RESEARCH

Preadmission Predictors of On-time Graduation in a Doctor of Pharmacy Program

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Objective. To determine which preadmission variables or combination of variables are able to predict on-time graduation in a doctor of pharmacy program.

Methods. Transcripts and student files were reviewed for 460 students who entered the college between 2007 and 2009.

Results. The preadmission variables with significant correlations to on-time graduation included having a prior degree, student type, the number of unsatisfactory grades (nonscience and math-science courses, and the combination), prepharmacy cumulative grade point average (GPA), and math-science GPA. Of these variables, the significant predictors of on-time graduation were prior degree, the presence of no unsatisfactory grades in nonscience courses, and prepharmacy cumulative GPA.

Conclusion. Having a prior degree, lack of unsatisfactory grades in nonscience courses, and prepharmacy GPA were identified as significant predictors of on-time graduation.

Keywords: Admission, pharmacy, grade point average, performance, graduation

INTRODUCTION

The Accreditation Council for Pharmacy Education (ACPE) requires colleges and schools of pharmacy to report on-time graduation rates for the most recent graduating class each year. Any program with an on-time graduation rate of less than 77% will receive a monitoring letter.¹ The council also encourages schools of pharmacy to develop admission criteria, policies, and procedures to maximize the likelihood of successful student completion of the professional degree program in the expected timeframe (Standard 19, Guideline 19.1).² This poses a challenge for admissions committees that endeavor to determine the most useful admission criteria in predicting which students will complete the program in a timely manner. This challenge is similar among most programs regardless of the type of institution (eg, research intensive, less research intensive, small, large, or historically black).

While on-time graduation is important, the impact of delayed graduation on students, the program, and society must be considered as well. Students who graduate late incur costs associated with repeating courses, such as tuition and room and board. They also lose potential

earnings because of delayed entry into the workforce. Pharmacy programs must allocate additional physical and human resources to accommodate students who are repeating courses during the summer or during sessions between regular terms. This also includes time spent on identifying preceptors and sites to provide experiential training for students who are not on schedule. Lastly, delayed graduation may negatively impact society, especially in areas with greater demand for pharmacists because of decreased availability of practice-ready pharmacists during a particular time period. The potential impact of delayed graduation along with the ACPE requirements underscore the importance of identifying preadmission criteria predictive of on-time graduation.

There are sparse evaluations on variables that predict on-time graduation among pharmacy students. Two studies examined the relationship between preadmission variables and on-time graduation in a doctor of pharmacy (PharmD) program.^{3,4} McCall et al evaluated the impact of variables such as completion of advanced biology, chemistry, and math courses beyond the required prerequisites, prepharmacy grade point average (GPA), organic chemistry taken at a 2-year or 4-year institution, and the attainment of a bachelor of science (BS), bachelor of arts (BA), or master of science degree, on graduation without academic delay or suspension. The study revealed that matriculates with advanced biology coursework or

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a BS degree prior to pharmacy school were significantly more likely to graduate on time.³ Steinberg et al reported preadmission characteristics that impact on-time graduation among pharmacy students in an accelerated doctor of pharmacy program.⁴ The authors found that students were more likely to graduate on time if they previously earned a bachelor's degree, attended a 4-year school, had an overall prematriculation grade point average (GPA) greater than or equal to 3.6, and graduated in the spring just prior to matriculation to the university in fall of the same year.⁴ The authors also reported that attending multiple schools prior to matriculation, delaying application to pharmacy school, having a lower GPA, and having a foreign degree were factors that reduced the likelihood of on-time graduation.⁴

Our study was undertaken to identify preadmission variables that predict students' likelihood of graduating on time (defined as completion of the program in four years). The results may also be used by the college's admission committee to determine which students will be placed in the Academic Enrichment Program (AEP). The AEP is designed to provide students with academic and nonacademic support so they can complete the program in the expected time frame. To our knowledge, no studies have included student type (internal, readmit, or transfer), the number of credit hours in advanced biology, chemistry, and math courses, the number of unsatisfactory grades (math-science courses, nonscience courses, and the combination of those), and the math-science GPA as preadmission variables. The variables were chosen in addition to prepharmacy cumulative GPA and prior degree because they can be considered by admissions committees when making decisions regarding prospective students.

