RESEARCH

Admission Variables Predictive of Academic Struggle in a PharmD Program

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Objective. To characterize and describe admission variables predictive of poor grade attainment by students in 2 pathways to a doctor of pharmacy (PharmD) program.

Methods. A retrospective analysis of course grades of PharmD students admitted from 2000 to 2009 (N= 1,019) in the traditional degree pathway ("1 plus 5" degree program) and the provisional pathway (admitted directly from high school) was performed.

Results. Four hundred three grades of D or less were earned by 183 (18%) students. There were more grades of D or less in the first pharmacy year. Receipt of an unsatisfactory grade was associated with all Pharmacy College Admission Test (PCAT) subcategory scores, PCAT composite score, cumulative prepharmacy coursework hours, prepharmacy grade point average (GPA), prepharmacy science and math GPA, and interview score for accepted students in the traditional pathway. For students in the provisional pathway, PCAT-quantitative analysis, PCAT composite score, prepharmacy cumulative GPA, prepharmacy science and math GPA, English American College Testing (ACT) score, and composite ACT score predicted poor grades.

Conclusion. Admissions committees should heed PCAT scores and GPAs, regardless of program pathway, while progression committees should focus on early program coursework when designing strategies to optimize retention.

Keywords: admission, pharmacy students, grades, academic performance, retention

INTRODUCTION

The number of pharmacy degree programs has grown to 129 (109 full accreditation, 15 candidate, 5 pre-candidate).¹ For the September 2009-August 2010 admission cycle, 111,744 admission applications were received and reported from 120 programs.² According to the American Association of Colleges of Pharmacy (AACP) 2010 Fall Enrollment Report, the number of students admitted to existing programs increased from 7,377 in 1980 to over 13,000 in 2010.² The ratio of applicants to admitted students has remained high, highlighting the need for efficient and effective admission screening.

Pharmacy degree programs continue to face the challenge of identifying and admitting applicants most likely to successfully complete the program and become competent members of the profession. According to AACP admissions requirement data of pharmacy colleges and schools, the average overall minimum grade point average

(GPA) is 2.7 and the Pharmacy College Admission Test (PCAT) minimum average score is 52. Applicants are encouraged or required to complete and submit PCAT results by over two-thirds of pharmacy colleges and schools.³

Many studies have looked at preadmission student characteristics and the correlations to academic success.⁴⁻³⁰ Most of those studies were conducted in 4-year programs over a 1- to 6-year period, with academic success being measured at different timeframes within the curriculum. Predictors of academic success within pharmacy degree programs have included prepharmacy GPA and prepharmacy math/science GPA,^{14,17,20,24} PCAT composite and PCAT subcategory scores,^{18,20,21,25,27} and achievement of a 4-year college degree.^{14,16,17,19,24,30} In contrast, some studies do not consider GPA as predictive,^{14,16,18,19,23,27} some studies suggest use of the PCAT subcategory scores^{10,15,20,22} over the PCAT composite score, and 1 study opposed the 4-year degree achievement as a predictor of success in pharmacy school.²² Another study assessed factors related to advanced pharmacy practice experience (APPE) grades in doctor of pharmacy (PharmD) programs.³¹ In this study, characteristics such as higher first-year GPA and more years of prior clinical

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pharmacy work experience were associated with higher APPE grades. One study concluded that students most successful in the first year of pharmacy school had prepharmacy cumulative GPAs of 3.5 and higher PCAT scores in all subsets except problem-solving, compared with students placed on academic probation.³²

Our study was conducted at a school of pharmacy within a public university serving more than 14,000 undergraduate, graduate, and professional students. The University of Missouri-Kansas City (UMKC) School of Pharmacy was established in 1885 and educates over 500 students per year using 2 campuses. During the study period, this PharmD program had 2 admission pathways for students: traditional and provisional acceptance. The traditional admission pathway was known as the 1 plus 5 program, wherein 1 year of prerequisite coursework is required before completing 5 years of the pharmacy curriculum. Students with a minimum cumulative GPA of 2.75 or higher and a minimum science/math GPA of 2.5 or higher were eligible to apply for this pathway. All student applicants had to complete the prerequisite coursework with grades of C or higher prior to admittance. Factors considered in the admission process are listed in Appendix 1.

