Predictors of Academic Success
at a Historically Black School of Pharmacy

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ABSTRACT. Pharmacy educators have long been interested in identifying the factors that may influence pharmacy student academic performance. A study was conducted at Howard University to investigate variables influencing the success of minority pharmacy students. A total of 293 students with evaluable data were analyzed. Logistic regression models were also performed to assess good academic standing and the factors responsible for students' failing a course. Significant predictors of a multiple regression analysis were GPA, PCAT chemistry, age, previous degree, and PCAT quantitative. These results suggest that the predictors of academic success for minority students are similar to predictors noted for nonminority students. *[Article copies available for a fee from The Haworth Document Delivery Service: 1-800-HAWORTH. E-mail address: <docdelivery@haworthpress.com> Website: <http://www.HaworthPress.com> © 2003 by The Haworth Press, Inc. All rights reserved.]*

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INTRODUCTION

Pharmacy educators have long been interested in identifying the factors that may influence pharmacy school performance. Such interest among pharmacy educators has been primarily due to the increase in competition for space within pharmacy schools, to increased representation of minority students, and to the widespread use of standardized tests (1). Moreover, identifying students who would succeed in pharmacy school, coupled with an interest in increasing student retention and graduation rates, has also prompted pharmacy educators to focus in this area (2, 3). Chisholm and colleagues reiterate that selecting the most promising students for admission into pharmacy school and the onus on pharmacy educators to maintain quality education programs have been some of the reasons for identifying the factors affecting pharmacy school performance (4). The literature is replete with variables that have been analyzed for their contribution to a student's performance in pharmacy school. Some of the most widely cited variables include standardized tests, grade point average (GPA), essays, interviews, and recommendations (5).

According to Chisholm et al., nearly 40% of all American Association of Colleges of Pharmacy (AACP) member schools use the Pharmacy College Admission Test (PCAT) in selecting students for admission (4). Liao and Adams, along with Van Breeman et al., have found overall PCAT scores to be significant predictors of academic success (6, 7). Both authors defined academic success in terms of higher first professional year GPA. Lowenthal et al., in a more in-depth analysis, have shown specific portions of the PCAT to be more predictive of students' academic performance (8, 9). In the study involving pharmacy students at the Medical College of Virginia, PCAT verbal and chemistry scores were found to be significant predictors of academic performance (8). Similarly, PCAT biology and reading comprehension scores were found to correlate with better academic performance at the University of Mississippi (6). In a more recent study, PCAT quantitative and reading scores were found to be significantly correlated with first-year GPA (10). The use of the predictive power of standardized tests is not limited to pharmacy. Studies involving medical and dental students have found the Medical College Admission Test (MCAT) and the Dental Admis-

sion Test (DAT) to be significant predictors of academic performance (11-14).

Pre-pharmacy school grade point average (PGPA) has consistently been shown to be a salient predictor of a pharmacy student's academic performance (2, 3, 6). Students with a higher PGPA tend to perform better in pharmacy school. Other studies involving medical students have also found PGPA to be a significant predictor of academic performance (15, 16).

In an effort to study the nuances of race or ethnicity on academic performance, Bandalos et al. found PGPA to be the strongest predictor of academic success for white students (2). However, for Asian and African-American students, the PCAT reading comprehension score was the strongest predictor of academic success. Bandalos and colleagues defined academic success in terms of student (first-year) GPA. In terms of other demographic variables, gender was not found to be significant in predicting academic performance (3, 6, 17). Jacoby et al. and Charupatanapong et al. have found age to be a significant predictor of pharmacy students' academic performance (1, 3). Both of these studies found age to be inversely correlated with academic performance, indicating that younger students tend to perform better in pharmacy school. However, the contrary conclusion was reached by Liao et al., who found age to be nonpredictive of pharmacy students' academic success (6).

