Predicting the Academic Performance of Pharmacy Students at a Predominantly Black Institution

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INTRODUCTION

The topic of predicting academic performance of students in higher education has been researched and reported on extensively. For the most part, these data have traditionally resulted from studies involving nonminority college students. Because of the lack of literature on the performance of undergraduate minority pharmacy students and the growing concern for equality of representation of minority groups, it is important to explore factors that could be used to predict academic performance in this student population.

The term "minorities" in this study includes Black Americans, Hispanic Americans, Asian Americans, American Indians, and Black students and Asian students from other countries. Minority pharmacy graduates in Texas made up about 49% of all pharmacy graduates in Texas during the 1988-89 academic year. Among these, Blacks made up about 7% (1). The total number of pharmacy graduates (B.S. level) at Texas Southern University for the 1988-89 academic year ($n = 44$) was far smaller than that for the other two pharmacy schools in Texas, the University of Houston ($n = 96$), and

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the University of Texas ($n = 162$) (1). The retention rates for minority students in higher education, particularly Blacks, are lower than the rates for majority students (2). This is obviously a great loss of human potential; thus, it is crucial that steps be taken to understand factors that help us to predict the academic performance of these students. By identifying these factors, we can design and implement programs aimed at meeting the academic needs of minority students. Increasing the academic success of minority pharmacy students may lead to a higher number of minority pharmacy students in graduate programs.

Previous study of predicting the success of pharmacy students has indicated that the predictors for pharmacy students differed significantly among the ethnic groups. For both Black and Asian pharmacy students, the Pharmacy College Admission Test (PCAT) reading comprehension score and prepharmacy GPA were found to be the first two significant predictors of pharmacy school GPA (3). On the other hand, prepharmacy GPA and the PCAT biology score were found to be the first two significant predictors of pharmacy school GPA for White pharmacy students (3). This indicated that the ability to read and understand written English is more important for the pharmacy school achievement of Black and Asian pharmacy students than for White pharmacy students. In other health professions, predictors of academic performance of minority students were also different from those of nonminority students (4).

Since PCAT scores are one of the criteria used in admitting students into pharmacy programs, many studies have reported the predictive power of both PCAT scores and prepharmacy GPA on pharmacy school GPA (3, 5-14). Findings of these studies were different among several pharmacy schools. Overall, it was found that different subjects of the PCAT–such as reading comprehension, chemistry, and biology–and prepharmacy GPA were the best predictors of academic performance among different groups of pharmacy students. However, most of these results were based on nonminority pharmacy students (5-14).

Although the PCAT reading comprehension score has been found to be the best predictor of Black and Asian pharmacy students' academic performance, cross-validation with new student samples is still recommended (3, 14). While one study has already

identified predictors of academic performance among several ethnic groups, the sample of that study was limited to a small number of Black pharmacy students ($n = 54$), and no Hispanic Americans or Black and Asian pharmacy students from other countries were included (3). In addition, many studies in this area were focused only on first professional year pharmacy students (5, 8, 10, 13). To overcome these two drawbacks, this study was designed to include a larger number of Black pharmacy students ($n = 131$) and other ethnic minorities, including Hispanic ($n = 11$) and Asian ($n = 14$) pharmacy students, in all three professional years.

Study Objectives

The objectives of this study were:

1. To identify factor(s) that can be used to predict minority pharmacy students' academic performance.
2. To determine the relationships between minority pharmacy students' academic performance and the factors examined in this study (prepharmacy GPA, pharmacy school GPA, and PCAT scores).

Study Hypotheses

Based on previous findings, two hypotheses were tested in this study:

H_1: Prepharmacy GPA is one of the two best predictors of minority pharmacy students' academic performance.
H_2: The PCAT reading comprehension score is one of the two best predictors of minority pharmacy students' academic performance.

