ORIGINAL ARTICLE

Influence of year-on-year performance on final degree classification in a chiropractic master's degree program

Philip Dewhurst, DC, Jacqueline Rix, DC, and David Newell, PhD

Objective: We explored if any predictors of success could be identified from end-of-year grades in a chiropractic master's program and whether these grades could predict final-year grade performance and year-on-year performance.

Methods: End-of-year average grades and module grades for a single cohort of students covering all academic results for years 1–4 of the 2013 graduating class were used for this analysis. Analysis consisted of within-year correlations of module grades with end-of-year average grades, linear regression models for continuous data, and logistic regression models for predicting final degree classifications.

Results: In year 1, 140 students were enrolled; 85.7% of students completed the program 4 years later. End-of-year average grades for years 1–3 were correlated (Pearson r values ranging from .75 to .87), but the end-of-year grades for years 1–3 were poorly correlated with clinic internship performance. In linear regression, several modules were predictive of end-of-year average grades for each year. For year 1, logistic regression showed that the modules Physiology and Pharmacology and Investigative Imaging were predictive of year 1 performance (odds ratio [OR] = 1.15 and 0.9, respectively). In year 3, the modules Anatomy and Histopathology 3 and Problem Solving were predictors of the difference between a pass/merit or distinction final degree classification (OR = 1.06 and 1.12, respectively).

Conclusion: Early academic performance is weakly correlated with final-year clinic internship performance. The modules of Anatomy and Histopathology year 3 and Problem Solving year 3 emerged more consistently than other modules as being associated with final-year classifications.

Key Indexing Terms: Chiropractic; Education; Educational Status; Forecasting

INTRODUCTION

The issue of which applicants should be accepted into health care courses in the United Kingdom has gathered momentum in the literature in recent years. It is now common practice for medical institutions to require their applicants to complete a test of intellectual aptitude, such as the UK Clinical Aptitude Test (UKCAT),[1] in addition to meeting institutional requirements for secondary education achievement. However, chiropractic educational institutions within the United Kingdom have no such requirement for applicants to complete an aptitude test, and admissions are based on the successful achievement of secondary education to meet individual institutional entry requirements.

Researchers have attempted to identify the factors that predict student success in higher education.[2] Traditionally, grades achieved during secondary education have been considered the most important indicator of higher education performance.[2–3] While some authors are critical of the predictive validity of secondary education performance (eg, General Certificate of Education Advanced-Level grades in the United Kingdom),[4] recent studies have supported their use in predicting success in higher education, with an estimated 65% of first-year exam variance at medical schools in the United Kingdom explained by advanced-level grades.[1] Other academic predictors of performance during higher education include General Certificate of Secondary Education (GCSE) performance,[1] Universities and Colleges Admissions Service (UCAS) entry points, and general mental ability (GMA).[3] While some authors have focused on the academic achievements of applicants prior to entering higher education,[1] others have also attempted to account for nonacademic factors, which may influence student performance at university. These factors include a student's psychological well-being (feeling sad, lonely, stressed, depressed, and hopeless), their sociodemographic

Table 1 - Overview of the AECC MChiro Program Curriculum

Year 1		Year 2	
Unit	Modules	Unit	Modules
Core Science 1	Anatomy	Core Science 2	Anatomy and Histopathology
	Histopathology		Physiology and Pharmacology
	Molecular Physiology		Cellular and Molecular Nutrition
	Physiology and Pharmacology	Diagnosis and Management 2	Diagnosis
Diagnosis and Management	Diagnosis		Psychosocial Concepts
	Psychosocial Concepts		Neuro-orthopedics
	Clinical Problem Solving		Investigative Imaging
Clinical Therapeutic Skills	Combined Adjustive Technique		Radiography
	Clinic Observation		Functional Management
	Biomechanics	Clinical Therapeutic Skills 2	Combined Adjustive Technique
Diagnostic Imaging Skills	Investigative Imaging		Clinic Observation
	Radiography	Clinical Problem Solving 2	Clinical Problem Solving
Introduction to Professional Issues	Chiropractic Concepts and Context	Research Skills 2	Research Skills

background (age, gender, religion, employment, physical health), and background academic performance (educational aspirations, class attendance, hours spent studying, father's education).[5]