Several studies have noted the influence of feeder schools on academic performance in pharmacy school. Wupong et al. have found high school percentile rank to be a significant predictor of academic success in pharmacy school (18). Wupong and colleagues defined academic success by two endpoints, pharmacy school GPA and the number of honors received during clinical rotations. Both Chisholm et al. and Allen et al. found that students with a four-year degree performed better academically (4, 19). Hamner et al. compared the performance of students accepted from community colleges with students accepted from noncommunity colleges and found no significant difference in performance between the two groups (20). In two separate studies, both Jacoby et al. and Bandalos et al. included the type of prior college attended as well as the time spent in that college in their analyses but combined the two variables as a product function (1, 2). For example, they first rated the prior college attended as community = 1, private = 2, state = 3, and parent university = 4. Then they multiplied the assigned rating of each college with the time (in years) a student spent in it. Finally, they studied the effect of this combination variable called "ori-

gin" or "source" (which is the product of the rating assigned to each institution and the time spent in years at those institutions) on pharmacy school performance. This "source" or "origin" variable was found to be significant in predicting the academic success of pharmacy students. Academic success was defined in terms of higher first-year GPA by both authors. The greater the value of the "origin" or "source" variable, the higher was its predictive power. This indicated that spending more time in education in a university/college prior to entering pharmacy school improved academic performance in the pharmacy program.

Thus we see that an assortment of variables has been assessed for influence on pharmacy school performance. However, a review of the literature did not reveal previous studies that have investigated predictors of academic success among students attending a historically Black school of pharmacy (HBSP) or at a school of pharmacy with substantial numbers of minority students. Moreover, because previous studies done at nonminority institutions have noted potential variations in predictors of academic success among their minority students, a study was conducted at Howard University School of Pharmacy to investigate which academic and demographic variables may influence the success of minority students at a HBSP (1-3, 6). It is possible that nonminority students have different predictors of academic success than minority students and that these predictors have not been explored heretofore.

Howard University, established in 1867, is the parent university of the oldest school of pharmacy (established 1868) in the United States providing pharmaceutical education to African-American students. One of the first graduates of Howard University received the doctor of pharmacy (Pharm.D.) degree in 1870. Howard University School of Pharmacy faculty adopted the doctor of pharmacy degree as the sole entry-level degree for the class entering in 1994. The curriculum was designed to enroll students transferring into the four-year Pharm.D. program upon successful completion of pre-pharmacy level academic preparation.

METHODOLOGY

Howard University School of Pharmacy has recently developed a database to track the academic performance of pharmacy students. Several demographic and academic performance variables were entered into the database retroactively for students who were admitted into the doctor of pharmacy program between 1996 and 1999, inclusive. During

this period, a total of 318 students were enrolled in the program. This study presents data on 293 students with complete or near complete data on demographic and academic variables. Demographic characteristics including age at admission, gender, prior bachelor's degree, and transfer status were reported. *The database did not contain race/ethnicity data on individual students. However, the Dean's Office at the School of Pharmacy provided us with a summary of the students' racial/ethnic profile for the years 1996 to 1999, based on data collected for internal purposes.* Academic variables including PCAT verbal, PCAT biology, PCAT reading, PCAT quantitative, PCAT chemistry, PCAT composite, pre-pharmacy science GPA (SGPA), pre-pharmacy cumulative GPA (PGPA), and interview scores were also reported for each student. The above-mentioned demographic and academic variables were used in the analyses.

Multiple regression models were conducted (forward method) to determine in a multivariate analysis which variables were predictive of academic success. The independent variables consisted of all the above-mentioned demographic and academic variables. The dependent variable, academic success, was measured by the student's GPA upon completion of the first year of the pharmacy curriculum. First-year GPA was used as a measure for academic success for the following reasons: first-year GPA was the only GPA variable that was complete for all students. Some students in the database had not completed all four years of pharmacy school and were yet to have cumulative GPAs for all four years of pharmacy school. Moreover, by considering second or a higher year's cumulative GPA, we would be effectively excluding those students who had dropped out or been expelled during their first year. This would potentially bias the analyses in favor of students who had completed two or more years of pharmacy school. The results would thus reflect the predictors for the successful students alone and exclude the students who had withdrawn or been asked to withdraw from pharmacy school at any point. First-year cumulative GPA was also compared to the other three years' GPAs (for students in this database) to ensure that it was not significantly different for those students who had GPAs reported for more than one year.

