

# Predictors of Academic Performance in a Doctor of Pharmacy Training Program

Fred M. Cox  
Daniel W. Teat

## *INTRODUCTION*

One of the most difficult aspects of assessing prepharmacy students for possible acceptance into a school of pharmacy is determining which students are most likely to perform well within a given training program. Most schools and colleges of pharmacy have formal screening procedures and programs that generally involve review of personal background information, transcripts, Pharmacy College Admissions Test (PCAT) scores, and letters of recommendation and a personal interview.

Several studies have examined PCAT scores, alone or in conjunction with other variables, as predictors of pharmacy school grade point average (GPA) (1-8). These studies found that use of PCAT scores along with prepharmacy GPA resulted in significantly greater predictive power than the use of prepharmacy grades alone. However, no studies to date have examined these variables as predictors of academic performance for a new school that offers only the Pharm.D. as its undergraduate degree. Because entry-level Pharm.D. programs must meet certain basic curricular criteria that are different from those of B.S. programs, the correlations with

---

Fred M. Cox, Ph.D., is Vice Chairman and Assistant Professor and Daniel W. Teat, Pharm.D., is Director of Admissions and Continuing Education and Assistant Professor, Department of Pharmacy Practice, School of Pharmacy, Campbell University, Buies Creek, NC 27506.

academic success identified in earlier studies may not hold true in a Pharm.D. program (9).

The admission program of Campbell University's School of Pharmacy began in September 1985, with the school's opening. Since that time, the admissions process has developed into a formalized program for prepharmacy recruitment. Candidacy assessment centers around the activities of an Admissions Committee composed of six School of Pharmacy faculty members from the Admissions Office and Departments of Pharmacy Practice and Pharmacy Science. The committee is charged with selecting 65 to 70 students for acceptance from over 350 applications received annually (currently, Campbell enjoys the highest application-to-position ratio in the nation). All accepted students start the four-year Doctor of Pharmacy program during the fall semester.

Currently, Campbell recruitment activities for prepharmacy applicants are being directed at 287 colleges and universities throughout the United States. Recruitment of students is coordinated and personally conducted by the Director of Admissions within the School of Pharmacy. Application and admission requirements include completion of a core of required prepharmacy courses (Table 1), a cumulative prepharmacy GPA of 2.5, prepharmacy transcripts, three letters of recommendation, and a personal interview. Interviewing of prospective candidates is scheduled through the Admissions Office and conducted by an Admissions Committee member. As part of the interview process, pharmacy student volunteers are solicited to conduct tours of the school for prospective candidates and to answer questions from the student's perspective.

Admissions Committee meetings are held monthly, during which members present to the group their impressions of candidates interviewed during the past month. During these meetings, candidates are generally placed in one of four categories:

- Category I:      Unconditional acceptance (all prepharmacy academic requirements fulfilled, academic excellence, good letters of recommendation, PCAT scores on file, and a favorable interview)
- Category II:     Conditional acceptance (reserved for candidates who still lack completion of some ad-

- mission requirements—usually course work or PCAT—but show exemplary promise from academic work thus far and favorable interview and letters of recommendation)
- Category III: Alternate status (promising candidates who may not have academic credentials as strong as those in Categories I and II but who would likely perform well in the program)
- Category IV: Additional prepharmacy preparation recommended (candidates who will not have fulfilled admission criteria by the next fall semester and/or will benefit from additional or repeated academic course work)
- Category V: Rejection (candidates deemed unsuited to the rigors of the program).

Category III candidates generally are ranked and serve as alternates if a Category I or II student elects not to come or if slots remain unfilled by the selection deadline for the upcoming fall semester.

Since the program's inception, this approach has resulted in an enrollment of 241 students from 125 campuses located predominantly in the southeastern states of North Carolina, Virginia, Tennessee, South Carolina, and Georgia.

### **STUDY OBJECTIVES**

During spring 1989, discussion arose within the Admissions Committee regarding the identification of preadmissions indicators that correlate with good academic performance in the Campbell program. Specifically, the committee initiated a preliminary investigation of certain quantitative admissions criteria currently used (e.g., PCAT scores and entering GPA) and demographic information (e.g., age and sex) in relation to later achieved cumulative GPA in the Campbell program. The variables were selected for investigation because they were generally included in other studies (1-9).

The study was based on the following research question: Is there a correlation between selected admissions criteria and actual aca-

TABLE 1. Required Prepharmacy Courses

Course	Required Semester or Quarter Hours	
English composition	6	9
Literature	3	4 to 5
Religion	3	4 to 5
Fine arts	3	4 to 5
History	6	9
Economics	3	4 to 5
Physical education	2	3
Math (trigonometry or higher)	3	4 to 5
Physics	4	6
General chemistry	8	12
Organic chemistry	8	12
Biological sciences	8	12
Electives	7	10 to 11

ademic performance, as measured by the GPA achieved at the end of the first, second, and third years? At the time of the study, the first graduating class (1990) had not reached the fourth year.

