RESEARCH

Use of Preadmission Criteria and Performance in the Doctor of Pharmacy Program to Predict Success on the North American Pharmacists Licensure Examination

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Objective. To determine which student characteristics and performance criteria in the prepharmacy and doctor of pharmacy (PharmD) program predict success on the North American Pharmacist Licensure Examination (NAPLEX).

Methods. Transcripts and NAPLEX scores were reviewed for 432 graduates from the Xavier University of Louisiana College of Pharmacy between 2008 and 2011.

Results. The preadmission variables that correlated with NAPLEX scores included math-science grade point average (GPA), cumulative GPA, student type (internal or transfer), and having no unsatisfactory grades ($p < 0.001$). In the PharmD program, cumulative GPA, on-time graduation, and having no unsatisfactory grades in the prepharmacy and PharmD programs correlated with NAPLEX scores ($p < 0.001$).

Conclusion. Having no unsatisfactory grades in the prepharmacy program and a high cumulative GPA in the PharmD program were identified as significant predictors of success on the NAPLEX.

Keywords: North American Pharmacist Licensure Examination, admissions, grade point average

INTRODUCTION

United States colleges and schools of pharmacy are challenged with identifying and enrolling students who are most likely to be successful in their programs and pass the NAPLEX. The latter can be a daunting task for admissions committees because of the number of applicants and the paucity of research on preadmission criteria as predictors of success on the NAPLEX.

A series of articles by Lowenthal and colleagues explored the relationship between preadmission criteria, academic performance in the PharmD program, and success on the National Association of Boards of Pharmacy Licensure Examination (NABPLEX) and reported that PCAT scores were predictive of NABPLEX scores and a significant correlation existed between GPA in the first 3 years and NABPLEX performance.[1,2] Manasse and colleagues also examined the relationship between academic performance in the PharmD program and NABPLEX scores. Although statistical modeling was not done to determine predictability, the authors noted a correlation between the graduating GPA and NABPLEX performance.[3]

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After the NABPLEX was changed to the NAPLEX, a study was done that evaluated preadmission criteria as a predictor of success on the NAPLEX and another study was done that examined academic performance in PharmD programs as a predictor. In 2007, McCall and colleagues examined the relationship between preadmission criteria to include PCAT composite scores, PCAT subcategory scores; California Critical Thinking Skills Test (CCTST) scores; cumulative GPA; prior degree; advanced math, chemistry, and biology courses; age; organic chemistry completed at a 2-year institution or a 4-year institution; and performance on the NAPLEX. There was a positive correlation between GPA, PCAT composite scores, CCTST scores, and NAPLEX scores. However, the PCAT composite score proved to be the strongest predictor of success or failure on the NAPLEX.[4] A study was also published that examined the impact of a student's remediation status on NAPLEX first-time pass rates. The students who required remediation for failing course grades had a lower pass rate compared to those who did not require remediation.[5]

The purpose of this study at Xavier University of Louisiana College of Pharmacy (XULACOP) was to confirm and expand the existing body of research on this topic by evaluating which student criteria in the prepharmacy and PharmD program predicted success or failure on

a student's first attempt on the NAPLEX. No studies have included the number of unsatisfactory grades, math-science GPA, or student type (internal or transfer) as pre-admission variables to predict success on the NAPLEX. We chose these variables, in addition to previous degree held and cumulative GPA, because they are most likely to be considered by admissions committees. Variables such as age, gender, and ethnicity were not included because we were not aware of any programs that consider these variables in the selection process. Likewise, no studies have examined PharmD program variables such as the number of unsatisfactory grades, cumulative GPA, and timely graduation as predictors of success on the NAPLEX. These variables were chosen because the results could have implications for student retention programs. Evaluation of these relationships is paramount because the NAPLEX is required for all graduates to be licensed to practice pharmacy. Also, the Accreditation Council for Pharmacy Education requires all US colleges and schools of pharmacy to assess student performance on the NAPLEX.[6]

METHODS

The Xavier University of Louisiana College of Pharmacy began offering the PharmD degree in 1991. The PharmD program requires 2 years of undergraduate coursework and 4 years in the PharmD program. The college requires 66 hours of prepharmacy coursework which can be divided into 39 semester hours of math and science courses, and 27 semester hours of nonscience courses. Upon entering the PharmD program, the students are required to complete 96 semester hours of lecture-based coursework and 48 semester hours of experiential education.