Within health care education, a number of attempts have been made to predict future performance.[6–8] In chiropractic education, most studies are concerned with predicting postgraduate national board exam performance[8,9] or within-program performance based on pre-chiropractic entry qualifications.[10,11] However, only a limited number of studies have investigated academic predictors of success within a program of study during chiropractic education. Where within-study and prestudy factors were assessed, only preprogram grade point average (GPA) was associated with biochemistry performance within the chiropractic program.[10]

Admitting a student into an institution carries with it a considerable amount of responsibility incumbent on the institution to support students and their success.[2] Information concerning early performance as related to later success would potentially allow faculty to focus on students who are struggling to perform in modules that are known to predict this later success. This would be of benefit for students and faculty alike as it allows an opportunity for students to be given feedback and advice to support their learning and decrease the likelihood of future failure. This information may also focus institutions to develop interventional strategies, reducing attrition rates and the number of students dropping out of courses or needing to repeat a year of study.[11] Currently, it is estimated that only 57% of students in US higher education complete their program of study within the intended period of time.[2] This is of some significance to UK higher education institutions as the majority of students embarking on professional qualifications do so at an undergraduate level, and thus predictors of academic success within the program may potentially be of benefit.

The aim of this study was to explore student grades from a single cohort of students studying chiropractic at the Anglo European College of Chiropractic (AECC) to assess if any predictors of success could be identified from end-of-year grades and whether these grades could predict final-year grade performance and year-on-year performance. Individual module grades and average end-of-year grades were analyzed using the hypothesis that preclinical module and end-of-year average grades could predict final degree classification (pass/merit/distinction).

METHODS

Participants

Participants consisted of all students at the AECC who enrolled into the undergraduate Master of Chiropractic (MChiro) program in 2009 and graduated in 2013. Anonymized module grades and year-end average grades for this single cohort of students progressing from year 1 to completion of year 4 (clinical internship year) were used in the analysis. A breakdown of the program curriculum is summarized in Table 1.

Data Management

Anonymization was carried out by the institution's Programs and Administration Office before making available an anonymized copy to the authors. The original data were kept on a secure, password-protected computer within the administration department at the institution.

Analysis

Data were cleaned prior to analysis. All marks of students enrolled into the 1st year in 2009 were put into a data spreadsheet. If a student failed the year and did not progress, those marks were not considered following the failed year, as the student would be required to repeat the year. Any student who failed from a higher year group who joined the 2009 cohort was not included in the study. All data were continuous marks and were normally distributed as determined by a 1-sample Kolmogorov-Smirnov test. The analysis consisted of within-year

Table 1 - Continued.

Year 3		Year 4 (Clinical Internship)	
Unit	**Modules**	**Unit**	**Modules**
Core Science 3	Anatomy and Histopathology	Professional Issues	Current Issues and Philosophy in Chiropractic
	Physiology and Pharmacology		Professional Practice
Diagnosis and Management 3	Diagnosis	Practice Procedures	Clinical Audit
	Neuro-orthopedics		Clinic Observation Mentorship
	Neurology	Clinical Internship	Clinical Internship
	Investigative Imaging	Clinical Chiropractic	Evidence-Based Clinical Chiropractic
	Radiography		Combined Adjustive Technique
	Functional Management		
	Pediatrics		
Clinical Therapeutic Skills 3	Combined Adjustive Technique		
	Clinic Observation		
	Clinical Nutrition		
Clinical Problem Solving 3	Clinical Problem Solving		
Research Skills 3	Research Project		

correlations of module grades with end-of-year average grades, linear regression models for continuous grades, and forward logistic regression models for predicting final degree classifications. For the logistic modeling, we collapsed the 3 levels, pass, merit, and distinction, into 2 (pass vs merit/distinction) due to the small number of distinction classifications in the final degree. The independent variables used to predict these final classifications were all continuous module marks.

Ethics

Ethical approval was sought from the AECC ethics committee in accordance with the AECC ethics policy. This study was deemed to not require ethical approval.