The provisional admission pathway was available to high school seniors with a cumulative GPA of 3.25 or above at the beginning of their senior year and those whose American College Testing (ACT) or Scholastic Aptitude Test (SAT) composite score was a minimum of 23 or 1060, respectively. Students accepted in the provisional pathway completed 1 year of prepharmacy coursework at the university before entering the 5-year pharmacy degree program. After completing the first year of prepharmacy coursework, an index score was created for provisional pathway students that included GPA and composite scaled PCAT scores (first-year GPA $\times$ 100 + scaled PCAT score). Provisional pathway students with indices greater than 500 were granted an interview. Provided that the interview session was a success, provisional pathway students were combined with traditional pathway students, creating the next incoming class. An analysis of the 2 admission pathways suggested that for traditional pathway students, academic dismissal was associated with the PCAT composite score ($p=0.006$) and the science/math GPA ($p=0.011$). For provisional pathway students, overall GPA ($p=0.004$), science/math GPA ($p=0.032$), English ACT score ($p=0.001$), and reading ACT score ($p=0.01$) predicted academic dismissal.³³

Though several studies, including 1 conducted at the UMKC School of Pharmacy, have explored correlations between preadmission data and academic success or dismissal within PharmD programs, few studies have been published addressing at what point in the curriculum

students might earn unsatisfactory grades and which preadmission factors may predict poor grade attainment. Further, while colleges and schools of pharmacy strive to identify academically prepared and motivated students, the admission requirements may differ based on a program's curricular structure. PharmD programs may begin when a student graduates from high school or after a student has earned a degree. In an extensive review of the literature, we found no studies of factors that predict academic success based on a student's entry point into a PharmD program.

Because of the inconsistency in findings regarding performance prediction studies and the paucity of research on academic struggle, a large, longitudinal study was developed to determine the predictors of low grade attainment for both traditionally and provisionally accepted pharmacy students at the UMKC School of Pharmacy. These issues are particularly relevant as programs develop progression plans and remediation strategies to optimize student retention and timely progression. The purpose of the present study was to identify at what point in the PharmD curriculum students are more likely to receive course grades of D or below and which admission variables are associated with poor grade attainment within the degree program. This twofold purpose was intended to assist programs in identifying relative admission variables and which courses are likely to be obstacles for student success.

METHODS

This study was conducted at a school of pharmacy at a public university and was approved by the University of Missouri – Kansas City Social Sciences Institutional Review Board. Data from students traditionally or provisionally accepted to the UMKC School of Pharmacy from 2000-2009 were analyzed retrospectively to determine predictors for low grade attainment. Academic struggle and poor grade attainment were defined as earning a grade of D or less in PharmD coursework. The number of students encountering difficulties or earning a grade of D or less in either classroom or experiential coursework was determined. Courses in which higher percentages of D and F grades were earned were also identified. In an effort to determine predictors of low grade attainment, students earning an unsatisfactory grade of D or F were compared to students who did not.

Univariate analysis was performed by the Student *t* test for continuous variables and the chi-square test for categorical variables. Factors analyzed included PCAT scores, prepharmacy course hours, prepharmacy GPA, prepharmacy science/math hours and GPA, leadership, writing ability, and interview ratings. Additionally, ACT

scores, high school GPA, and science/math units were examined for provisional students. Covariants that were significant predictors of academic withdrawal in the univariate analysis were included in the correlation analysis. Because of the strong homogeneity of cumulative GPA and math/science GPA (provisional $r=0.912$, $p<0.001$, traditional $r=0.815$, $p<0.001$), a combined variable was used (cumulative GPA multiplied by math/science GPA) for the analysis. All statistical tests were 2-tailed. A p of <0.05 was considered significant. All statistical tests were performed using SPSS Statistics, version 18.0 (SPSS, Inc., Chicago, IL).

RESULTS

Eight hundred seventeen students accepted into the traditional PharmD pathway and 202 accepted into the provisional pathway were admitted to the UMKC School of Pharmacy during the years of 2000 through 2009 for a total of 1,019 students. The majority of students enrolled in the PharmD program at UMKC are Caucasian females in their third decade of life. The average prepharmacy GPA prior to admission for traditionally accepted students was 3.5 ± 0.3 , whereas the mean high school GPA for provisionally accepted students was 3.6 ± 0.4 . The average PCAT subscores of traditional students ranged from 60 to 67. The provisionally accepted students' range for the PCAT subscores varied more, ranging from 48 to 72.