The study population consisted of students who graduated from the program between 2008 and 2011. Although all of the students did not participate, 432 students gave the NABP permission to release their test scores to XULACOP. The prepharmacy variables that were considered in this study included previous degree held (bachelors, masters, and doctorate), the number of unsatisfactory grades ("D" or "F"), prepharmacy cumulative GPA as calculated from the required prepharmacy coursework, math-science GPA as calculated from the required prepharmacy math and science courses, and student type (internal or transfer). Internal students completed their prepharmacy coursework at Xavier University and the transfer students completed their prepharmacy coursework at another institution. The PCAT was not included because it was not a requirement until 2009. The PharmD program variables that were considered included the total unsatisfactory grades in the prepharmacy and PharmD programs (grades

of "D" or "F"), timely graduation (graduation in 4 years), and cumulative GPA upon graduation calculated using the required lecture-based courses. All of the GPAs were calculated using every attempt for a course to include passing and failing grades. The experiential education courses were not included in the cumulative GPA because they were pass/fail courses. However, if a student failed a practice experience, that grade of "F" was included in the unsatisfactory grades count in the PharmD program. Interview evaluations were not included in this analysis because the subcomponents and the weighting of the subcomponents in the interview score changed over the 4-year study period.

Descriptive statistics were calculated for all pre-admission and PharmD program variables. Bivariate correlations were estimated using the Pearson correlation coefficient for continuous pairings and point biserial correlations for discrete/continuous pairings. With an adequate sample size for the analysis of preadmission and PharmD program variables, large sample z tests were used to compare NAPLEX passing rates for internal vs transfer students; having no unsatisfactory grades vs having at least 1 unsatisfactory grade; and on-time graduation vs delayed graduation. Test results were reported using 95% confidence intervals (CI).

Logistic regression analysis was performed to determine if passing the NAPLEX was associated with the following preadmission variables: previous degree held, transfer student status, having no unsatisfactory grades, math-science GPA, and prepharmacy GPA. A similar analysis was performed to determine if passing the NAPLEX was associated with the following PharmD program variables: having no unsatisfactory grades, timely graduation, and cumulative GPA. Results from the regressions were reported as significant predictors of passing the NAPLEX along with interpretations of the estimates of the regression coefficients.

Data were entered into an MS Excel spreadsheet. Significance was defined *a priori* as $p < 0.05$. All analyses reported were performed using SPSS, version 12.0 (IBM SPSS, New York). This study was approved by the Xavier University of Louisiana Institutional Review Board.

RESULTS

The study analysis included 432 senior pharmacy students who graduated from 2008 to 2011 (Table 1). Each student gave XULACOP permission to receive their NAPLEX score.

The results of the correlation of the preadmission variables with the NAPLEX score found that students with a previous degree were not significantly correlated (Table 2). The math-science GPA, prepharmacy GPA,

Table 1. Demographics of Doctor of Pharmacy Program Graduates From 2008 to 2011 (n=432)

Demographic	Value
Preadmission	
Age (years) on admission, mean (SD)	23.0 (4)
Gender (% female)	78.2
Ethnicity (%)	
Black	51.2
White	16.9
Asian/Pacific Islander	9.7
Asian American	17.8
Other (Hispanic, unknown, other minority)	4.4
No previous degree held, %	84.5
Student type, internal, %	77.8
No unsatisfactory grades (D/F), %	74.3
Math-Science GPA, mean (SD)	3.19 (0.5)
Cumulative GPA, mean (SD)	3.24 (0.4)
Professional program	
No unsatisfactory grades through completion (D/F), %	70.4
Timely completion, %	85.4
Cumulative GPA, mean (SD)	3.10 (0.5)
NAPLEX score, mean (SD)	98.5 (20.7)

Abbreviations: GPA=grade point average, NAPLEX=North American Pharmacist Licensure Examination, PharmD=doctor of pharmacy.

being a transfer student, and having no unsatisfactory grades ("D" or "F") were each significantly positively correlated with the NAPLEX score. The prepharmacy GPA had the strongest correlation ($p<0.001$).

Of the 432 students, 96 (22.2%) were transfer students and 336 (77.8%) were internal students. Of the transfer students, 87 (90.6%) obtained a passing score on the NAPLEX compared to 285 (84.8%) of the internal students, which was not a significant difference in passing rates (95% CI for the difference in passing rates between internal and transfer students: 5.8%±7.0%).

Of the 432 students, 321 had no unsatisfactory grades and 111 had at least 1 unsatisfactory grade (range from

Table 2. Correlations Between Doctor of Pharmacy Program Preadmission Variables and North American Pharmacist Licensure Examination Scores

Variable	Correlation with NAPLEX, P
Math-Science GPA	<0.001
Cumulative GPA	<0.001
Previous degree held	0.757
Transfer student	<0.001
No unsatisfactory grades	<0.001

Abbreviations: GPA=grade point average, NAPLEX=North American Pharmacist Licensure Examination.