## METHODS

Data were collected at the end of the spring semester in 1989 from the academic and admissions records of 178 students enrolled in 3 respective years of the Campbell program. Data gathered included cumulative prepharmacy GPA; raw PCAT scores (verbal ability, reading ability, biology, chemistry, quantitative ability, arithmetic ability, and mathematical ability); GPA achieved as of the end of the spring 1989 semester by the first year (graduating 1992), second year (graduating 1991), and third year (graduating 1990); sex; and year of birth (age).

Regression analysis was conducted using the PROC REG procedure of PC-SAS (version 6.03) in conjunction with the maximum  $R^2$  improvement method (MAXR) to determine which combination of independent variables comprises the best predictive model of achieved GPA (10). The maximum  $R^2$  improvement method was chosen because, unlike stepwise regression used in previous studies, MAXR attempts to find the best predictive model by adding only the variables that yield the greatest increase in  $R^2$  at each step (10, 11). Regression analysis was conducted for the total sample and for each of the three classes. Statistical significance is reported at  $p \leq 0.05$ .

## RESULTS

Table 2 describes the respective three classes included in the study with regard to gender. Tables 3 through 7 describe the results of regression analysis for the total sample and each of the respective three classes by PCAT section and best predictive model. This analysis indicated that only entering prepharmacy GPA and PCAT biology scores were significantly correlated with achieved GPA for the total sample and for the GPA attained by each of the classes (Table 7). MAXR analysis indicated that for the total sample, the 1991 class, and the 1992 class, entering GPA was placed in the model

TABLE 2. Gender Composition of Students by Graduating Class

<b>Class</b>	<b><u>N</u></b>	<b>Percentage</b>
Class of 1990		
Men	23	49.94
Women	24	51.86
Class of 1991		
Men	21	31.82
Women	45	68.18
Class of 1992		
Men	22	33.85
Women	43	66.15

TABLE 3. Correlations with Current GPA for All Students

Variable	<u>N</u>	<u><math>\bar{X}</math></u>	<u>SD</u>	<u>R</u>
Entering GPA	178	3.10	0.45	0.49
Total raw PCAT*	171	204.95	38.68	0.41
Verbal ability	171	44.50	12.90	0.22
Reading ability	171	32.09	5.97	0.38
Biology	171	27.84	6.66	0.48
Chemistry	171	30.00	7.97	0.31
Quantitative ability	171	35.17	8.63	0.28
Arithmetic ability	171	18.22	4.88	0.30
Mathematical ability	171	17.01	4.77	0.22
Sex†	178	*	*	0.09
Age	178	25.29	4.67	0.09

\*PCAT scores were not on file for seven students.

†Sex was coded as Men = 0 and Women = 1 for statistical purposes.

TABLE 4. Correlations with Current GPA for Class of 1990

Variable	<u>N</u>	<u><math>\bar{X}</math></u>	SD	<u>R</u>
Entering GPA	47	2.97	0.45	0.45
Total raw PCAT*	41	199.71	39.40	0.46
Verbal ability	41	42.46	12.10	0.30
Reading ability	41	31.95	5.52	0.33
Biology	41	28.56	6.54	0.46
Chemistry	41	29.53	7.81	0.26
Quantitative ability	41	33.43	8.63	0.42
Arithmetic ability	41	17.61	5.37	0.51
Mathematical ability	41	16.14	4.56	0.27
Sex†	47	*	*	0.16
Age	47	26.43	3.94	0.08

\*PCAT scores were not on file for six students.

†Sex was coded as Men = 0 and Women = 1 for statistical purposes.



TABLE 5. Correlations with Current GPA for Class of 1991

Variable	<u>N</u>	<u><math>\bar{X}</math></u>	<u>SD</u>	<u>R</u>
Entering GPA	66	3.07	0.42	0.60
Total raw PCAT*	65	203.86	41.16	0.41
Verbal ability	65	44.38	12.14	0.22
Reading ability	65	31.92	6.64	0.51
Biology	65	28.46	7.11	0.50
Chemistry	65	29.89	7.70	0.44
Quantitative ability	65	34.60	9.49	0.20
Arithmetic ability	65	17.56	5.16	0.16
Mathematical ability	65	17.03	5.34	0.19
Sex <sup>†</sup>	66	*	*	0.08
Age	66	24.83	4.14	0.07

\*PCAT scores were not on file for one student.

<sup>†</sup>Sex was coded as Men = 0 and Women = 1 for statistical purposes.

TABLE 6. Correlations with Current GPA for Class of 1992

Variable	<u>N</u>	<u><math>\bar{X}</math></u>	<u>SD</u>	<u>R</u>
Entering GPA	65	3.23	0.42	0.61
Total raw PCAT	65	209.35	35.66	0.46
Verbal ability	65	46.12	14.14	0.26
Reading ability	65	32.37	5.63	0.32
Biology	65	26.78	6.22	0.47
Chemistry	65	30.42	8.43	0.27
Quantitative ability	65	36.83	7.52	0.39
Arithmetic ability	65	19.27	4.10	0.40
Mathematical ability	65	17.55	4.26	0.31
Sex*	65	*	*	0.11
Age	65	24.93	5.52	0.07

\*Sex was coded as Men = 0 and Women = 1 for statistical purposes.