A separate forward logistic regression was conducted with the outcome variable of whether a student was in good academic standing upon completion of the first year of the pharmacy curriculum. Good academic standing was defined by the standard of the School of Pharmacy as a GPA at or above 2.50. For purposes of the logistic regression, students with a GPA at or above 2.50 after their first year were considered

to be in good academic standing. A second logistic regression analysis was conducted to assess predictors of whether students had ever failed a course during their entire academic career as pharmacy students. Both these dependent variables were artificially coded into "yes" and "no" to comply with the principles of logistic regression. The independent variables comprised the same variables that were used in the multiple regression model.

RESULTS

Data were entered into the academic database for a total of 293 students enrolled at Howard University School of Pharmacy between 1996 and 1999, inclusive. Although, the actual number of students enrolled during this period was 318, this study only included students for whom there was complete or nearly complete academic and demographic data. Demographic variables are listed in Tables 1 and 2. The mean age at admission was 26 years. During this period, over two-thirds of the students enrolled were female (68.9%). Based on the overall estimates provided by the Dean's Office, the racial/ethnic distribution for students from 1996 to 1999 inclusive, was as follows: two-thirds (66%) of the students were Black or African-American, 28% were Asian, and the remaining 6% were either Caucasian or Hispanic. Approximately one-fifth (23%) were transfers from Howard University's undergraduate programs, but the majority (77%) completed their prepharmacy requirements at another academic institution. Nearly one-half (48.8%) completed prepharmacy course work at a community college. Seventeen percent entered pharmacy school after receiving a bachelor's or graduate degree, while 25% had received an associate's degree prior to pharmacy school.

PCAT component percentile scores for each section of the PCAT are reported for the students. The mean PCAT percentile scores are listed in Table 1. Regarding good academic standing after the first year, 244 students (83.3%) were in good academic standing (GPA $\geq$ 2.50), while 49 (16.8%) were not (GPA < 2.50). During their academic careers, a total of 105 (35.8%) students had failed a course in pharmacy school, while 188 (64.2%) had never failed any courses. The mean PGPA was 3.22, while the mean SGPA was 3.08. The mean GPA after completion of the first year of the pharmacy curriculum was 2.93. The mean GPAs are reported in Table 2.

TABLE 1. Demographic and Academic Characteristics*

Variable	*N*	*Mean*	*Std. Deviation*
Gender			
Male	91 (31.1%)		
Female	202 (68.9%)		
Race/Ethnicity⁺			
Black	211 (66.35%)		
Asians	90 (28.30%)		
White	12 (3.77%)		
Hispanics	4 (1.28%)		
American Indian	1 (0.3%)		
Prepharmacy Institution			
Howard U.	67 (22.9%)		
Other	226 (77.1%)		
Prepharmacy College/University			
Two-Year	143 (48.8%)		
Four-Year	149 (51.2%)		
Missing Data	1		
Previous Degree			
No Degree	167 (57.0%)		
Associate's	73 (24.9%)		
Bachelor's	50 (17.1%)		
Graduate	3 (1%)		
Year			
1996	80 (27.3%)		
1997	69 (23.5%)		
1998	71 (24.2%)		
1999	73 (24.9%)		
First-Year Good Academic Standing			
Yes	244 (83.3%)		
No	49 (16.7%)		
Ever Failed a Course			
Yes	105 (35.8%)		
No	188 (64.2%)		

TABLE 1 (continued)

Variable	N	Mean	Std. Deviation
PCAT Verbal	284	36.60	25.44
PCAT Biology	284	55.02	24.26
PCAT Reading	284	32.92	24.87
PCAT Quantitative	284	48.36	27.46
PCAT Chemistry	284	56.11	26.35

*During 1996-1999 a total of 318 students entered the School of Pharmacy. Data are presented for 293 students with complete or near complete data regarding demographic and academic variables.
+ Individual race/ethnicity data was unavailable. The data in the table represents an overall estimate of students' Race/Ethnicity profile.

TABLE 2. Academic Characteristics.

