
ORIGINAL ARTICLES

The Correlation of Students' Entry-Level GPA, Academic Performance, and the National Board Examination in All Basic Science Subjects

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This study investigates whether the entry-level grade point average (GPA) can be used to predict students' academic performance in the Doctor of Chiropractic program and on the National Board of Chiropractic Examiners (NBCE) in all basic science subjects. Fifty-two students enrolled in Sherman College of Straight Chiropractic, who had completed all basic science classes and the NBCE Part I, were selected for the study. Each student's letter grades from all basic science courses were converted to numeric scores to represent academic performance. Class scores were averaged to derive a mean score for each subject. (Physiology class performance included fluid (respiratory and renal), endocrine, neural, and cardiovascular sections.) Each student's performance on the NBCE was determined by his or her score on the exam from NBCE Part I which was subdivided into general anatomy, spinal anatomy, physiology, biochemistry, pathology, and microbiology. The results showed that students' entry-level GPA had a moderate to good correlation in all basic science subjects: general anatomy ($r = 0.670$), spinal anatomy ($r = 0.620$), physiology ($r = 0.570$), biochemistry ($r = 0.548$), pathology ($r = 0.583$), and microbiology ($r = 0.640$). GPA appeared to be a good indicator of students' class performance. An analysis of the correlation of GPA to overall basic science class performance showed that students' overall GPA had a good correlation to their overall class performance ($r = 0.720$). Students' entry-level GPA had a low to moderate correlation with students' NBCE scores as shown in the following: general anatomy ($r = 0.514$), spinal anatomy ($r = 0.521$), physiology ($r = 0.512$), biochemistry ($r = 0.552$), pathology ($r = 0.205$), and microbiology ($r = 0.292$). An analysis of the correlation of GPA to overall NBCE scores showed that students' overall GPA had a moderate correlation to their overall NBCE performance ($r = 0.515$). GPA has good correlation with students' class performance and moderate correlation with the NBCE performance. Further study on GPA in comparison to other predictors may be indicated for improving chiropractic education. In summary, GPA is a better predictor of class performance than NBCE scores. (The Journal of Chiropractic Education 13(2): 91-99, 1999)

Key words: GPA, chiropractic, learning, National Board Examination

INTRODUCTION

Chiropractic educators are interested in predictors that can reliably predict students' performance in class and on the National Board of Chiropractic Examiners (NBCE) Part I. Many predictors have been used and investigated. However, among all the predictors, the most used predictor is the grade

point average (GPA). The significance of using GPA as a selecting indicator for student admission in medical school was best illustrated by Cooke and Fontenella's study (1). The authors noted that the chance of acceptance increased by a factor of about 2 for each increment of 0.2 in the GPA in applicants with a GPA between 3.0 and 3.8. They studied nine of the most selective institutions and found that the chance of acceptance increased by a factor of 5 for each increment of 0.2. Of 1157 applicants to these nine institutions, only four students with a GPA of less than 3.4 were approved for admission to medical school. It is clear from the study that

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student admission to medical schools across the country is weighted heavily on GPA. This is also true for chiropractic colleges, as GPA often is the only academic criterion for admission.

The reason for the widely accepted use of GPA in the selection process for student admission is a simple one: GPA is computed from a student's previous cumulative class performance. If a student was capable of receiving a high GPA in one institution, presumably the individual will be capable of doing well again. The only factors excluded from the consideration were the improvement in one's learning strategies, behavior, and attitude as the student matures. There are many studies supporting the value of using GPA for initial evaluation of students' academic standing. One study reports a moderate predictive value of GPA for students taking the Chiropractic National Board exam (2).

The predictive value of GPA is affected by several factors. One factor is when a student received his or her GPA. GPAs that were received earlier may not accurately assess a student's current learning ability. Another factor that affects academic performance is the student's attitude toward learning while he or she is in school. The age and maturity of a student enrolled in a professional school with a chosen profession may have significant impact on the individual's attitude toward learning. This individual may also have improved learning strategy and desire to work hard to excel in academic programs.