Four hundred three grades of D or less were earned by 183 students for the 9-year period of study. A majority of the unsatisfactory grades (181/183; 99%) were earned in lecture courses. Two students earned unsatisfactory grades in their pharmacy practice experiences. Students appeared to struggle more academically in the first year of the PharmD program in the following courses: Cellular Biology, Organic Chemistry I, Organic Chemistry II, and Human Anatomy (Table 1). Second-year and third-year courses in which students earned low grades were Physiology, Biochemistry I, Pharmacology I, and Pharmaceutics I (Table 2).

Students in the provisional pathway ($n=17$, 10.2%) were more likely to earn a poor grade when compared

Table 2. Selected Courses and Number of Students With Poor Grades From 2000-2009

Courses	Year	Students, No (%)	
		Traditional Pathway (N=817)	Provisional Pathway (N=202)
Cellular Biology	1	45 (6)	11 (5)
Organic Chemistry I	1	14 (2)	3 (10)
Organic Chemistry II	1	15 (2)	5 (2)
Human Anatomy	1	13 (2)	2 (1)
Introduction to Law	1	0	6 (3)
Physiology	2	42 (5)	15 (7)
Biochemistry I	2	35 (4)	14 (7)
Pharmaceutics I	2	13 (2)	4 (2)
Pharmacology I	3	18 (2)	5 (2)

with students in the traditional pathway ($n=40$, 5.5%), $p=0.038$. A comparison of admission variables for students earning an unsatisfactory grade is presented in Table 3. Prior to pharmacy school admission, traditional pathway students completed 92 ± 47 hours compared with provisional pathway students who, on average, completed 30 ± 22 hours of coursework during their provisional year. During prepharmacy coursework, traditional pathway students completed 53 collegiate science and math credit hours, whereas provisional pathway students obtained 16 science and math credit hours. The science/math GPAs were 3.4 and 3.6 for traditional and provisional pathway students, respectively. The average leadership score was 11 for all students, irrespective of acceptance pathway.

For both traditional and provisional pathway students, the PCAT subcategory scores, cumulative GPA, and science/math GPA were associated with poor grade attainment. For traditional pathway students, all PCAT subscores were associated with poor grade attainment ($p<0.001$), whereas only quantitative analysis ($p=0.012$) and chemistry ($p=0.014$) were associated with poor grade attainment for provisionally accepted students. English ($p=0.003$) and composite ($p=0.040$) ACT scores predicted receipt of a low grade in provisional pathway students. The number of prepharmacy course credit hours was associated with earning unsatisfactory grades for traditional pathway students ($p=0.001$), but not for provisional pathway students ($p=0.326$). The correlation analyses were consistent with the comparative analyses. The results of the correlation analyses (Table 4) were consistent with the univariate analysis. The strongest predictors of poor grade attainment were the combined GPA, the interview score and reading and biology PCAT subscores for the traditional pathway students, and the

Table 1. Rates of Occurrence of Unsatisfactory Grades by Year in Pharmacy School

Year	Percentage of All Unsatisfactory Grades Earned During Pharmacy School
1	44
2	38
3	15
4	3
5	0

Table 3. Comparison of Admission Variables and Grade Performance from 2000-2009

Admission Variable	Students, No. (SD)			
	Traditional Pathway (N=817)		Provisional Pathway (N=202)	
	Satisfactory	Unsatisfactory	Satisfactory	Unsatisfactory
Cumulative GPA	3.5 (0.3) ^a	3.3 (0.4)	3.7 (0.3) ^a	3.4 (0.5)
Science/math GPA	3.4 (0.4) ^a	3.2 (0.6)	3.6 (0.5) ^a	3.2 (0.56)
Cumulative hours	92 (47) ^b	81 (44)	30 (22)	35 (33)
Science/math hours	53 (31)	45 (22)	16 (6)	17 (10)
Interview-combined	42 (6) ^a	46 (6)	38 (7)	39 (10)
Interview-verbal	25 (6) ^a	20 (2)	24 (6)	18 (5)
Leadership score	11 (2)	11 (2)	11 (3)	10 (5)
Coursework factor	3 (1)	3 (1)	3 (1)	3 (1)

Abbreviation: GPA=grade point average

^a $p < 0.001$

^b $p < 0.05$

combined GPA and English ACT score for the provisional pathway students.