Variable	N	Mean	Std. Deviation
Admissions Math Score	286	55.48	14.82
Admissions Essay Score	274	79.42	9.64
Age at Admission	292	25.76	5.28
Prepharmacy Science GPA (SGPA)	290	3.08	0.3633
Prepharmacy Cumulative GPA (PGPA)	290	3.22	0.3008
First-Year GPA	292	2.93	0.6127

Multivariate Regression Results

The following variables were entered into a forward regression analysis with a dependent variable of first-year GPA: gender, age at admission, PCAT comprehensive, PCAT verbal, PCAT biology, PCAT reading, PCAT quantitative, PCAT chemistry, admissions math test, admissions essay, SGPA, PGPA, interview score, and previous degree. *Due to the unavailability of individual racial/ethnic data, this variable was not included in the analysis.* The variables found to be significant predictors of first-year GPA were PGPA, PCAT chemistry, age at admission, previous degree, and PCAT quantitative (Table 3). A value of 0.53 for multiple *R* indicates a linear relationship between the independent and the dependent variables. Higher entering cumulative GPA, higher PCAT chemistry score, and higher PCAT quantitative were significantly pre-

TABLE 3. Multiple Regression Model* (Dependent Variable–First-Year Pharmacy GPA, Significant Variables Reported; N = 293).

Model	Standardized Beta Coefficient	T	Sig.
Constant		1.384	.168
Cumulative Entering GPA	0.343	6.230	0.000
PCAT Chemistry	0.228	3.650	0.000
Age at Admission	−0.121	−2.297	0.022
Previous Degree	0.128	2.388	0.018
PCAT Quantitative	0.124	2.019	0.044

*R = 0.523; R^2 = 0.275; Adjusted R^2 = 0.261

dictive of higher first-year GPA. Younger age was associated with higher first-year GPA. The predictor variables cumulatively accounted for 28% of the variance in first-year GPA, as indicated by the R^2 (R^2 = 0.275). The increase in the overall value of the adjusted R^2 (0.26) for the final regression model indicates that each of the predictor variables added to amount of explained variance of first-year GPA.

A forward logistic regression analysis was conducted with an outcome variable of good academic standing (GPA $\geq$ 2.50) after the first year in the pharmacy curriculum. Variables entered into the analysis included gender, age, previous degree, PCAT comprehensive, PCAT verbal, PCAT biology, PCAT reading, PCAT quantitative, PCAT chemistry, admissions math score, admissions essay score, interview score, PGPA, and SGPA. *Due to the unavailability of individual racial/ethnic data, this variable was not included in the analysis*. The significant predictors of good academic standing were previous degree, PCAT chemistry, and SGPA. Students with a previous degree were more likely to be in good academic standing; students with higher PCAT chemistry and SGPA were also more likely to be in good academic standing (Table 4).

A second forward logistic regression model was performed with an outcome variable of whether or not students had ever failed a course during their academic pharmacy career. The same variables listed in the previous logistic regression model were included in this model. The significant predictors of ever failing a course were PCAT chemistry score and entering science GPA (Table 5).

TABLE 4. Logistic Regression Model (Dependent Variable–Good Academic Standing; Yes, or No. Significant Variables Reported; *N* = 293).

Variable	β	S.E.	Wald	Sig.
Previous Degree	−0.490	0.242	4.094	0.043
PCAT Chemistry	−0.023	0.007	10.616	0.001
Entering Science GPA	−2.801	0.653	18.410	0.000
Constant	8.185	1.931	17.966	0.000

TABLE 5. Logistic Regression Model (Dependent Variable–Ever Failed a Course; Yes, or No. Significant Variables Reported; *N* = 293).

Variable	β	S.E.	Wald	Sig.
PCAT Chemistry	−0.018	0.005	11.301	0.001
Entering Science GPA	−1.829	0.434	17.751	0.000
Constant	4.632	1.377	11.319	0.001

DISCUSSION AND CONCLUSION

This study presents results of an analysis to assess predictors of academic performance among a large group of minority students at Howard University. The results of this study demonstrate that the most significant predictors of academic performance (first-year GPA) were PGPA, PCAT chemistry score, age at admission, possession of a previous degree, and PCAT quantitative score. These findings are similar to previous studies of pharmacy student academic performance conducted among largely white populations of students (8, 10).