RESULTS

One hundred and forty students enrolled in year 1 of the MChiro program in 2009. Of those, 67 (47.8%) students were female, and 73 (52.1%) students were male. Table 2

Table 2 - Characteristics of Cohort at Entry (*n* = 140)

Variable	Percent	Mean (SD)
Mean age		22.8 (4.4)
Nationality		
UK	44.6	
Nordic	30.9	
European	23.0	
Other	1.4	
Age category on entry		
School leaver (≤18)	2.8	
Young mature (19–22)	61.4	
Medium mature (23–30)	29.7	
Mature (>30)	1.4	
Previous qualification		
Degree or higher	17.2	
No degree	82.8	

shows additional demographic characteristics of this cohort at entry. The largest proportion of entrants was British/Nordic, consisting of three quarters of the total number of students, with over 90% between 19 and 30 years of age and the largest proportion by far being nongraduates.

The attrition rate over the 4 years was 14%, amounting to 20 students who did not progress with this cohort and did not complete the program in 2013. All students who entered the clinic year passed the year and obtained their degree. This was unusual as normally it is expected that 1 or 2 students will repeat the year (Table 3). Mean and median grades were very similar across the 4 years, although categorization of year-end average grades using the same criteria as final-year degree classification shows a rise in "distinction" classification from year 1 to years 2 and 3. This was markedly different in year 4 (clinical internship year), where the majority of students obtained marks classified as "pass" or "merit." Module grades were highly correlated within individual years to average end-of-year grades. However, on the whole, correlations of within-year modules to the year-end average grade decreased from the 1st to the 4th year. End-of-year overall average grades for years 1–3 were markedly correlated, but were poorly correlated with the final clinic year performance (Table 4).

Linear regression models predicting subsequent and remaining year averages and adjusted for all within-year modules for each year are shown in Table 5. There were a limited number of modules where student performance in 1 year was related to performance in the following year. Histopathology in year 1 was predictive of year 3 performance. This year-on-year trend continued from year 3 to year 4, with Anatomy and Histopathology 3 and Pediatrics predicting clinic year performance. No other modules in the preclinical years were related to clinical internship year performance.

Logistic regression models for each year elicited some significant predictors of the difference between a pass/

Table 3 - Final Grades and Categorization for Each Year

	No.	FTP	[a]Category (% in year)			Mean (SD)	Median
			Pass	Merit	Distinction		
Year 1	140	–	37.9	45.7	16.4	69.6 (7.0)	70.0
Year 2	133	7	29.3	43.6	27.1	71.0 (8.1)	71.0
Year 3	122	11	17.2	56.6	26.2	72.8 (6.4)	73.0
Clinic	120	2	53.3	44.2	2.5	67.0 (5.0)	67.0
Degree[b]	120	–	46.7	48.3	5.0	69.4 (4.5)	69.0

FTP, number failing to progress that year.
[a] Pass (50.0–66.4), Merit (66.5–75.4), Distinction (≥75.5).
[b] Final degree classification is based on end-of-year average grades from year 2, year 3, and clinic as follows: year 2 (15%), year 3 (25%), clinic (60%).

merit or distinction final degree classification (Table 6). However, a model combining module performance in all years resulted in only the modules Anatomy and Histopathology in year 3 and Problem Solving in year 3 predicting the final degree classification. (For every point increase: Anatomy/Histopathology, OR = 1.1, 95% confidence interval [CI], 1.02–1.15; Problem Solving, OR = 1.1, 95% CI, 1.02–1.2.)

DISCUSSION

Studies exploring predictors of success in chiropractic education have either tended to explore preprogram characteristics[5,10–12] or national board exam performance.[6,8,9] This study aimed to discover if there are identifiable academic predictors of success within a program of study at a chiropractic educational institution.

We have demonstrated that there are specific modules that predict the students' grades later in their studies. A general trend identified suggested that in preclinical years only the previous year was associated with the following years' performance, with only weak associations linking success across more than 1 year. This may reflect the evolving nature of academic strategies and learning, such as goal orientation and test strategies, including reduction in anxiety and familiarity with the system[5] and the rapidity with which this may change from year to year. The fact that success in the final year was not strongly associated with preclinical years suggests that clinical training as a clinical intern consists of unique skills not directly assessed within the preclinical academic modules in this program. However, this did not preclude a small number of preclinical modules being predictive of final degree classification. The module Problem Solving in year 3, which centers on clinical diagnostic skill training, was, perhaps unsurprisingly, linked to clinic year performance. More surprising, perhaps, is that the modules Anatomy