METHODOLOGY

Subjects were pharmacy students who entered the College of Pharmacy and Health Sciences at Texas Southern University, a

predominantly Black institution, between 1983 and 1990. All pharmacy students in the sample were admitted into the first professional year at the school. The Admission Committee of the school uses PCAT scores and prepharmacy GPA as two of five criteria for the basis of their recommendations. As a result, students in the sample were assumed to have taken the PCAT during or after the prepharmacy experience.

Data were obtained from pharmacy school records in the spring of 1991. A total of 302 pharmacy student files were audited. The students' status (first, second, or third professional year); current cumulative GPA; prepharmacy GPA; semester entered; year admitted to pharmacy school; and PCAT scores on verbal ability, reading comprehension, biology, chemistry, quantitative ability total, arithmetic skills, and mathematical reasoning were obtained. Based on the audit, a total of 159 pharmacy students were included in the sample. Pharmacy students who did not have complete data on the variables of interest were not included in the study sample. The PCAT percentile scores were used in this study because of their comparative values. The school records were used because it is believed that they provide more accurate data than self-reports. However, no demographic data was obtained due to student confidentiality.

To provide ethnic information for the students in the sample, data from the pharmacy school record were used (15). Of the total number of pharmacy students (n = 302) in fall 1991, 53% were Black, 7% were Hispanic, 2% were White, and the remaining 38% were international students. The majority of international students in the pharmacy program at Texas Southern University were Black students from Nigeria (77%), and the remaining students were from Vietnam (23%). These ethnic statistics were used to estimate the number of ethnic minorities in the study sample. Based on 159 pharmacy students in the sample, there were 85 Black Americans, 11 Hispanic Americans, 3 White Americans, 46 Black Nigerians, and 14 Vietnamese.

Data obtained were coded and then keypunched into the computer. Data analyses were performed using PC-SAS (Personal Computer Statistical Analysis Software), and an alpha level of .05 was chosen as the level of significance to be used in the study. Frequen-

cy counts, means, and standard deviations were computed for all continuous variables. *T*-tests were used to compare the continuous variables between the two groups. Finally, Pearson correlation tests were used to determine the intercorrelations among the factors examined, and forward stepwise regression analyses were performed to select the best predictor(s) of pharmacy students' academic performance.

RESULTS

Sample Description

Table 1 shows the number of pharmacy students categorized by professional year and year entered into the pharmacy program. For descriptive analyses of the factors examined, Table 2 shows the means and standard deviations of pharmacy students' cumulative GPA; prepharmacy GPA; and PCAT scores on verbal ability, reading comprehension, biology, chemistry, quantitative ability total, arithmetic skills, and mathematical reasoning. On average, students' prepharmacy GPA (mean = 2.82 ± 0.46) was higher than their cumulative GPA (mean = 2.61 ± 0.45). Pharmacy students in the sample had the highest scores on the PCAT biology section (mean = 33.38 ± 24.26) and the lowest scores on the PCAT quantitative ability total (mean = 15.56 ± 20.02). The score for the quantitative ability total section is a composite of the scores achieved in the arithmetic skills (mean = 18.25 ± 21.37) and mathematical reasoning (mean = 18.13 ± 20.73) sections.

Table 1: Number of Pharmacy Students categorized by Professional Year and Year Entered

	Professional Year			
Year Entered	First	Second	Third	Total
1983	0	1	0	1
1986	0	4	0	4
1987	0	13	0	13
1988	0	28	4	32
1989	2	48	0	50
1990	58	1	0	59
Total	60	95	4	159

Table 2: Descriptive Statistics

Variable	N	Mean±SD
GPA		
Cumulative GPA	159	2.61±0.45
Prepharmacy GPA	159	2.82±0.46
PCAT Scores		
Verbal Ability	159	21.00±24.66
Reading Comprehension	159	20.31±23.02
Biology	159	33.38±24.26
Chemistry	159	21.06±19.57
Quantitative Ability Total	159	15.56±20.02
Arithmetic Skills	159	18.25±21.37
Mathematical Reasoning	159	18.13±20.73