1 to 6) in their prepharmacy courses. Of the 321 students who had no unsatisfactory grades, 289 (90%) obtained a passing score on the NAPLEX. Of the 111 students who received at least 1 unsatisfactory grade, 83 (74.8%) obtained a passing score. The comparison of these 2 proportions yielded a significant difference in passing rates (95% CI for the difference in passing rates between those students having no unsatisfactory grades and those students having at least 1 unsatisfactory grade: 15.2%±8.7%).

NAPLEX passing rates were computed as a percentage of students falling within 4 ranges of math-science GPAs and prepharmacy GPAs (Table 3). The 4 GPA ranges chosen were defined by the smallest value, 1st quartile, 2nd quartile (median), 3rd quartile, and largest value.

All PharmD program variables were significantly positively correlated with NAPLEX scores (Table 4). The PharmD program variable that had the strongest correlation with the NAPLEX score was cumulative GPA ($p<0.001$). NAPLEX passing rates were computed as a percentage of students falling within the 4 ranges of PharmD program cumulative GPAs (Table 5).

Of the 432 students, 369 (85.4%) graduated from the PharmD program on time and 63 (14.6%) graduated later. Of the 369 on-time graduates, 325 (88%) obtained a passing score on the NAPLEX. Of the 63 delayed graduates, 47 (75%) obtained a passing score. The comparison of these 2 proportions yielded a significant difference in passing rates (95% CI for the difference in passing rates between on-time graduates and delayed graduates: 13.0%±11.2%).

Of the 432 students, 254 (58.7%) had no unsatisfactory grades and 178 (41.3%) had at least 1 unsatisfactory grade (range from 1 to 12) in their prepharmacy and PharmD

Table 3. North American Pharmacist Licensure Examination Pass Rates and Pharmacy Program Preadmission Grade Point Averages

Quartiles	GPA	Pass Rate, No. (%)
Math-Science		
Smallest value – 1st quartile	1.7 – 2.8	111 (79)
1st quartile – 2nd quartile	2.8 – 3.2	105 (86)
2nd quartile – 3rd quartile	3.2 – 3.5	108 (88)
3rd quartile – largest value	3.5 – 4	108 (92)
Cumulative		
Smallest value – 1st quartile	2.3 – 2.9	112 (80)
1st quartile – 2nd quartile	2.9 – 3.2	106 (84)
2nd quartile – 3rd quartile	3.2 – 3.5	107 (86)
3rd quartile – largest value	3.5 – 4	107 (94)

Abbreviations: GPA=grade point average.

Table 4. Correlations Between Doctor of Pharmacy Program Variables and North American Pharmacist Licensure Examination Scores

Variable	Correlation With NAPLEX, *P*
Cumulative GPA	<0.001
Timely graduation	<0.001
Total unsatisfactory grades	<0.001

Abbreviations: GPA=grade point average, NAPLEX=North American Pharmacist Licensure Examination.

program courses. Of the 254 students who received no unsatisfactory grades, 235 (92.5%) obtained a passing score on the NAPLEX. Of the 178 students who received at least 1 unsatisfactory grade, 137 (77.0%) obtained a passing score. The comparison of these 2 proportions yielded a significant difference in passing rates (95% CI for the difference in passing rates between those students having no unsatisfactory grades and those students having at least 1 unsatisfactory grade: 15.5%±7.0%). To predict student scores on the NAPLEX, we used a logistic regression model for analysis because the only outcome of interest on the NAPLEX was pass/fail. In addition, a multiple regression model was investigated to predict raw NAPLEX scores. This model resulted in 100% of the predicted scores being passing scores, which further supported the use of a logistic model. A logistic regression was performed using the following preadmission variables: previous degree held, transfer student status, no unsatisfactory grades, math-science GPA, and prepharmacy GPA. The forward-selection procedure identified only 1 significant predictor of success, having no unsatisfactory grades. The estimate of the coefficient for no unsatisfactory grades (-1.114) being negative indicated the probability of passing the NAPLEX was significantly lower for students with at least 1 unsatisfactory grade.