DISCUSSION

Although admission committees for pharmacy degree programs tend to review many of the same variables (eg, PCAT scores, GPA) when making admission decisions, variations exist in the benchmarks or standards (eg, PCAT at the 50th percentile; GPA greater than or equal to 3.25).³ This large, longitudinal study indicates that some variables are more predictive than others in identifying students at risk for academic course grade deficiencies. Poor grade attainment (D or F) was associated with pre-pharmacy course GPA, prepharmacy science/math GPA,

the PCAT composite score, all PCAT subscores, cumulative prepharmacy course credit hours, and the interview score for students accepted in the traditional pathway. For provisional pathway students, the cumulative high school GPA, science and math high school GPA, the PCAT composite score, the PCAT quantitative analysis subscore, and composite and English ACT scores were indicative of poor grade attainment within the curriculum.

Eighty-two percent of poor grades were earned within the first 2 years of the pharmacy degree program, with 44% earned in the first year alone. Students tended to struggle early in the pharmacy curriculum in basic science courses such as cellular biology, biochemistry, and physiology. In our program, basic science coursework is completed within the first 2 years of the curriculum. During the study period, these courses did not have a laboratory component and primarily used recall-based assessments. Recent changes have resulted in increased integration of application instruction, making the material more meaningful to students and thus more readily learned and retained.³⁴

GPA and PCAT scores have been stable predictors of academic success and degree conferment, although findings from a few studies indicate otherwise.⁴⁻³⁰ The PCAT was developed to measure the applicant's abilities, aptitudes, and skills deemed essential for academic success in PharmD programs. The PCAT is revised periodically to align with contemporary pharmacy school prerequisite requirements in the sciences, math, and language arts. This correlational study shows a significant association between academic struggle and a student's PCAT score and GPA.

Our findings demonstrate that there are factors beyond GPA and PCAT scores that are predictive of poor grade attainment. Entry level into the PharmD program may be 1 such variable, as point of entry was associated

Table 4. Correlation of Admissions Variables With Poor Grades, 2000-2009

Variable	Traditional Pathway ^a	Provisional Pathway ^b
Combined variable of cumulative and science/math GPA	-0.215 ^c	-0.327 ^c
Cumulative hours	-0.085 ^d	N/A
Interview-combined	-0.266 ^c	N/A
Interview-verbal	-0.181 ^c	N/A
PCAT-verbal	-0.174 ^c	N/A
PCAT-reading	-0.209 ^c	N/A
PCAT-quantitative Analysis	-0.190 ^c	-0.175 ^d
PCAT-chemistry	-0.189 ^c	-0.170 ^d
PCAT-biology	-0.209 ^c	N/A
English ACT	N/A	-0.303 ^c
Composite ACT	N/A	-0.210 ^d

Abbreviations: GPA=grade point average; PCAT=Pharmacy College Admission Test; ACT=American College Testing.

^a N=817 students

^b N=202 students

^c $p < 0.01$

^d $p < 0.05$

with academic struggle. A few related issues may account for differences between entry into the program immediately following high school graduation and entry after completing 1 year of college. Provisional pathway students who may have potentially performed poorly in the program may not have been viable applicants if they had applied through the traditional pathway, as prerequisite coursework would be known. The traditional pathway students are compared with a larger pool of applicants, which may result in higher overall aptitude among those selected. Traditional pathway students also have more college experience prior to admission into the program, which also may aid in their success.

Findings from this study may be readily applied to other programs that have different prepharmacy coursework requirements. In our program, traditional pathway students must have 2 years of prerequisites, whereas provisional pathway students have 1 year of prerequisite coursework; however, in the study, the traditional pathway students averaged approximately 3 years of coursework prior to entry into the program. Information derived from this study is applicable to pharmacy colleges and schools that require from 1 to 3 or more years of coursework prior to pharmacy school.