METHODS

Xavier University of Louisiana is a historically black university located in New Orleans, Louisiana. Its College of Pharmacy maintains an average enrollment of more than 600 students. The mission of the Xavier University of Louisiana College of Pharmacy is to prepare pharmacists to impact medically underserved communities, particularly African Americans, in an effort to eliminate health disparities through patient-centered care, community service, and scholarly work. The college has offered the entry-level PharmD since 1991. The PharmD program requires at least two years of undergraduate prerequisite courses followed by four academic years of professional pharmacy study.

The preprofessional curriculum includes 39 semester hours of math and science courses (chemistry-8 hours, organic chemistry-8, biology-8, microbiology-3, physics-4,

and calculus-8) and 27 semester hours of nonscience courses (English-6, theology-3, speech-3, philosophy-3, health ethics-3, microeconomics-3, psychology or sociology-3, and an elective-3). In the professional program, students are required to complete 96 credit hours of coursework and six hours of experiential education during the first three years.

During the first professional year the majority of the courses are taught by the pharmaceutical sciences faculty members and include biomedical immunology-2, human anatomy-4, introduction to pharmacy-2, pharmacy calculations-2, biostatistics-3, pharmaceutical biochemistry-3, introductory pharmacy practice experience-2, human physiology-3, pharmacy skills laboratory I-1, pharmaceuticals I-4, principles of drug action-2, molecular biology and biotechnology-3, and an elective-2. In the second professional year, students complete the remaining pharmaceutical sciences courses and transition into the clinical and administrative science courses. They include medicinal chemistry-6, pathophysiology-4, pharmacology-8, pharmaceuticals II-3, pharmacy skills laboratory II-1, pharmaceutical sciences laboratory-1, introductory pharmacy practice experience-2, disease state management-5, behavioral pharmacy communications-2, and biopharmaceutics/basic pharmacokinetics-3. The remaining clinical and administrative science courses are completed in the third professional year and include pharmacy practice-4, applied pharmacokinetics-3, disease state management-10, pharmacy management-3, research and literature evaluation-2, introductory pharmacy practice experience-2, elective-2, practice management/pharmacoeconomics-3, pharmacy law-2, and basic and clinical nutrition-3. The last year is composed of 42 credit hours of experiential training.

The study population consisted of students who entered the college between 2007 and 2009 (Table 1). Any student who had an incomplete file or voluntarily withdrew from the program for nonacademic reasons was excluded from the study. The prepharmacy variables considered in this study included prior degree (bachelor's, master's, and doctorate), cumulative and math-science GPA (MSGPA) as calculated from the required prepharmacy coursework, the presence of unsatisfactory grades (D or F) in nonscience courses or in math-science courses using the categories none and 1 or more. Students were also grouped by the presence of any unsatisfactory grades using the categories none, 1, 2, and 3 or more. Additional prepharmacy variables included the number of credit hours in advanced biology, chemistry, and math courses, and student type (internal, readmit, or transfer). All GPAs were calculated using every attempt for each course. The advanced courses were any courses taken beyond the prerequisite courses at the junior or senior level or above.

Table 1. Demographics of Doctor of Pharmacy Admissions From 2007-2009 (n=460)

Demographic	Value (n,%)			
	2007 (154, 33.5)	2008 (155, 33.7)	2009 (151, 32.8)	Overall (460, 100)
Gender (Female)	109, 70.8	94, 60.6	107, 70.9	310, 67.4
Ethnicity				
Black	83, 53.9	68, 43.9	75, 49.7	226, 49.1
White	21, 13.6	18, 11.6	21, 13.9	60, 13.1
Asian/Pacific Islander	6, 3.9	22, 14.2	12, 7.9	40, 8.7
Asian American	34, 22.1	29, 18.7	35, 23.2	98, 21.3
Other (Hispanic, unknown, other minority)	10, 6.5	18, 11.6	8, 5.3	36, 7.8
No previous degree held	118, 76.6	102, 65.8	92, 60.9	312, 67.9
Student type				
Internal	102, 66.2	115, 74.2	92, 60.9	309, 67.2
Readmit	12, 7.8	13, 8.4	20, 13.2	45, 9.7
Transfer	40, 26	27, 17.4	39, 25.8	106, 23.0
Prepharmacy coursework completed at 4-year institution	150, 97.4	150, 96.8	146, 96.7	446, 97.0
No unsatisfactory grades (D/F)	98, 63.6	85, 54.8	93, 61.6	276, 60.0
No advanced coursework	111, 72.1	94, 60.6	90, 59.6	295, 64.1
On-time graduation	101, 65.6	106, 68.4	115, 76.2	322, 70
Delayed graduation	39, 25.3	39, 25.2	29, 19.2	107, 23.3
Dismissed	14, 9.1	10, 6.5	7, 4.6	31, 6.7
Age (years) on admission, mean (SD)	23.8 (3.7)	23.0 (3.7)	24.1 (4.8)	23.6 (4.1)
Prepharmacy cumulative GPA (4.0 scale), mean(SD)	3.11 (0.43)	3.06 (0.55)	3.25 (0.41)	3.14 (0.47)
Math-science GPA (4.0 scale), mean (SD)	3.02 (0.52)	3.05 (0.59)	3.19 (0.49)	3.09 (0.54)