The latest proposed changes in the Council on Chiropractic Education (CCE)-accredited chiropractic colleges, requiring a GPA of 2.50 or higher for admission, reflected the importance of GPA for students' admission into a chiropractic college. How reliable is the GPA in predicting a student's performance? Our previous study, using only one physiology class, seemed to indicate that GPA is a valuable tool but was not a good predictor of all student performance (3). In one example, a student with low entry-level GPA performed well on both class and National Board tests. In this follow-up project, an effort was made to eliminate the bias inherently carried by using one basic science subject to evaluate the predictive value of GPA. To provide a reliable prediction of performance, all basic science subjects are included. The benefit of this approach enables us to identify which basic science subjects have higher predictive value, although these may differ at other chiropractic colleges. This is due to the fact that individual instructors in different chiropractic colleges have different teaching efficiency levels for specific

subjects. The hypothesis put forward in this study is that GPA has no predictive value on students' academic and NBCE performance, and class performance has no correlation with the NBCE scores.

METHODS

A total of 52 students enrolled in Sherman College of Straight Chiropractic in the 1994 and 1995 academic years, who had taken the National Board of Chiropractic Examination Part I, were selected for the study. Students were enrolled in the Cardiovascular Physiology 205 and Fluid 202 classes. There were 35 male and 17 female students. Their entry-level GPAs were obtained through the college admissions office. Academic performance was represented by the students' final grades in all basic science courses, including anatomy, physiology, biochemistry, microbiology, and pathology. In each major subject, several classes may have been included. Physiology, for example, contained the following classes: fluids (including renal, respiratory physiology), cardiovascular, neurophysiology, and endocrine physiology. The final grade was reported to the Registrar's office as a letter grade. An effort was made to obtain the numeric grades, but it was found to be too difficult to collect all grades from each instructor for that period of time. In order to calculate a statistical correlation, the letter grade was converted to a numeric grade by the following standard: A = 95, B = 87, C = 79, D = 72, and F = 69. This conversion lost some information on students' scores. To correlate the students' academic performance to their NBCE scores, we used the NBCE Part I scores on all basic science sections. Students' NBCE scores were obtained through the Registrar's office. All student records were kept confidential.

An overall correlation analysis was performed by combining all basic science NBCE scores as one value for each student to determine the predictive value of GPA on the NBCE and class scores. The same analysis was also used to predict overall class scores from entering GPA.

Students' GPA, academic, and NBCE performance on all tests were analyzed by the SPSS 8.0 computer program (SPSS Inc., Chicago, IL, 1998) and Microsoft Excel. Descriptive statistics were used to show variations of the original data. A linear regression method was used to determine correlation between different scores. There are no

widely accepted criteria for defining a strong versus moderate versus weak association. Colton suggests some general guidelines for use in health science studies (4). Correlation ranging from .00 to .25 indicates little or no relationship; values from .25 to .50 suggest a fair degree of relationship; values of .50 to .75 are moderate to good; and values above .75 are considered good to excellent. Correlations are presented by line graphs and tables. All statistical tests were considered significant at the $p < .05$ level.

The significance of a correlation coefficient does not mean that a correlation coefficient represents a strong relationship. Statistical significance only indicates that an observed value is unlikely to be the result of chance.

RESULTS

1. **Students' class grades:** Students' class performances are summarized in Table 1.
2. **Correlation of students' entering GPA and final class grade:** As illustrated in Figures 1–6 students with a low entry-level GPA showed a low final class

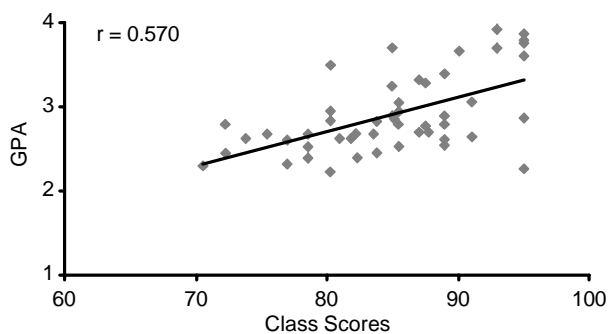


Figure 1. Correlation of GPA and class scores in physiology.