Grade Point Average by Professional Year

Of the 159 students, 60 (37.7%) were in the first professional year, 95 (59.8%) were in the second professional year, and 4 (2.5%) were in the third professional year. Due to the very low number of pharmacy students in the third professional year, only the results of the first and second professional years were compared. *T*-tests were used to compare the mean cumulative GPA and the mean prepharmacy GPA of the two groups. There were significant differences between the first professional year and the second professional year pharmacy students in both the cumulative GPA and the prepharmacy GPA. In both cases, the mean cumulative GPA (mean = 2.80 ± 0.44) and the mean prepharmacy GPA (mean = 2.92 ± 0.40) of the first professional year pharmacy students were significantly higher than the mean cumulative GPA (mean = 2.47 ± 0.40) and the mean prepharmacy GPA (mean = 2.74 ± 0.48) of the second professional year pharmacy students (Table 3).

PCAT Scores by Professional Year

As shown in Table 3, significant results were also found in the PCAT quantitative ability total ($p < 0.01$), arithmetic skills ($p < 0.05$), and mathematical reasoning ($p < 0.01$) for pharmacy students in the first and second professional years. In all cases, the first professional year pharmacy students performed significantly better

Table 3: Descriptive Statistics by Professional Year

Variable	Mean±SD		
GPA	First	Second	p
Cumulative GPA	2.88±0.44	2.47±0.40	p<.01
Prepharmacy GPA	2.92±0.40	2.74±0.48	p<.05
PCAT Scores			
Verbal Ability	21.40±25.65	20.98±24.21	NS
Reading Comprehension	20.63±24.19	19.88±21.90	NS
Biology	30.78±22.27	34.06±25.19	NS
Chemistry	21.43±19.52	19.71±18.52	NS
Quantitative Ability Total	20.53±22.07	11.65±16.39	p<.01
Arithmetic Skills	22.98±23.22	14.65±18.29	p<.05
Mathematical Reasoning	23.00±23.20	14.08±16.90	p<.01

NS=Not statistically significant

than the second professional year pharmacy students. No significant differences were found in the PCAT verbal ability, reading comprehension, biology, and chemistry scores of pharmacy students in the two professional years.

Correlations Among the Factors Examined

Table 4 shows the correlation matrix of nine factors (cumulative GPA, prepharmacy GPA, and seven PCAT scores) examined in the study. According to Table 4, Pearson correlation coefficients indicated a medium positive correlation between pharmacy students' pharmacy school GPA (cumulative GPA) and their prepharmacy GPA ($r = 0.48$) and between pharmacy school GPA and several PCAT scores: quantitative ability total ($r = 0.50$), arithmetic skills ($r = 0.46$), and mathematical reasoning ($r = 0.47$). On the other hand, correlations between pharmacy students' prepharmacy GPA and PCAT scores were not as strong as the correlations between pharmacy school GPA and PCAT scores. Only one negative correlation was found; this was between pharmacy students' prepharmacy GPA and PCAT verbal ability score ($r = -0.02$). It appeared that students' prepharmacy GPA did not correlate well with their PCAT verbal ability ($r = -0.02$), reading comprehension ($r = 0.0$), and biology ($r = 0.05$) scores.

Table 4: The Correlation Matrix

CUMGPA	PREGPA	VA	RC	BIO	CHEM	QAT	AS	MR
CUMGPA 1.0	.48	.22	.17	.25	.44	.50	.46	.47
PREGPA	1.0	-.02	0.0	.05	.23	.24	.18	.22
VA		1.0	.57	.48	.39	.18	.20	.15
RC			1.0	.44	.45	.28	.25	.27
BIO				1.0	.56	.26	.22	.27
CHEM					1.0	.50	.45	.52
QAT						1.0	.92	.94
AS							1.0	.76
MR								1.0