Internal students were students who completed their prepharmacy requirements at Xavier University. “Readmit” students were students who earned a degree from Xavier University in the College of Arts and Sciences and were readmitted to the university in the College of Pharmacy. Transfer students were students who completed their prepharmacy coursework at another institution. The Pharmacy College Admission Test (PCAT) was not included because it was not required for the students who entered the program in 2007 and 2008. The interview evaluations were not included because the subcomponents and the weighting of the subcomponents in the interview score changed over the 3-year study period.

To investigate whether any of the categorical prepharmacy variables (prior degree, presence of unsatisfactory grades in nonscience courses or in math-science courses, presence of any unsatisfactory grades, student type, and advanced coursework) were associated with on-time graduation, the chi-square test of association was performed reporting *p* values and group percentages. Estimated odds ratios and corresponding 95% confidence intervals (CI) were also reported when appropriate. The presence of any unsatisfactory grades included combined unsatisfactory grades in nonscience courses and in math-science courses.

For the continuous prepharmacy variables (cumulative and math-science GPA), correlations with on-time graduation were investigated using point biserial estimates. The outcome of interest in investigating the categorical prepharmacy variables was whether the variable had a significant effect on delaying graduation. Since correlations were used to investigate the continuous variables, the outcome of interest was whether the variable was significantly positively correlated with on-time graduation. Lastly, logistic regression was used to determine if any prepharmacy study variables were significant predictors of on-time graduation. Data were initially entered into an MS Excel spreadsheet. Significance was defined a priori as $p < 0.05$. All analyses were performed using SPSS Statistics, v19 (IBM, Armonk, NY). This study was approved by the Xavier University of Louisiana Institutional Review Board.

RESULTS

Four hundred ninety-six students entered the College of Pharmacy between 2007 and 2009. The investigators were able to obtain a complete file for 465 (94%) students. All were included in the analysis except five students who withdrew from the program for nonacademic reasons.

Students entering the program without a prior degree were 1.7 times more likely to have a delayed graduation compared to students who entered the program with a prior degree (95% CI from 1.07 to 2.63; $p=0.024$). For the student type variable, to control for possible Xavier-related confounding, the combined internal and readmitted students were 2.96 times more likely to have a delayed graduation compared to transfer students (95% CI from 1.66 to 5.26; $p=0.001$).

Students with the presence of at least one unsatisfactory grade in nonscience courses were 3.33 times more likely to have a delayed graduation compared to students with no unsatisfactory grades in nonscience courses (95% CI from 1.98 to 5.59; $p<0.001$). Students with the presence of at least one unsatisfactory grade in math-science courses were 2.43 times more likely to have a delayed graduation compared to students with no unsatisfactory grades in math-science courses (95% CI from 1.61 to 3.66; $p<0.001$). Table 2 summarizes these results.

For the presence of any unsatisfactory grades, students were categorized into the following four groups: none, 1, 2, and 3 or more. The chi-square test found a significant association between the delayed graduation rates in the four groups ($p<0.001$). Students with three or more unsatisfactory grades had the highest rate of delayed graduation at 49.3% ($n=67$). For those students with two unsatisfactory grades, the rate of delayed graduation decreased to 46.5% ($n=43$), and for those students with one unsatisfactory grade the rate of delayed graduation decreased to 35.1% ($n=74$). Finally, those students with no unsatisfactory grades had the lowest rate of delayed graduation at 21.4% ($n=276$). Table 3 summarizes the association of the presence of any unsatisfactory grades and delayed graduation rates.