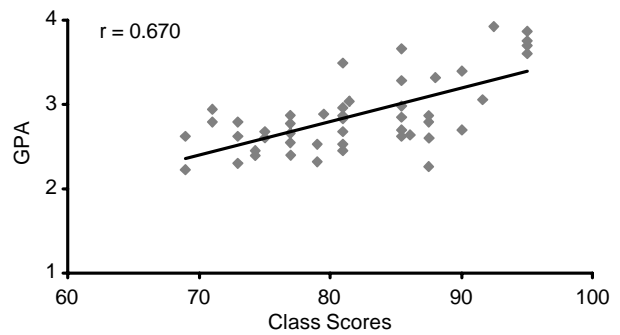


Figure 2. Correlation of GPA and class scores in general anatomy.

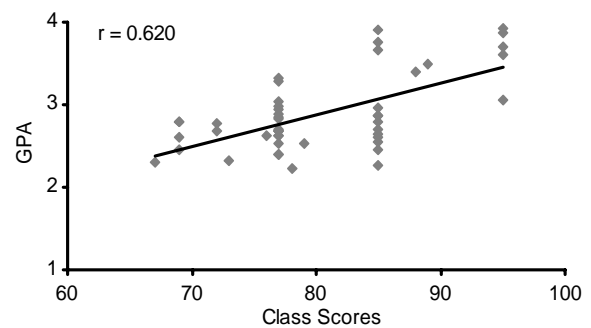


Figure 3. Correlation of GPA and class scores in spinal anatomy.

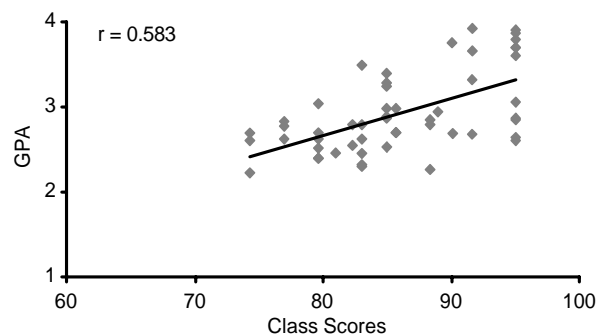


Figure 4. Correlation of GPA and class scores in pathology.

Table 1. Students' Class Performance

	GEA	SPA	PHYS	CHE	PAT	MPH
Sample size	52	52	52	52	52	52
Missing	4	4	1	7	0	4
Minimum	72.00	72.00	73.40	72.00	76.67	76.67
Maximum	95.00	95.00	95.00	95.00	95.00	95.00
Std deviation	6.512	6.697	5.722	6.846	5.617	5.986
Mean	83.543	82.146	86.418	86.556	87.340	87.163

GEA, general anatomy; SPA, spinal anatomy; PHYS, physiology; CHE, biochemistry; PAT, pathology; MPH, microbiology and public health.

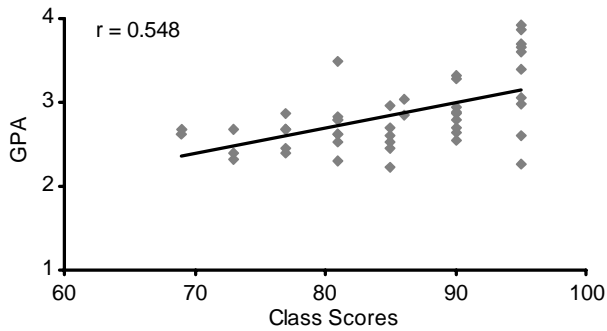


Figure 5. Correlation of GPA and class scores in biochemistry.