Table 4 - Correlation of End-of-Year Average Grades Between Years

	Year 1	Year 2	Year 3	Clinic
Year 1	–	.87[*]	.75[*]	.32[*]
Year 2	–	–	.84[*]	.36[*]
Year 3	–	–	–	.37[*]

[*] *p* < .001.

and Histopathology in year 3, the overall year 2 end-of-year average grade, and the modules Physiology and Pharmacology and Investigative Imagining in year 1 were also associated with degree classification. As a possible explanation, the module Anatomy and Histopathology 3 in this institution is traditionally considered a difficult module and often is discriminatory in terms of pass/fails at this stage of the degree. The overall year 2 end-of-year average mark is calculated inclusive of the topic paper, which is often a challenging examination that requires students to have an understanding of a wide range of scientific knowledge and clinical pathologies. Given this, the association of these marks with final degree classification may reflect general academic ability, degree of academic effort, or successful learning styles. Finally, the year 1 Physiology and Pharmacology and Investigative Imaging module marks may reflect the perceived ease of these subjects at this stage of the program, with the majority of students obtaining high grades.

Predicting those students likely to be struggling during a clinical degree has recently been explored in undergraduate training in medicine.[6] These authors developed a toolkit to identify flags associated with categorizations of students experiencing academic problems as the course progressed. They identified that within-course factors such as missed attendance, unsatisfactory attitude or behavior, health problems, social/family problems, failure to complete immunity status checks, and attendance at an academic progress committee could predict a "struggling" status. Although we did not measure factors other than the grade at each year, it is plausible that ongoing analysis of grades, along with such factors as identified by Garrud et al,[7] could prove useful in monitoring student performance. Such monitoring of student performance and identification of those who are a risk of failure would be beneficial, as those students who are struggling would be offered additional support in their future studies.

It is clear that academic performance can be influenced by a multitude of nonacademic issues,[5] and it is not clear what other factors potentially affect student's experiences in the higher education environment and performance. It has been suggested that for students to achieve academic success, they should be physically and psychologically well, be motivated in their educational attainment, and attend classes and study on a regular basis.[7]

Table 5 - Multiple Linear Regression Models for Predicting End-of-Year Average Grades for Each Year

Dependent	Independent	B (95% CI)[a]	p
Year 2 average	*Year 1*		
	Histopathology	0.09 (0.07 to 0.31)	.003
	Molecular physiology	0.08 (0.04 to 0.33)	.012
	Investigative Imaging	0.03 (0.01 to 0.25)	.034
Year 3 average	*Year 2*		
	Anatomy/Histopathology 2	0.11 (0.03 to 0.19)	.008
	Investigative Imaging	0.09 (0.01 to 0.17)	.032
	Topic Paper	0.15 (0.02 to 0.25)	.036
	Year 1		
	Histopathology	0.22 (0.08 to 0.37)	.002
Clinic average	*Year 3*		
	Anatomy/Histopathology 3	0.15 (0.04 to 0.25)	.006
	Pediatrics	0.16 (0.03 to 0.29)	.013
	Year 2	None	
	Year 1		
	Investigative Imaging	−0.19 (−0.36 to −0.03)	.036

B, unstandardized regression coefficient; CI, confidence interval.
[a] *Analysis included all module marks within each year (continuous data only and excluding end-of-year average).*

Caution should be applied when interpreting these results. Further study would perhaps be most usefully centered on following a cohort of students throughout the student journey from performance before university entry, to comments and feedback acquired during the interview process,[3] to their academic results throughout the undergraduate period, in combination with a series of measures that analyze the psychosocial- and personality-based aspects of the students' lives.

CONCLUSION

This study used within-year module grades and year-end average grades to explore the predictive nature of early-year academic performance on final degree classification for students attending a chiropractic program in the United Kingdom. Despite the limited nature of this study, using module and end-of-year average grades, we found only a small number of modules associated with final degree performance. In addition, generally year 4 (clinic internship year) performance is poorly correlated with early academic success. Wider exploration of pre- and within-chiropractic degree factors is called for to fully explore the potential to identify and support struggling students.