Table 5. North American Pharmacist Licensure Examination Pass Rates and Doctor of Pharmacy Program Cumulative Grade Point Average Correlations

	Correlation with NAPLEX	
Quartiles	PharmD Program Cumulative GPA	Pass Rate, No.(%)
Smallest value – 1st quartile	2.0-2.7	110 (70)
1st quartile – 2nd quartile	2.7-3.1	108 (82)
2nd quartile – 3rd quartile	3.1-3.5	107 (94)
3rd quartile – largest value	3.5-4.0	107 (98)

Abbreviations: GPA=grade point average, NAPLEX=North American Pharmacist Licensure Examination, PharmD=doctor of pharmacy.

A secondary logistic regression with success on the NAPLEX as the outcome of interest was performed using the following variables: no unsatisfactory grades in the prepharmacy and PharmD program, timely graduation, and cumulative GPA. The procedure identified only 1 significant predictor of success: cumulative GPA with an estimated logistic regression coefficient of 2.092. This positive coefficient indicated that the probability of passing the NAPLEX was higher for students with higher cumulative GPAs. The positive estimated coefficient for cumulative pharmacy GPA indicated that the probability of a student passing the NAPLEX was higher when the student's cumulative pharmacy GPA was higher.

DISCUSSION

Identifying predictors of success on the NAPLEX in prepharmacy and PharmD programs can be difficult because of the dearth of research on this topic. The few studies that have been published focus on the NABPLEX or they examine prepharmacy program variables or PharmD program variables alone. For example, the articles by Lowenthal and Manasse were published before the NABPLEX was changed to the NAPLEX computer-adaptive format. The examination at that time was divided into 5 subcategories to include pharmacy, pharmacy calculations, pharmacology, pharmaceutical chemistry, and pharmacy practice. These subcategories varied from the 3 focal areas in the current NAPLEX blueprint. Therefore, it is difficult to make any comparisons with these studies. However, the McCall publication did examine 2 similar preadmission variables, PGPA and previous degree held, and the study by Malden and colleagues focused on remediation status in the PharmD program.

The investigation of preadmission variables yielded significant positive correlations of NAPLEX scores with MSGPA and PGPA. As ranges of these 2 GPA measures increased, so did the passing rates on the NAPLEX. The finding for prepharmacy GPA is consistent with the results in the study by McCall. A correlation was found for previous degree held, but it was weak and insignificant. This finding is also consistent with the study by McCall and colleagues. While significant, the correlation between transfer and internal student status, and NAPLEX score was weak. Further analysis of this variable in the logistic regression model resulted in student type not being a significant predictor of success on the NAPLEX. The last preadmission variable analyzed was whether a student had no unsatisfactory grades or at least 1 unsatisfactory grade. This variable significantly correlated with NAPLEX score and further analysis resulted in a significant difference in passing rates between the 2, with having no unsatisfactory grades yielding the higher pass rate.

The preadmission analysis results cannot be readily generalized to other institutions because there has only been 1 other study that has evaluated preadmission criteria and success on the NAPLEX. However, this study confirms and extends previous research on this topic. Significant positive correlations were noted with PGPA in our study, which is consistent with the McCall publication. Prepharmacy cumulative grade point average has been shown to be a stable predictor of success in PharmD programs.[7-23] The MSGPA was not a predictor in this study, but did show significant positive correlations with success on the NAPLEX. This is consistent with previous studies when math-science GPA has been examined as a predictor of success in pharmacy programs.[13,16,17,20,23-25] Although admissions committees make comparisons between internal students and transfer students, this study did not find any appreciable differences between the 2 groups. Of all the preadmission variables studied, having no unsatisfactory grades was the best predictor of success on the NAPLEX. Admissions committees should continue to use prepharmacy GPA and math-science GPA, and consider examining the number of unsatisfactory grades during the selection process.

The investigation of PharmD program variables yielded significant positive correlations with timely graduation, having no unsatisfactory grades in the prepharmacy and PharmD program, and cumulative GPA. Results showed significantly different NAPLEX pass rates for students who graduated on time compared to students whose graduation was delayed, with on-time graduates having the higher rate. NAPLEX pass rates for students with no unsatisfactory grades were significantly different from those with at least 1 unsatisfactory grade. Students with no unsatisfactory grades had the higher pass rate. Cumulative GPA was significantly positively correlated with NAPLEX scores and as ranges of cumulative GPA increased so did pass rates.

The results of the PharmD program analysis support and expand previous research on this topic and may have implications for student retention programs. In the study by Madden and colleagues, students who did not require remediation were more likely to pass the NAPLEX on the first attempt compared to those who did require remediation, suggesting that students who have not had any unsatisfactory grades in the PharmD program are more likely to pass the NAPLEX. We also found that students with no unsatisfactory grades had a higher pass rate compared to those with 1 or more unsatisfactory grades.