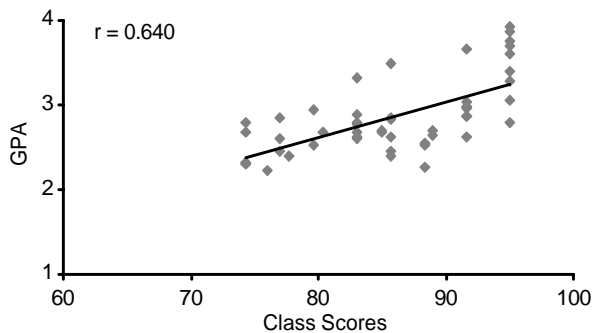


Figure 6. Correlation of GPA and class scores in microbiology.

grade (representing their academic performance). The GPA has a moderate to good correlation to the students' class performance. These included all six basic science subjects: physiology ($r = .570$), general anatomy ($r = .670$), spinal anatomy ($r = .620$), biochemistry ($r = .548$), pathology ($r = .583$), and microbiology ($r = .640$). Students with a GPA above 3.0 produced higher class grades in all basic science subjects.

3. Student performance on the NBCE and entering GPA: As illustrated in Figures 7–12, the students' performance on the NBCE showed a low to moderate correlation with their entering GPA. Low correlation includes pathology ($r = .205$) and microbiology ($r = .292$). In these two subjects, students with low GPA achieved higher NBCE scores in many instances (Figs. 11 and 12). Moderate correlations were found in general anatomy ($r = .514$), spinal anatomy ($r = .521$), physiology ($r = .512$), and biochemistry ($r = .552$). It is clearly demonstrated in Figures 7–10 that students with high GPAs obtained higher NBCE scores. However, it was not uncommon for

students with low GPAs to achieve higher scores in the NBCE. Students with GPAs between 2.5 and 3.0 had NBCE scores in the 420–550 range. Students with GPAs of 3.0 and above tended to produce NBCE scores in the 500–520 range. The overall mean for the NBCE score is 489.2 in basic sciences.

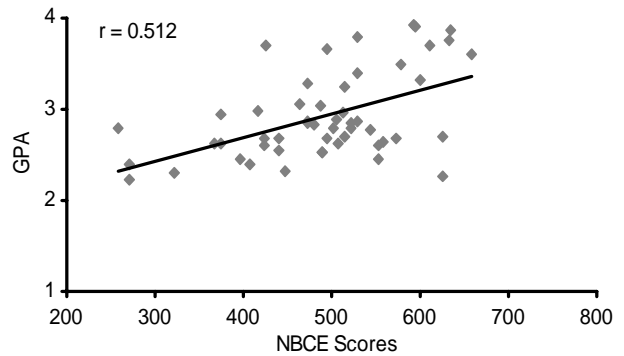


Figure 7. Correlation of GPA and NBCE physiology scores.

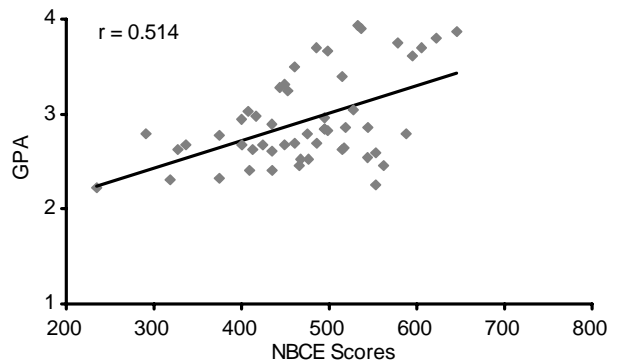


Figure 8. Correlation of GPA and NBCE general anatomy scores.