In analyzing the continuous prepharmacy variables (cumulative GPA, math-science GPA, and advanced coursework), correlations with on-time graduation were investigated using point biserial estimates. Prepharmacy cumulative GPA (0.275; $p<0.001$) and math-science GPA (0.249; $p<0.001$) were significantly positively correlated with on-time graduation while advanced coursework (0.065; $p=0.164$) was not. A separate investigation of an association between on-time graduation and students who completed advanced coursework in either biology, chemistry, and math was completed and summarized in Table 4. None of the advanced coursework variables were significantly associated with on-time graduation.

Based on these findings, a logistic regression model was used to predict on-time graduation using the following candidate predictor variables: prior degree, student type, the presence of unsatisfactory grades in nonscience courses or math-science courses, the presence of any

Table 2. Delayed Graduation Rates by Presence of Unsatisfactory Grades (USGs) Earned in Nonscience and Math-Science Courses

Presence of USGs in Nonscience Courses	Students with Delayed Graduation, % (n)
1 or more	53.5 (71)
None	25.7 (389)
Presence of USGs Math-Science Courses	Students with delayed graduation % (n)
1 or more	42.3 (163)
None	23.2 (297)

unsatisfactory grades, prepharmacy GPA, and math-science GPA. With all seven variables in the model, the logistic regression procedure identified that having a prior degree increased the odds of on-time graduation by a factor of 1.9, the presence of unsatisfactory grades in nonscience courses decreased the odds of on-time graduation by a factor of 0.6, and each unit increase in prepharmacy GPA increased the odds of on-time graduation by a factor of 3.5. The results of the logistic regression, coefficients, confidence intervals, and their significance are summarized in Table 5. While the predictors in the model are significant, the overall explained variability of the model was only 10.2%.

DISCUSSION

Schools of pharmacy are faced with the challenge of identifying and admitting qualified and competent students who will complete the program in a timely manner. In a climate of growing competition for these students, it is paramount that admissions committees have effective criteria to evaluate potential candidates.

Many studies evaluated the relationship between preadmission variables and success in a PharmD program. The outcome measures in these studies included, but were not limited to, academic performance in each professional year, capstone examinations, and performance on the North American Pharmacists Licensure Examination (NAPLEX).⁵⁻²⁹ While these outcomes are important, they don't allow for an analysis of which pre-admission variables are able to predict if a student will progress through the program in the expected timeframe. The present study confirms and expands on the previous research on this topic.

The current study demonstrated that having a prior degree is predictive of on-time graduation. This is similar to findings of McCall and colleagues who found a significant correlation between students with prior BS degrees and timely graduation.³ Also, Steinberg and colleagues found that students with a prior bachelor's degree were more likely to graduate on time.⁴ However, Thomas et al found no significant difference between students with a

Table 3. Significant Association ($p < 0.001$) Between Delayed Graduation Rates and the Presence of Any Unsatisfactory Grades (USGs)

Group	Students with Delayed Graduation, % (n)
3 or more USGs	49.3 (67)
2 USGs	46.5 (43)
1 USG	35.1 (74)
No USGs	21.4 (276)

4-year college degree and academic performance in the first year of pharmacy school.²⁸ This is in contrast to several published studies demonstrating the effect of prior degree completion on success in the PharmD program.^{4,25-27,29} Renzi et al found students with bachelor degrees prior to entry into the PharmD program were more likely to perform better academically. They attributed this finding to factors such as increased maturity, exposure to courses at higher academic levels, increased likelihood of being independent learners, and expectations of more demanding, higher-order thinking course work.²⁰ Chisholm et al also found that students with a prior bachelor's degree obtained higher GPAs in the first year of pharmacy school compared to students without a prior degree.^{26,27} Unni et al noted a relationship between a science-related bachelor degree and success in the first professional year of an accelerated program.²⁹