Although the results of this analysis need to be confirmed by additional studies among different student populations in different environments, they may warrant colleges and schools of pharmacy to examine their retention strategies to determine what services are being provided to ensure students are able to progress through their program in a timely manner. At XULACOP, the student retention services are designed around the premise of early identification and early intervention. Student performance is monitored early and frequently to detect signs of academic struggle. If a student is in jeopardy of earning/receiving an unsatisfactory grade, faculty, staff, or peer tutors intervene to provide assistance. The services provided include, but are not limited to, development of a comprehensive study schedule, online practice examinations, and faculty and peer tutoring. Being able to assist students before they experience academic difficulty may prevent unsatisfactory grades, improve GPAs, and lead to timely graduation.

CONCLUSION

This study determined which student criteria were significant predictors of success on the NAPLEX. Having no unsatisfactory grades in the preadmission program and a high cumulative GPA in the PharmD program stood out as the most significant predictors of success on the NAPLEX. The exploration of interview scores, PCAT composite scores, PCAT subcategory scores, and noncognitive variables (eg, empathy, leadership, integrity) may expand the findings of this study.

REFERENCES

1. Lowenthal W, Wergin JF. Relationship among student preadmission characteristics, NABPLEX scores, and academic performance during the later years in pharmacy school. *Am J Pharm Educ.* 1979;43(1):7-11.
2. Lowenthal W. Relationships among student admission characteristics, licensing examinations and didactic performance: comparison of three graduating classes. *Am J Pharm Educ.* 1981; 45(2):132-139.
3. Manasse H, Purohit A, Blake M, and Barnes B. Relationship between Collegiate Performance and Performance on the NABPLEX. *Am J Pharm Educ.* 1980;44(1):1-5.
4. McCall K, MacLaughlin E, Fike D, Ruiz B. Preadmission Predictors of PharmD Graduates' Performance on the NAPLEX. *Am J Pharm Educ.* 2007;71(1):Article 05.
5. Madden MM, Etzler FM, Schweiger T, Bell HS. The impact of pharmacy students' remediation status on NAPLEX first-time pass rates. *Am J Pharm Educ.* 2012;76(10): Article 191.
6. Accreditation Council for Pharmacy Education. Accreditation standards and guidelines for the professional program in pharmacy leading to the doctor of pharmacy degree. 2.0. Vol 2007. Illinois: Accreditation Council for Pharmacy Education; 2011. point biserial correlations https://www.acpe-accredit.org/pdf/S2007Guidelines2.0_ChangesIdentifiedInRed.pdf. Accessed November 26, 2012.
7. Munson JW, Bourne DW. Pharmacy College Admission Test (PCAT) as a predictor of academic success. *Am J Pharm Educ.* 1976;40(3):237-239.
8. Kotzan JA, Entrekin DN. Validity comparison of PCAT and SAT prediction of first-year GPA. *Am J Pharm Educ.* 1977;41(1):4-7.

9. 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.

10. 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.

11. 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.

12. 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.

13. Torosian G, Marks RG, Hanna DW, Lepore RH. An analysis of admission criteria. *Am J Pharm Educ.* 1978;42(1):7-10.

14. 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.

15. Charupatanpong N, McCormick WC, Rascati KL. Predicting academic performance of pharmacy students: demographic comparisons. *Am J Pharm Educ.* 1994;58(3):262-268.

16. 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.

17. 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.

18. 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.

19. Allen DD, Bond CA. Prepharmacy indicators of success in pharmacy school: grade point average, pharmacy college admission test, communication abilities, and critical thinking skills. *Pharmacotherapy.* 2001;21(7):842-849.

20. Thomas MC, Draugalis JR. Utility of the pharmacy college admission test (PCAT): implications for admissions committees. *Am J Pharm Educ.* 2002;66(1):47-51.

21. Kuncel N, Crede M, Thomas L, Kileger D, Sieler S, Woo S. 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.

22. Meagher D, Lin A, Stellato C. A predictive validity study of the Pharmacy College Admission Test. *Am J Pharm Educ.* 2006;70(3): Article 53.

23. Meagher D, Pan T, Perez C. Predicting performance in the first-year of pharmacy school. *Am J Pharm Educ.* 2011;75(5): Article 81.

24. Chhisolm 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.

25. Lobb W, Wilkin N, McCaffrey, Wilson M, and Bentley J. The predictive utility of nontraditional test scores for first-year pharmacy student performance. *Am J Pharm Educ.* 2006;70(6): Article 128.