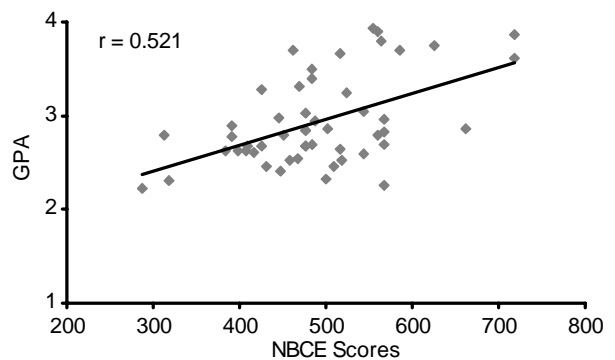


Figure 9. Correlation of GPA and NBCE spinal anatomy scores.

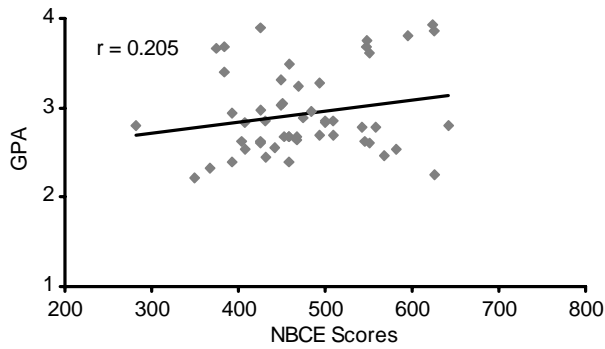


Figure 10. Correlation of GPA and NBCE pathology scores.

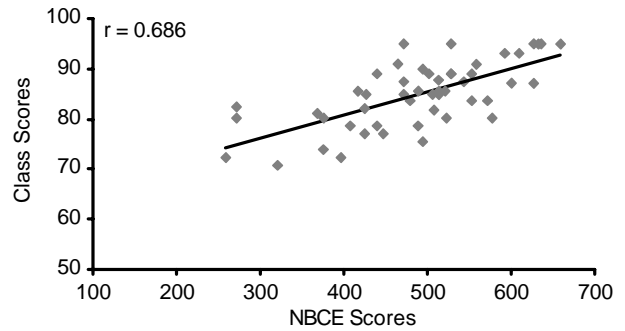


Figure 13. Correlation of class and NBCE scores in physiology.

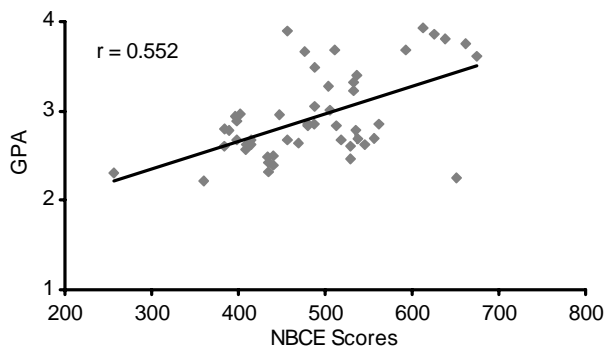


Figure 11. Correlation of GPA and NBCE biochemistry scores.

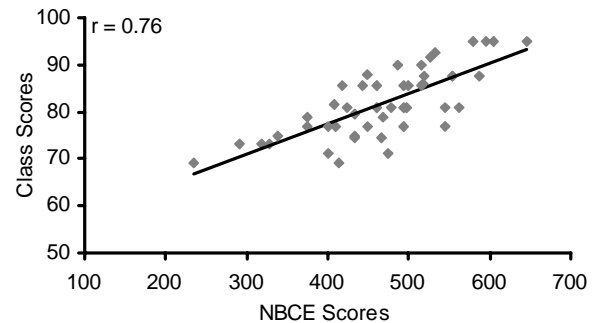


Figure 14. Correlation of class and NBCE scores in general anatomy.

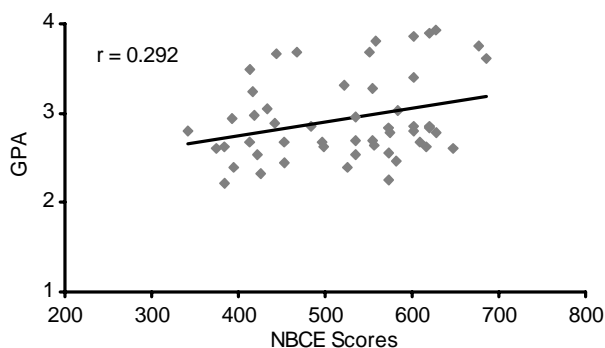


Figure 12. Correlation of GPA and NBCE microbiology scores.