About the Authors

Philip Dewhurst is a lecturer in the Department of Academic Affairs at Anglo European Chiropractic College (13-15 Parkwood Road, Bournemouth, BH5 2DF, England, United Kingdom; pdewhurst@aecc.ac.uk). Jacqueline Rix is a lecturer in the Department of Academic Affairs at Anglo European Chiropractic College (13-15 Parkwood Road, Bournemouth, BH5 2DF, England, United Kingdom; jrix@aecc.ac.uk). David Newell is the Director of Research in the Departments of Research and Academic Affairs at Anglo European Chiropractic College (13-15 Parkwood Road, Bournemouth, BH5 2DF, England, United Kingdom; dnewell@aecc.ac.uk). Address correspondence to David Newell, 13-15 Parkwood Road, Bournemouth, BH5 2DF, England, United Kingdom; dnewell@aecc.ac.uk. This article was received September 16, 2014; revised January 24 and February 27, 2015; and accepted March 8, 2015.

Table 6 - Individual Modules Within Years Significantly Associated With Final Degree Classification of Merit/Distinction vs Pass

	OR[a]	(95% CI)
Year 1		
Physiology/Pharmacology (+1)	1.15	(1.1–1.2)
Investigative Imaging (+1)	0.9	(0.8–1.0)
Year 2		
Year 2 average (+1)	1.08	(1.0–1.2)
Year 3		
Anatomy/Histopathology (+1)	1.06	(1.0–1.1)
Problem Solving (+1)	1.12	(1.0–1.2)

OR, odds ratio, CI, confidence interval.
[a] *Adjusted for all other modules in that year, gender, and age.*

Author Contributions

Concept development: PD, JR, DN. Design: JR. Supervision: DN. Data collection/processing: JR. Analysis/interpretation:

DN. Literature search: PD. Writing: PD, JR, DN. Critical review: PD, JR, DN.

REFERENCES

1. McManus IC, Dewberry C, Nicholson S, et al. Construct-level predictive validity of educational attainment and intellectual aptitude tests in medical student selection: meta-regression of six UK longitudinal studies. *BMC Med*. 2013;11(243):1–21.
2. Krumrei-Mancuso EJ, Newton FB, Kim E, et al. Psychosocial factors predicting first-year college student success. *J Coll Stud Dev*. 2013;54(3):247–266
3. Barmby P. Predicting success on a bachelor of arts primary education degree course. *Educ Res*. 2012;54(3): 323–330
4. Peers IS, Johnston M. Influence of learning context on the relationship between A-level attainment and final degree performance: a meta-analytic review. *Br J Educ Psychol*. 1994;64(1)1–18.
5. Chow HPH. Predicting academic success and psychological wellness in a sample of Canadian undergraduate students. *Electronic J Res Educ Psychol*. 2010; 8(2): 473–496.
6. Schutz CM, Dalton L, Tepe, RE. Learning and Study Strategies Inventory subtests and factors as predictors of National Board of Chiropractic Examiners Part 1 examination performance. *J Chiropr Educ*. 2013;27(1): 5–10.
7. Garrud P, Yates J. Profiling strugglers in a graduate-entry medicine course at Nottingham: a retrospective case study. *BMC Med Educ*. 2012;12(1):1–8.
8. McCall AR, Harvey RD. Predictors of performance on the National Board of Chiropractic Examiners Parts I and II. *J Chiropr Educ*. 2014;28(1):9–15.
9. Kenya AWM, Kenya HM, Hart J. Correlation between academic performance and NBCE part I scores at a chiropractic college. *J Chiropr Educ*. 2013; 27(1):27–32.
10. McRae MP. Correlation of preadmission organic chemistry courses and academic performance in biochemistry at a Midwest chiropractic doctoral program. *J Chiropr Educ*. 2010;24(1):30–34.
11. Green BN, Johnson CD, McCarthy K. Predicting academic success in the first year of chiropractic college. *J Manipulative Physiol Ther*. 2003;26(1):40–46.
12. Shaw K, Rabatsky A, Dishman V, Meseke C. Predictors of performance of students in biochemistry in a doctor of chiropractic curriculum. *J Chiropr Educ*. 2014;28(1):28–31.
13. Schutz M, Gallagher ML, Tepe RE. Differences in learning and study strategies inventory scores between chiropractic students with lower and higher grade point averages. *J Chiropr Educ*. 2011;25(1):5–10.