The prepharmacy cumulative GPA was significantly correlated and found to be a predictor of on-time graduation in the present study. McCall and colleagues also found prepharmacy cumulative GPA to be a predictor of on-time graduation.³ Also, Steinberg and colleague found greater likelihood for on-time graduation in students with overall prematriculation GPA greater than or equal to 3.6.⁴ While many studies confirmed that prepharmacy cumulative GPA is a stable predictor of success in pharmacy programs,^{6-20,24,25,29} two studies found no association with prepharmacy cumulative GPA and academic performance.^{27,28}

The mean prepharmacy cumulative GPA was above 3.0 in this study. However, the on-time graduation rate was below the ACPE threshold. A possible explanation could be that the students were not used to the rigor of a professional program. The courses are more intense and often require many hours of studying beyond the time spent in the classroom to be successful. Also, some students may have relied on previous study habits such as rote memorization to be successful in the program. This can be problematic as courses in a pharmacy curriculum build upon one another and require students to be able to apply, analyze, and evaluate information. Lastly, students can struggle with managing their time wisely. Being able

Table 4. Association Between Advanced Coursework (Biology, Chemistry, and Math) and On-Time Graduation

Course	No. of students (range of credit hours)	Students with Delayed Graduation (%)	p value
Biology			
Yes	142 (2-44)	25.4	0.1
No	318	32.1	
Chemistry			
Yes	128 (1-27)	25.0	0.1
No	332	31.9	
Math			
Yes	20 (1-11)	15.0	0.1
No	440	30.7	

to maintain a balance between school and personal life can be a difficult task for a student who has transitioned into a professional program.

The investigation of math-science GPA in the present study yielded a significant correlation with on-time graduation. McCall et al did not evaluate this variable.³ However, other studies supported the significance of math-science GPA with success during the first year of pharmacy school, program success, and poor grade attainment in the PharmD program.^{12,15,16,20,22,24-29} One study showed at least 90% of students entering with a prepharmacy math-science GPA of 2.5 or higher attained a first-year GPA of 2.5 or higher.²⁷

There were no significant correlations found with on-time graduation and advanced coursework in biology, chemistry, and math. These results are similar to the McCall study with the exception of advanced coursework in biology. It was not only found in the McCall study to be a predictor of academic performance in the program, but also found to be significantly associated with the odds of graduating on time.³

Significant correlations were found between the presence of unsatisfactory grades in nonscience courses, math-science courses, and the combination and on-time graduation. This is similar to Allen and Diaz's study that evaluated the presence of any unsatisfactory grades made in the prepharmacy program as a predictor of success on the NAPLEX.²¹ Among these variables, a lack of unsatisfactory grades in nonscience courses was found to be a predictor of on-time graduation. A possible explanation of this finding may lie in the relationship between reading comprehension and academic performance. The nonscience courses included in this analysis were English, theology, speech, philosophy, health ethics, microeconomics, psychology or sociology, and an elective. The majority of these courses require students to be able to read and comprehend the text materials.

Table 5. Significant Predictors of On-time Graduation

Predictor	Coefficients (B)	p value	Exp (B)	95% CI For Exp (B)
Constant	-3.08	< 0.001	0.05	
Prior Degree	0.65	0.007	1.9	1.2-3.1
Number of Unsatisfactory Grades in Nonscience Courses	-0.49	0.018	0.6	0.4-0.9
Prepharmacy GPA	1.25	< 0.001	3.5	2.1-5.8

Exp (B) represents the odds of graduating on time for those with the predictor characteristic compared to those without the predictor characteristic; GPA=grade point average

Likewise, in pharmacy programs, the demand for reading increases along with the complexity of the reading materials (eg, textbooks and primary literature).³⁰ These factors alone could impact reading comprehension and academic performance. Several studies also demonstrated a significant relationship between the PCAT reading comprehension section and academic performance in a PharmD program. For example, Meagher et al noted that the reading comprehension section of the PCAT was predictive of GPA in each year of a 4-year pharmacy program.¹⁸ Schauner et al also found that the PCAT reading comprehension section was predictive of poor grade attainment.²⁵

Approximately 23% of the pharmacy students included in this study were transfer students, who were found to have a significantly higher rate of on-time graduation than internal or readmit students. Most students who transfer into a PharmD program complete their prepharmacy prerequisites at a 2-year or 4-year institution.