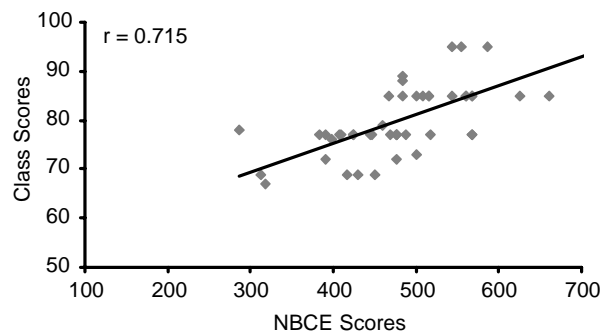


Figure 15. Correlation of class and NBCE scores in spinal anatomy.

4. Correlations of NBCE and class performance:

As illustrated in Figures 13–18, the students' class performance showed a moderate to good correlation with their NBCE scores. Good correlations were found in general anatomy ($r = .76$), spinal anatomy ($r = .715$), and physiology ($r = .686$). In these basic science subjects, students' class performance is closely correlated with their

NBCE scores. Low to moderate correlations were found in biochemistry ($r = .441$), pathology ($r = .339$), and microbiology ($r = .516$). The students' final class grades, representing their class performance, showed a good correlation with their NBCE scores in three subjects (Figs. 13–15). As demonstrated in Figures 13–15, students with final class grades above 85 on a 100-point scale had a consistent passing rate on the NBCE. On the other hand, students with class grades below

85 showed a higher failure rate on the NBCE. Although it was a moderate to low correlation in biochemistry, students with passing scores of 70 in classes showed consistent passing scores on the NBCE; students with an average of 95 scored higher in the NBCE (Fig. 16).

5. Overall correlation of students' GPA with NBCE and class scores: It is clearly indicated

in Figure 19 that students' entering GPA had a strong correlation with the students' class scores ($r = .720$). Students' entering GPA had a good correlation with the NBCE scores ($r = .515$) (Fig. 20). Students' overall class performance had a good correlation with the NBCE scores ($r = .774$) (Fig. 21).

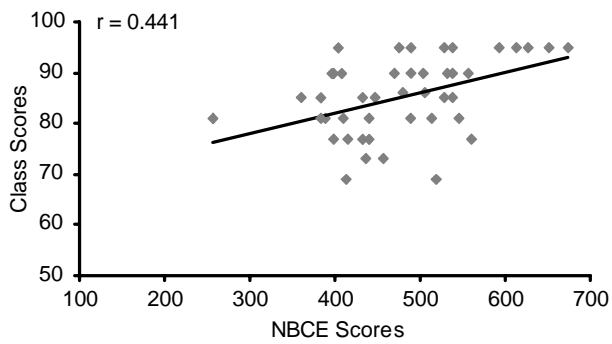


Figure 16. Correlation of class and NBCE scores in biochemistry.

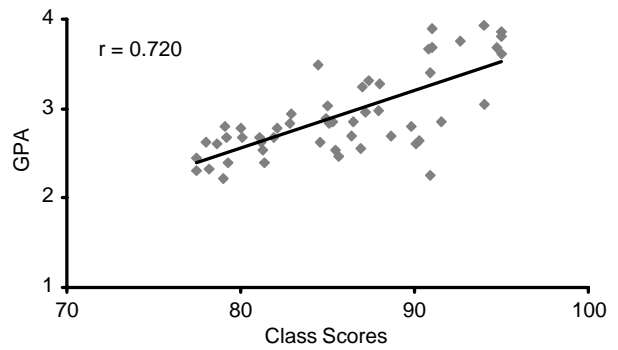


Figure 19. Correlation of GPA and overall class scores.