CUMGPA-Cumulative GPA
PREGPA-Prepharmacy GPA
VA-Verbal Ability
RC-Reading Comprehension
BIO-Biology
CHEM-Chemistry
QAT-Quantitative Ability Total
AS-Arithmetic Skills
MR-Mathematical Reasoning

Predictors of Academic Performance

Forward stepwise regression analyses were used to select the best predictor(s) of pharmacy students' academic performance. In this case, current cumulative GPA was used as the dependent variable (predicted variable), while prepharmacy GPA and the PCAT scores for verbal ability, reading comprehension, biology, chemistry, quantitative ability total, arithmetic skills, and mathematical reasoning were used as the independent variable (predictors) of the dependent variable. The forward stepwise method first selects the predictor that accounts for the most variance of the dependent variable. Then, the second best predictor is selected and added to the model. This process continues until there is no other best predictor for the dependent variable.

Based on the analyses, quantitative ability total was the best predictor of cumulative GPA ($R^2 = 25.08\%$). Further analyses were performed to determine the association between prepharmacy GPA and PCAT scores using prepharmacy GPA as the dependent variable and PCAT scores as the independent variables. Quantitative ability total was again the best predictor of prepharmacy GPA ($R^2 = 5.62\%$). Quantitative ability total had higher predictive power for cumulative GPA (pharmacy school GPA) than prepharmacy GPA. Table 4 shows the results of forward stepwise regression analyses

for both cumulative GPA and prepharmacy GPA. As indicated in Table 4, the PCAT reading comprehension score was the poorest predictor of pharmacy students' cumulative GPA, and the PCAT biology score was the poorest predictor of pharmacy students' prepharmacy GPA.

LIMITATIONS

The results of this study are limited to only one pharmacy school which is a predominantly Black institution. The sample for this study was comprised of Black ($n = 46$) and Asian ($n = 14$) international students and only 2% White American students ($n = 3$). Generalization of the results is limited to the ethnic groups represented in the study.

DISCUSSION AND CONCLUSIONS

The first hypothesis (H_1) was accepted. Prepharmacy GPA was found to be one of the two best predictors of pharmacy school GPA. On the other hand, the second hypothesis (H_2) was rejected. In this study, the PCAT quantitative ability total score was the best predictor of pharmacy school GPA, while the PCAT reading comprehension score was the poorest predictor of pharmacy school GPA (Table 5).

When we compared the results of this study with those of a previous study, our results were different (3). In the previous study, the PCAT reading comprehension score and prepharmacy GPA were the two best predictors of pharmacy school GPA for both Black ($n = 54$) and Asian ($n = 96$) pharmacy students. In our study ($n = 159$), we found that the PCAT quantitative ability total score and prepharmacy GPA were the two best predictors of pharmacy school GPA for pharmacy students in the sample and that the PCAT reading comprehension score was the poorest predictor of pharmacy school GPA. The difference found in the two studies may be accounted for by the difference in the sample size or the difference between the two pharmacy schools where the samples were drawn.

Table 5: Forward Stepwise Regression Analyses for Cumulative GPA and Prepharmacy GPA

CUMULATIVE GPA

Step	Variable	R^2	F	p
1	Quantitative Ability Total	25.08%	52.57	<.01
2	Prepharmacy GPA	39.08%	50.03	<.01
3	Chemistry	42.06%	37.51	<.01
4	Verbal Ability	42.97%	29.01	<.01
5	Reading Comprehension	43.35%	23.42	<.01

PREPHARMACY GPA

Step	Variable	R^2	F	p
1	Quantitative Ability Total	5.62%	9.35	<.01
2	Chemistry	7.39%	6.22	<.01
3	Verbal Ability	8.78%	4.97	<.01
4	Arithmetic Skills	9.25%	3.93	<.01
5	Mathematical Reasoning	11.58%	4.01	<.01
6	Reading Comprehension	12.13%	3.50	<.01
7	Biology	12.56%	3.10	<.01

As stated by Bandalos and Sedlacek, the effect of separate analyses for different racial groups with a small sample size in their study can limit both the validity and generalizability of their findings (3).