Despite the model explaining only 10.2% of the variability, admissions committees should strongly consider prepharmacy cumulative GPA and prior degree when evaluating students during the admissions process. Prepharmacy cumulative GPA is significantly correlated and/or predictive of success in the program and on-time graduation.^{6-20,24,25,29} Likewise, having a prior degree is significantly correlated with success in a PharmD program.^{3,25-27,29} The presence of unsatisfactory grades in nonscience courses and math-science courses and the combination of those were new variables, which were all significantly correlated with on-time graduation. Although the presence of no unsatisfactory grades in nonscience courses proved to be a predictor of on-time graduation, additional studies may be warranted before its role in the selection process can be determined. The math-science GPA was a new variable as well and only showed significant correlations with on-time graduation. However, several studies showed it to be a predictor of success in a PharmD programs and should be strongly considered as well.^{12,15,16,20,22,24-29} Lastly, additional evidence is needed to determine the value of student type and the number of credit hours in advanced coursework.

The college will continue to use prepharmacy cumulative GPA, prior degree, and math-science GPA to identify students who are likely to complete the program in a timely manner and for potential placement in the AEP. However, the weighting of these components will be reevaluated. Future research efforts will focus on adding the PCAT and noncognitive admission qualities to the existing variables. Noncognitive admission qualities are predictive of clinical performance in pharmacy, nursing, and physical therapy programs.^{31,32} The qualities we will examine are empathy, integrity, problem solving, social awareness, and leadership.

The limitations of this study include the retrospective nature of data collection, which may have resulted in missing or incomplete data. The definition of advance courses beyond the prerequisites may include or exclude courses that are not considered to be at the junior or senior level. This may be attributed to the difference in classification of the courses among schools. The authors were also unable to differentiate between the various types of degrees and majors. In particular the types of bachelor degrees (BS or BA). Lastly, the results of this analysis may not be generalizable to other institutions. Further research in different student populations are needed to confirm the results of this study.

CONCLUSION

This study confirmed that prepharmacy cumulative GPA is a predictor of on-time graduation. It also expanded on research on this topic by showing that prior degree, and the presence of no unsatisfactory grades in nonscience courses are predictors of on-time graduation as well.

REFERENCES

1. Accreditation Council for Pharmacy Education. Policies and procedures for accreditation of professional degree programs. Chicago, IL. (Revised. July 2014).
2. Accreditation Council for Pharmacy Education. Accreditation standards and guidelines for the professional program in pharmacy leading to the doctor of pharmacy degree. Chicago, IL. (Effective. February 2011).
3. McCall KL, Allen DD, Fike DS. Predictors of academic success in a doctor of pharmacy program. *Am J Pharm Educ.* 2006;70(5): Article 106.