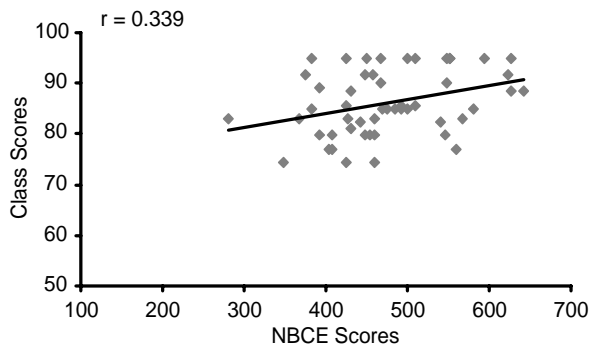


Figure 17. Correlation of class and NBCE scores in pathology.

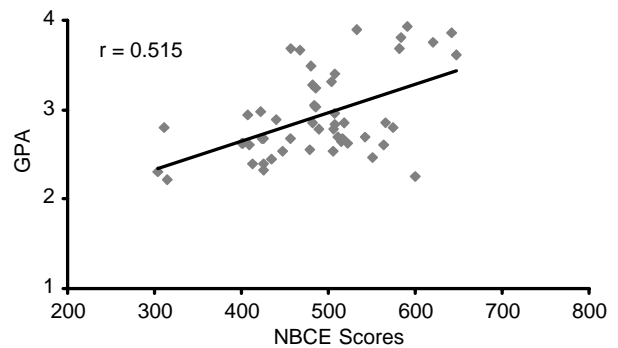


Figure 20. Correlation of GPA and NBCE overall scores.

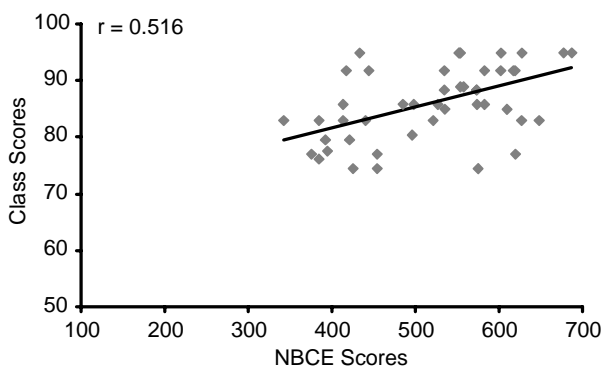


Figure 18. Correlation of class and NBCE scores in MPH.

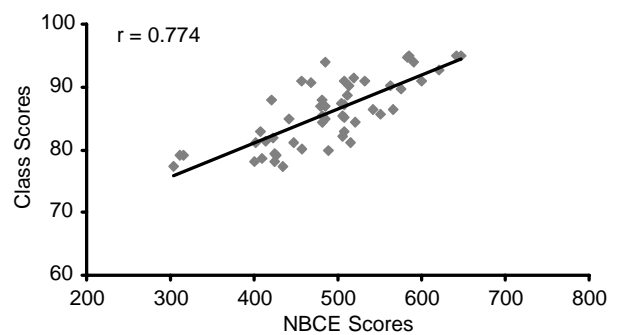


Figure 21. Correlation of overall class performance and NBCE overall scores.

DISCUSSION

Two important questions were asked before the study commenced. One was, "How good was the predictive value of GPA on students' class performance?" This question is answered using correlations in all basic science subjects. The results are very consistent across basic science subjects with moderate to good correlations. This indicates that the GPA is a good indicator in predicting students' class performance. This result is consistent with our previous report (3). There are other studies that support this view.