In attempting to account for the difference, separate analyses were performed for the first and the second professional year pharmacy students in our sample. It was found that quantitative ability total and prepharmacy GPA were still the best predictors of pharmacy school GPA for the first professional year pharmacy students. On the other hand, prepharmacy GPA and chemistry were the best predictors of pharmacy school GPA for the second professional year pharmacy students. The results of the third professional year cannot be obtained due to the small number of pharmacy students ($n = 4$) in this group. Table 6 shows results of the separate analyses by professional year using forward stepwise regression. It appears that the results from our separate analyses are different from the overall analyses. Therefore, if our sample was comprised of only pharmacy students from the first professional year or the second professional year, the results would be different.

It seems that different parts of the PCAT may be good predictors of cumulative GPA, depending on how far students have progressed in the curriculum. The predictive ability and the usefulness of the

Table 6: Separate Forward Stepwise Regression Analyses for Cumulative GPA by Professional Year

CUMULATIVE GPA (THE FIRST PROFESSIONAL YEAR)

Step	Variable	R^2	F	p
1	Quantitative Ability Total	31.41%	26.56	<.01
2	Prepharmacy GPA	36.39%	16.31	<.01
3	Chemistry	38.13%	11.50	<.01
4	Arithmetic Reasoning	39.42%	8.95	<.01

CUMULATIVE GPA (THE SECOND PROFESSIONAL YEAR)

Step	Variable	R^2	F	p
1	Prepharmacy GPA	23.52%	28.59	<.01
2	Chemistry	34.64%	24.38	<.01
3	Quantitative Ability Total	35.96%	17.03	<.01
4	Verbal Ability	37.02%	13.23	<.01
5	Reading Comprehension	39.02%	11.39	<.01

PCAT across schools, ethnic groups, and class year within schools are still questionable. Because of this, future studies with new student samples are strongly recommended. We should be more specific when discussing the association between the PCAT scores and pharmacy school GPA. The PCAT can be viewed as a combination of three different subjects: linguistics (verbal and reading comprehension), sciences (biology and chemistry), and mathematics (quantitative ability total, arithmetic skills, and mathematical reasoning). Our results seem to indicate that mathematics, as measured by the PCAT quantitative ability total score, is the best predictor for pharmacy school achievement of students in this study. This type of information can be used to help pharmacy school admission committees select those students who have the greatest potential for academic success. Generally speaking, different sections of the PCAT may be used as predictors of academic success in different groups of pharmacy students or in different ethnic groups. To further investigate the recent findings, researchers may wish to use a new student sample or examine the relationships between pharmacy school GPA and the GPA of math-related versus non-math-related pharmacy courses.

It seemed that there was a larger number of pharmacy students in the second professional year than in the first professional year, based on the fact that approximately 80 students were admitted

once a year to our pharmacy program in the fall semester. This may imply that most of the pharmacy students in this study were delayed or had some academic difficulties in the program at the second professional year level. As supported by the data in Table 3, pharmacy students in the second professional year also had significantly lower scores on the PCAT quantitative ability total, arithmetic skills, and mathematical reasoning than those in the first professional year.

It would be interesting to compare pharmacy students' academic performance within their own ethnic groups. Future studies could compare the academic performance of Black pharmacy students who are from countries other than the United States with that of Black American pharmacy students. The academic performance of Asian pharmacy students from other countries could be compared with that of Asian American students.

In conclusion, we found that the PCAT quantitative ability total score was the best predictor of pharmacy students' cumulative GPA in this study, while the seven PCAT scores were found to be poor predictors of pharmacy students' prepharmacy GPA. According to the results of this study, the PCAT quantitative ability total score and prepharmacy GPA could be used to predict minority pharmacy students' academic success in the pharmacy school, but their prepharmacy GPA may not be a good predictor of how well they will perform on the PCAT.

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