the English language was not evaluated. The previous pharmacy technician experience varied greatly among entering pharmacy students. For instance, this study did not classify previous pharmacy experience in terms of setting, which may have affected the quality of the pharmacy work experience. How recently the students had their previous pharmacy technician experience also was not considered. The level and number of biochemistry courses students had taken before pharmacy school was not considered. The institution where students had taken their biochemistry and how recently they took the course also were not considered.

CONCLUSION

Using traditional measures of academic achievement, such as the prerequisite cumulative GPA and PCAT scores, were predictors of students' didactic success. In particular, PCAT biology and chemistry were predictors of P1 didactic performance and PCAT reading of P2 didactic performance. In addition to prerequisite cumulative GPA, the only predictors for African-American students' didactic performance were PCAT writing scores (problem solving and essay). The observational scores and previous pharmacy technician experience were predictors of experiential performance, particularly among African-American students. Further studies are needed to evaluate other potentially relevant characteristics, such as motivation, communication skills, and study habits, that may better predict students' overall academic success, particularly that of African-American students, in a concentrated pharmacy program.

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