TABLE 7. Results of Regression Analysis for Prediction of Achieved GPA  
for Total Sample and by Class

Variable	$R^2$ for Model	F Value for Model*	B Estimates for Parameters
Total sample ( $\underline{n}$ = 171) <sup>†</sup>	0.42	60.52	
Entering GPA			0.57
Biology PCAT			0.04
Class of 1990 ( $\underline{n}$ = 41)	0.39	11.94	
Entering GPA			0.51
Biology PCAT			0.04
Class of 1991 ( $\underline{n}$ = 65)	0.48	32.33	
Entering GPA			0.61
Biology PCAT			0.03
Class of 1992 ( $\underline{n}$ = 65)	0.50	31.00	
Entering GPA			0.80
Biology PCAT			0.04

\*All F ratios were significant at the 0.001 level.

<sup>†</sup>PCAT scores were missing for six class of 1990 students and one class of 1991 student.

first (e.g., produced the highest initial  $R^2$ ), followed by biology PCAT score. The  $R^2$  changes resulting from this addition were 0.24 to 0.42 (total sample), 0.34 to 0.48 (1991 class), and 0.37 to 0.50 (1992 class). For the 1990 class, biology PCAT emerged first in the model ( $R^2 = 0.21$ ), followed by entering GPA ( $R^2 = 0.39$ ).

In all analyses, entering GPA was the stronger of the two predictors. However, the portion of variance in achieved GPA explained by entering GPA decreased with each subsequent year in training, while the portion explained by biology PCAT score remained relatively constant.

### DISCUSSION

The results of this study support those of earlier studies in suggesting that entering GPA is a strong predictor of academic performance. Earlier studies generally used first-year achieved GPA as the dependent variable; however, the present study suggests that the predictive power remains at least through completion of the third year.

The results also support earlier studies with regard to the increase in predictive power when prepharmacy GPA is used in conjunction with biology PCAT scores. The importance of biology PCAT scores as an academic predictor may reflect the importance and predominance of biology-based courses early in the academic curriculum. While the contribution of biology PCAT to the predictive model is statistically significant, the effect is relatively small.

The results did deviate somewhat from previous studies with regard to the best combination of variables for predicting academic performance. Historical review of studies of this nature indicates a variety of PCAT and demographic combinations comprising the best predictive model ( $R^2$  values ranging from 0.179 to 0.603) (12). Unlike earlier studies, reading comprehension and verbal ability PCAT scores did not contribute significantly to the predictive model. This may reflect curricular differences and/or differences arising from individual student populations.

In summary, the results of this study have renewed questions regarding the value of the PCAT examination for screening prepharmacy applicants. However, because the predictive value may vary significantly between training programs, individual schools

should assess the value in relation to their own students and curriculum. Hopefully, the present study will serve as a guide for this assessment.

### **LIMITATIONS**

The results of this study should be generalized only to the population of pharmacy students included in this study and presently enrolled in the Campbell University Doctor of Pharmacy program. It should be recognized that students considered in this study may not be representative of a national cross section of pharmacy students.

### **REFERENCES**

1. Belmonte AA, Strickland EI. Prediction of academic success using selected variables. *Am J Pharm Educ* 1978;42:122-4.
2. Jacoby KE, Plaxco WB, Kjerolft K, Weinert AB. The use of demographic variables as predictors of success in pharmacy school. *Am J Pharm Educ* 1978;42:4-17.
3. Sisson HE, Dizney HF. The predictive validity of the pharmacy college admissions test as compared with that of other academic predictors. *Educ Psychol Meas* 1980;40:425-9.
4. Kotzan JA, Entrekin DN. Validity comparison of PCAT and SAT in the prediction of first-year GPA. *Am J Pharm Educ* 1977;41:4-7.
5. Liao WC, Adams JP. Methodology for the prediction of pharmacy students' academic success: preliminary aspects. *Am J Pharm Educ* 1977;41:124-7.
6. Lowenthal W, Wergin JF, Smith HL. Predictors of success in pharmacy school: PCAT versus other admissions criteria. *Am J Pharm Educ* 1977;41:267-9.
7. Lowenthal W, Wergin JF. Relationships among student preadmission characteristics, NABPLEX scores, and academic performance during later years in pharmacy school. *Am J Pharm Educ* 1979;43:7-11.
8. Lowenthal W. Relationships among student admissions characteristics, licensing examinations, and academic performance: a comparison of three graduating classes. *Am J Pharm Educ* 1981;45:135-9.
9. American Council on Pharmaceutical Education. Accreditation standards and guidelines. 8th ed. Chicago: ACPE, 1984:15-8.
10. SAS Institute, Inc. SAS user's guide. Version 6.03 ed. Cary, NC: SAS Institute, 1989.
11. Bandalos DL, Sedlacek WE. Predicting success of pharmacy students using traditional and nontraditional measures by race. *Am J Pharm Educ* 1989;53:145-8.
12. Cunny KA, Perri M. Historical perspective on undergraduate pharmacy student admissions: the PCAT. *Am J Pharm Educ* 1990;54:1-6.