4. Steinberg M, Morin AK. The impact of prematriculation admission characteristics on graduation rates in an accelerated doctor of pharmacy program. *Am J Pharm Educ.* 2015;79(8):118.
5. Munson JW, Bourne DW. Pharmacy College Admission Test (PCAT) as a predictor of academic success. *Am J Pharm Educ.* 1976;40(3):237-239.
6. Kotzan JA, Entrekin DN. Validity comparison of PCAT and SAT prediction of first-year GPA. *Am J Pharm Educ.* 1977;41(1):4-7.
7. Liao WC, Adams JP. Methodology for the prediction of pharmacy student academic success I: preliminary aspects. *Am J Pharm Educ.* 1977;41(2):124-127.
8. Lowenthal W, Wergin JS, Smith HL. Predictors of success in pharmacy school: PCAT versus other admission criteria. *Am J Pharm Educ.* 1977;41(3):267-269.
9. Munson JW, Bourne DW. Pharmacy College Admission Test (PCAT) as a predictor of academic success. II: a progress report. *Am J Pharm Educ.* 1977;41(3):272-274.
10. Jacoby KE, Plaxco WB, Kjerulff K, Weinert AB. The use of demographic background variables as predictors of success in pharmacy school. *Am J Pharm Educ.* 1978;42(1):4-7.
11. Torosian G, Marks RG, Hanna DW, Lepore RH. An analysis of admission criteria. *Am J Pharm Educ.* 1978;42(1):7-10.
12. Friedman CB, Lage G, Norwood J, Stewart J. Predictive validity of the pharmacy college admission test. *Am J Pharm Educ.* 1987;51(3):288-291.
13. Charupatanpong N, McCormick WC, Rascati KL. Predicting academic performance of pharmacy students: demographic comparisons. *Am J Pharm Educ.* 1994;58(3):262-268.
14. Chisolm MA, Cobb HH, Kotzan JA. Significant factors for predicting academic success of first-year pharmacy students. *Am J Pharm Educ.* 1995;59(4):364-370.
15. Chisolm MA, Cobb HH, Dipiro JT, Lauthenschlager GJ. Development and validation of a model that predicts the academic ranking of first-year pharmacy students. *Am J Pharm Educ.* 1999;63(4):388-394.
16. Kelly KA, Secnik K, Boye ME. An evaluation of the pharmacy college admissions test as a tool for pharmacy college admissions committees. *Am J Pharm Educ.* 2001;65(3):225-230.
17. Kuncel NR, Credé M, Thomas LL, Klieger DM, Seiler SN, Woo SE. A meta-analysis of the validity of the Pharmacy College Admission Test and grade predictors of pharmacy student performance. *Am J Pharm Educ.* 2005;69(3):Article 51.
18. Meagher DG, Lin A, Stellato C. A predictive validity study of the Pharmacy College Admission Test. *Am J Pharm Educ.* 2006;70(3): Article 53.
19. Lobb WB, Wilkin NE, McCaffrey DJ, Wilson MC, Bentley JP. The predictive utility of nontraditional test scores for first-year pharmacy student performance. *Am J Pharm Educ.* 2006;70(6):Article 128.
20. Renzi SE, Krzeminski MA, Sauberan MM, Brazeau DA, Brazeau GA. Prepharmacy years in college and academic performance in a professional program. *Am J Pharm Educ.* 2007;71(4):69.
21. Allen RE, Diaz C Jr. Use of preadmission criteria and performance in the doctor of pharmacy program to predict success on the North American Pharmacists Licensure Examination. *Am J Pharm Educ.* 2013;77(9):Article 193.
22. McCall KL, MacLaughlin EJ, Fike DS, Ruiz B. Preadmission predictors of PharmD graduates' performance on the NAPLEX. *Am J Pharm Educ.* 2007;71(1):5.
23. Allen DD, Bond CA. Prepharmacy predictors of success in pharmacy school: grade point averages, pharmacy college admissions test, communication abilities, and critical thinking skills. *Pharmacotherapy.* 2001;21(7):842-849.
24. Meagher DG, Pan T, Perez CD. Predicting performance in the first-year of pharmacy school. *Am J Pharm Educ.* 2011;75(5):Article 81.
25. Schauner S, Hardinger KL, Graham MR, Garavalia L. Admission variables predictive of academic struggle in a PharmD program. *Am J Pharm Educ.* 2013;77(1):Article 8.
26. Chisholm MA, Cobb HH, Kotzan JA. Prior four year college degree and academic performance of first year pharmacy students: a three year study. *Am J Pharm Educ.* 1997;61(3):278-281.
27. Chisholm MA. Students' performance throughout the professional curriculum and the influence of achieving a prior degree. *Am J Pharm Educ.* 2001;65(4):350-354.
28. Thomas MC, Draugalis JR. Utility of the Pharmacy College Admission Test (PCAT): Implications for admission committees. *Am J Pharm Educ.* 2002;66(1):47-51.
29. Unni EJ, Zhang J, Radhakrishnan R, Smith K, et al. Predictors of academic performance of pharmacy students based on admission criteria in a 3-year pharmacy program. *Curr Pharm Teach Learn.* 2011;3(3):192-198.
30. Fuller S, Horlen C, Cisneros R, Merz T. Pharmacy students' reading ability and the readability of required reading materials. *Am J Pharm Educ.* 2007;71(6):Article 111.
31. Stolte SK, Scheer SB, Robinson ET. The reliability of non-cognitive admissions measures in predicting non-traditional doctor of pharmacy student performance outcomes. *Am J Pharm Educ.* 2003;67(1) Article 18.
32. Latif DA. Including the assessment of nontraditional factors in pharmacy school admissions. *Ann Pharmacotherapy.* 2005;39(4):721-726.