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## Research Paper

## Examining the relationship between prerequisite grades and types of academic performance in pharmacy school

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## ABSTRACT

**Purpose:** To investigate relationships between different prerequisite course grades and grade point average (GPA) of different types of academic performance in a Canadian entry-to-practice pharmacy program while controlling for important demographic variables.

**Methods:** Data from eight years of recently admitted students (2007–2014) were used to conduct a series of multiple linear regression analyses to assess relationships between prerequisite course GPA and eight different pharmacy school academic performance variables including: GPA in each of the first three years of the program, overall Y1-Y3 GPA, and GPA in pharmaceutical science, clinical science, clinical practice, and behavioral, social, and administrative (BSA) science courses. Demographic predictor variables including gender, mature status, and whether students attended ranked versus non-ranked universities were included as control variables.

**Results:** Analysis reveals that Biology and Biochemistry prerequisite GPA consistently predicts all eight academic performance variables while prerequisite English GPA was found to predict only clinical practice and BSA GPA. Being female and attending ranked universities were revealed as positively associated with most types of performance. Being classified as a mature student generally predicted lower academic performance.

**Conclusions:** The consistent relationship between biology-based prerequisites and academic performance warrants consideration for increasing their weight in admissions GPA calculations. The fact that the set of prerequisites and demographic variables are weaker predictors of clinical practice and BSA performance than pharmaceutical science performance provides empirical support for recent moves to include non-traditional admission criteria.

## Introduction

Most North American pharmacy programs admit students based in large part on the completion of pre-pharmacy university course work. At least some of the pre-pharmacy coursework is defined to include specific prerequisite courses.<sup>1</sup> This is usually combined with other criteria, such as specialized pharmacy admittance examinations, admissions essays, and/or interviews. Assessing the ability of admissions criteria to predict pharmacy academic performance is an ongoing and important area of scholarship because demand for pharmacy education usually exceeds capacity. Without highly predictive admissions criteria there remains a chance of both false positive and false negative decisions regarding who to admit to a program.

There exists a tremendous amount of literature investigating relationships between various types of admissions criteria (e.g., Pharmacy College Admission Test (PCAT), multiple mini interviews (MMIs), pre-pharmacy grade point average (GPA), interview scores, demographic characteristics) and different measures of academic performance/success in pharmacy education. A basic search

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of pharmacy education journal databases using the key words “admissions,” “predicting,” and “success” reveals over 100 studies that have examined relationships between different admissions criteria and various types of academic success outcomes. A meta-analysis of many of these studies that examined the relationships between PCAT and overall pre-pharmacy GPA with various academic success outcomes like first-year GPA revealed pre-pharmacy GPA as a moderate to strong predictor of academic performance.<sup>2</sup> These findings provide support for the use of pre-pharmacy GPA as an important admissions decision metric.

An examination of studies that specifically focus on pre-pharmacy GPA as a predictor of academic performance reveals an interesting gap. In most of these studies, pre-pharmacy GPA is operationalized as a single overall pre-pharmacy measure or as multiple measures that differentiate between overall pre-pharmacy GPA and an overall pre-pharmacy GPA in only science/math.<sup>3-6</sup> There has been only a limited amount of research studying more detailed breakdowns of pre-pharmacy GPA in the literature. For example, McCall, Allen, and Fike<sup>7</sup> showed that advanced biology pre-pharmacy GPA is more strongly correlated with overall pharmacy GPA than other types of science-based pre-pharmacy courses. These findings show differences in the predictive utility of different types of prerequisite courses suggesting a need for more research to better understand differences in how prerequisite courses predict academic performance.

Furthermore, most research in this area tends to operationalize academic performance as overall GPA at various points in time in a program. There have only been limited attempts to explore how academic performance can be broken out in to different categories (e.g., pharmaceutical science, clinical science, clinical practice, and behavioral, social and administrative science (BSA)). In one study that explored a more nuanced breakdown, Allen and Bond<sup>5</sup> showed that PCAT scores and overall pre-pharmacy course GPA differentially predict clinical skills type academic performance also supporting an interesting area for further research.

Our review of the studies that look at the relationship between prerequisite course GPA and academic performance reveals a lack of research simultaneously examining how different types of prerequisite course GPA predict different types of academic performance. The present study intends to improve on the work done in this area by analyzing a full set of prerequisite course grades as predictors of different types of academic performance using multiple linear regression. This information can be used to identify where prerequisite course grades differ in their ability to predict different types of academic performance supporting decisions about how to weight prerequisites in overall pre-pharmacy GPA calculations as well as identifying where prerequisite grades are less effective at predicting performance.

## Methods

### *Background of the program*

The curriculum in years 1–3 of the program that serves as a basis for the present study consists of courses in four general areas: Pharmaceutical/basic Sciences (PharmSci), Behavioral, Social and Administrative Sciences (BSA), Clinical Sciences (ClinSci), and Clinical Practice (ClinPrac, including skills-based and experiential courses). Generally, the initial stages of the program are populated by courses in the PharmSci and BSA areas, which transitions towards a heavy emphasis on ClinSci and ClinPrac towards the end of the program. The program also involves 50 hours of Community Service Learning in year 1, 240 hours of Introductory Pharmacy Practice Experience (IPPE) in years 2 and 3, and 640 hours of Advanced Pharmacy Practice Experience (APPE) in the fourth year of the program.

The program is fully accredited by the Canadian Council of Accreditation of Pharmacy Programs in Canada, which has a history of working with the United States (US) Accreditation Council for Pharmacy Education in establishing and aligning criteria for accreditation. Similar to entry to practice programs in the US, the accreditation standards stipulate Canadian programs must adhere to a nationally accepted framework of educational outcomes – the Association of Faculties of Pharmacy of Canada (AFPC) Educational Outcomes. These outcomes are analogous to the Center for the Advancement of Pharmacy Education (CAPE) Educational Outcomes including overlapping roles such as care provider, collaborator, manager, leader, etc. As a result, with the exception of there being less time allotted to APPEs in fourth year of the program, the core curriculum that serves as a basis to define the non-experiential course work is expected to be very similar to most programs in North America.

The admissions criteria to the program includes the following designated prerequisite courses: one course in each of biochemistry, cell biology, calculus and statistics as well as two courses of English or writing studies and two courses each of general and organic chemistry. While specified prerequisite course requirements vary somewhat across North American entry to practice pharmacy programs, the ones used in our analysis represent the common core courses in the physical sciences, social sciences, and liberal arts categories as outlined in the most recent American Association of Colleges of Pharmacy (AACCP) summary of admissions requirements.<sup>8</sup> Specifically, out of 138 programs included in the AACCP report, 88% require at least one course of general biology, 99% require calculus, 77% require a course in statistics, 78% require English/English composition, and 99–100% require two courses in each of general and organic chemistry, respectively. Interestingly, only 30% require a course in biochemistry.

Other criteria used in making admissions decisions include an admissions questionnaire that asks students a set of basic questions to evaluate writing skills and a general interview process to evaluate basic oral communication skills. In addition, overall GPA within the most recent two years of entering the program and overall GPA while taking a full-time course load are also considered.

QS World rankings are an internationally accepted standard for comparing the quality of higher education institutions. Ranking is based on 5 indicators including academic peer review, faculty student ratio, citations per faculty, employer reputation, and international student ratio. The majority of students applying and admitted to our program come from QS World ranked schools such as the Universities of Alberta and Calgary, while the rest come from other smaller institutions from across Alberta. Approximately 40% of students possess a previous degree before entering program and greater than 95% of students are admitted with at least two years

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