PGPA has been consistently found to be an important predictor of academic success in pharmacy school; this was also the case in our study (2, 3, 6). Lower age at admission was also associated with improved academic performance. Age seemed to have a confounding effect on first-year GPA. Possibly, older students may not do better in pharmacy school because of the potential detrimental effect of a delay in completing prepharmacy course work, then attending pharmacy school after a period of separation from academia. It is also possible that older students may have greater responsibilities, family commitments, and other

life stresses that negatively affect academic performance in a rigorous curriculum. This result has also been noted in previous studies (1, 3).

Predictably, students who had earned a previous academic degree also performed better during pharmacy school, likely because of their familiarity with the academic environment and greater exposure to prerequisite courses (4, 19). Having a previous degree may also have helped them with the course work in pharmacy school. Although gender did not prove to be significant in predicting academic success, females in general tended to perform better academically than males in our sample population. There was a positive correlation of GPA with female students in our sample, albeit not significant. Possibly, the regression model was unable to elicit significance in terms of gender because of the smaller number of males in our sample.

The logistic regression analysis assessing good academic standing (GPA $\geq$ 2.50) after the first year in the pharmacy curriculum concludes that the significant predictors of good academic standing were possession of a previous degree, PCAT chemistry, and SGPA. This is fairly consistent with the results of the multivariate regression, except that SGPA was predictive of good academic standing, but not PGPA. Also, age at admission and PCAT quantitative were no longer significant predictors of good academic standing, as they were of first-year GPA. The second logistic regression analysis found PCAT chemistry and entering science GPA to be the significant predictors of whether students ever failed a course during their academic pharmacy career.

This result further highlights the significance of the variables PCAT chemistry and SGPA in the prediction of academic success during pharmacy school. Because the pharmacy curriculum heavily emphasizes chemistry and other basic sciences, it is clear that competency in these subjects is likely to influence the success of pharmacy students. PCAT quantitative may have been significant in the multiple regression alone because the first- and second-year courses at Howard University School of Pharmacy are mainly in pharmaceutics. As such, these courses require a strong math background. The regression model is probably reflective of such an association. Because the remainder of the curriculum has a greater emphasis on chemistry, it is possible that PCAT chemistry was more strongly correlated to good academic standing and whether students ever failed a course and as such replaced PCAT quantitative from the logistic model.

The results of this study are important as they highlight several variables that may be predictive of pharmacy student success. While it is important to assess other factors, including professionalism, moral

character, and general attitude, it is evident from our analysis that components of the PCAT examination (chemistry, quantitative) may be more useful in the assessment of student admissions than the overall comprehensive PCAT score. This study is also important because it highlights the consistencies between predictors in academic performance of minority students and earlier studies, which have found similar findings among larger groups of nonminority students (1, 3, 4, 19). Thus, it is our conclusion that the predictors contributing to academic success are not radically different in minority students than those contributing to the success of nonminority students. This consistency is possibly due to the similarity in curriculum requirements and similar core-competency evaluations among schools of pharmacy. As such, we find "success predictors" that are similar for minority and nonminority students.

LIMITATIONS

There are several limitations in this study, including the retroactive assessment of academic performance. Unfortunately, complete data were not available for all students, and some demographic data were missing. Individual data regarding race/ethnicity would have further strengthened the study. However, since a majority of the students in the database were African Americans, we do not feel that race would have made a significant contribution to academic success for this particular sample. In this study, the definition of academic success is limited to the measurement of the students' first-year GPA alone. Other academic characteristics, like students' performance during experiential course work and clinical rotations, that may not be reflected in GPA but are an important part of professional education, have not been considered in defining academic success for our study. Also, this study did not assess other nonacademic characteristics, such as professionalism, motivation, perseverance, social support, financial difficulty, and ability to deal with stress, which may also influence academic performance.

Future studies involving a direct comparison of a HBSP and a traditionally nonminority school in terms of academic success of their graduates may be helpful to elicit the relative success of HBSPs in educating minorities. Despite these limitations, this study provides valuable data on the academic performance of minority students and will provide a valuable foundation for future research. Future research should include

the assessment of other noncognitive variables that may influence academic performance and the assessment of whether prepharmacy variables may affect quality and attitudes of graduate practitioners.
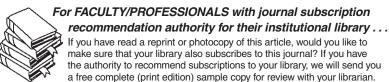
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