One limitation to our study was that we did not evaluate how much time students worked while completing pharmacy coursework or the level of student involvement in professional pharmacy organizations and its relationship to academic struggle. These extracurricular commitments could potentially have had a negative impact on student success within the PharmD program. Another limitation to our study was that there were 2 admission formula changes during the study period. In 2009, the provisional pathway ACT requirement was changed to a minimum of 23. In the previous process, provisional pathway applicants were eligible if they were in the top 10% of their high school graduating class and scored a minimum ACT composite of 23; applicants not in the top 10% of their high school graduating class were deemed eligible if they had an ACT composite score in the 90th percentile (28 or above). However, the change in ACT minimum did not decrease the mean ACT score of accepted applicants over the study period. The second change to the admission formula occurred when leadership was incorporated to assess applicants' overall abilities. In our study, the leadership score did not predict poor grade attainment. Further investigation may be warranted to determine how best to use the leadership score in the admission process. Another limitation was that minimum scores for admission were not determined in our study; ie, optimal lower limits were not investigated. Future research should investigate cut scores for admission variables that

may increase the accuracy of identifying likely successful and unsuccessful students in the admissions process. Finally, as noted in a study of predictors of first-year pharmacy school performance, restriction of range is a persistent limitation for studies examining the correlation between admission variables and achievement.³² The Pearson-product moment correlation is sensitive to restrictions of range in the values of variables. In the present study, correlations could be underreported. For example, PCAT scores are restricted, with scores clustering in the 50s, and the ACT was limited to scores of 23 and higher. This restriction in variability could result in artificially lower correlations.

CONCLUSION

Students tend to struggle early in the pharmacy curriculum in basic science courses such as cellular biology, biochemistry, and physiology. Predictors of poor course grades may vary for degree programs depending upon students' entry points into the program. Poor grade attainment in the provisional PharmD degree pathway was associated with cumulative and science/math GPA, PCAT-quantitative analysis and PCAT-chemistry subscores, and English and composite ACT scores. For traditional pathway students, poor grade attainment was associated with cumulative and science/math GPA, cumulative prepharmacy course credit hours, the interview score, and all PCAT subscores. Admissions committees should heed PCAT scores and GPAs, regardless of program pathway, while progression committees should focus on early program coursework when designing strategies to optimize retention.

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Appendix 1. Variables Included in 2000-2009 Admission Formulas

Admission Formula Variable	Traditional Pathway	Provisional Pathway
Minimum GPA	X	X
GPA- Cumulative	X	X
GPA – Science/Math	X	
Interview ^a	X	X
Science/Math Coursework ^b		X
PCAT - Total	X	
Leadership, Service, Honors/Awards ^c	X	X
Reference Request	X	X
Coursework Factor ^d	X	
Minimum ACT ^e		X
ACT		X

Abbreviations: GPA=grade point average; PCAT=Pharmacy College Admission Test; ACT=American College Testing.

^a A 3-on-1 interview with a pharmacy faculty member, an upper level doctor of pharmacy (PharmD) student, and a pharmacy practitioner was conducted. During the interview, candidates were asked behavior-based questions regarding attention to detail, integrity, and decision-making. The candidates were scored in these areas as well as verbal communication (36 points possible) and written communication (9 points possible). Provisional students were interviewed at the end of the prepharmacy year. Provisional students who scored “acceptable,” “strong,” or “very strong” in all interview categories were allowed to begin the first professional year of the PharmD program. “Very strong” was defined as providing complete responses, “strong” included relatively complete responses, “acceptable” was defined as the candidate having difficulties in thought process and requiring prompting. If the students received a score of “limited” or could not provide a complete response, even with prompting, the candidate did not pass the interview.

^b Points were awarded based on the number of math and science units taken in the freshman through junior years of high school. For example, a student who completed 3 math courses and 3 science courses would be awarded 6 points.

^c In 2007, a leadership component was added to the admissions assessment; prior to that, more weight was given to references. Leadership points for various activities included: participation in extracurricular/community service (eg, clubs/societies, sports/teams, volunteer activities, etc.), health-related experience or non-health-related work experience (eg, jobs, missions, shadowing, armed service, etc.) and honors/awards not based on academic achievement or financial status (eg, Eagle Scout). Activities completed within the previous 4 years are considered and the maximum points awarded are 12.

^d Up to 4 points are awarded based on the types of courses taken and the number of college credits completed.

^e The provisional admission requirements were changed in 2009. Previously, provisional applicants were required to be in the top 10% of their high school class and have an ACT composite of 23 or higher. Applicants not in the top 10% of the graduating high school class may still have been eligible if they had an ACT composite in the 90th percentile (28 or above).