Dartmouth Medical School in New Hampshire compared undergraduate science GPA, MCAT scores, and the academic caliber of the undergraduate schools of the applicants to predict success effectively in the first year of the program (5). Ficklin tried to predict students' success in medical school science courses by using the cumulative GPA for selecting students at the Indiana University School of Medicine (6). He found cumulative GPA to be a better predictor than science GPA. The correlation reached .45 between undergraduate cumulative GPA and medical school science GPA for all students. Similar findings were also reported by Calkins and Willoughby on minority medical students (7). The authors noted that GPA was a good indicator for the success of minority students in an academic setting. Templeton et al. (8) investigated the relationship of 12 pre-admission academic scores with the professional cumulative grade point average achieved in a 2-year physical therapy program. They found that pre-admission academic grades in chemistry, physics, and science were significant predictors of students' academic performance in physical therapy.

Contrary to those positive findings, the predictive value of GPA was not confirmed in other reports. Hall and Stocks (9) investigated the relationship between the quantities of undergraduate science education completed by medical students and their subsequent preclinical performances in medical school. They found there was no significant relationship between total hours of undergraduate science completed and average preclinical performance in medical school. In addition, the correlation between subdivisions of total hours of undergraduate science (total hours of chemistry, biology, math, physics) and subdivisions of average preclinical performance (year 1 preclinical performance and year 2 preclinical performance) also proved to be nonsignificant. The study concluded that quantity of

science-based undergraduate premedical education did not affect the performances of the selected medical school students in their preclinical years of medical school.

Abedi studied the correlation between graduate academic success and undergraduate academic performance at University of California (10). The author concluded that undergraduate GPA had virtually no relationship with any of the measures of graduate academic success. The reasons given by the author were: 1) lack of comparability—the GPAs were obtained from different educational institutions with different levels of quality and different bases for grading; 2) lack of variability—theoretically, the GPA ranges from 0 to 4, but in reality the majority of undergraduate GPAs tend to fall between 2 and 3.5, creating an extremely skewed distribution; and 3) non-normality of the GPA distribution—the skewed distribution obtained for the undergraduate GPAs becomes even more skewed when students apply for university admission, especially at the more prestigious universities, because students with low GPAs typically do not consider their chances for admission to be high and therefore tend not to apply. Wright and Palmer (11) used ANOVA and split-sample regression to analyze the GPA of 86 business administration graduate students. They found GPA did not discriminate adequately between moderately low and very low performers in graduate programs. GPA appeared to predict academic performance for only the most successful students.

The second question posted before the study was "How reliable was the predictive value of GPA to the NBCE scores." This study demonstrated a low to moderate correlation using GPA to predict NBCE scores, except in microbiology and pathology. It is natural to ask why GPA predicted class performance better than the NBCE scores. The answer to this question may be twofold. First, entry-level GPA is directly derived from class performance from previous schools. It bares direct correlations with the students' learning ability, though it was from past classes. If a current GPA were used to correlate students' class performance, it would generate much better correlation as they are very close to each other. Second, the NBCE test questions are selected from a wide area of studies to represent the core content of those basic science subjects, which covers a vast amount of information to be tested in 2 or 3 days. In addition, there is always a latent period from the time students complete the subjects of study or classes to the time of the NBCE. The stress of taking the

NBCE may be another factor that contributes to the lowered scores in the NBCE. Regardless of factors that may affect a student's score on the NBCE, many studies have shown moderate to good correlations of entry-level GPA to the National Board Examinations.

Roth et al. (12) examined the relationship between the objective premedical credentials and performances on step 2 on the United States Medical Licensing Examination (USMLE) for 480 students in three classes at the Virginia Commonwealth University Medical College of Virginia School of Medicine. The final results showed that the premedical GPA was strongly associated with the verbal section of the SAT, which was determined to be the best predictor of students' USMLE scores. Meleca found that the combination of GPA and MCAT scores was a good predictor of students' NBME scores (13). Mennin et al. (14) at the University of New Mexico School of Medicine, studied the correlation of entry-level GPA and NBME I, II, and III. They only found weak predictive values of GPA on the NBME. Erdmann et al. (15) studied whether prediction models for subgroups of medical school applicants led to more accurate predictions of performance than did one model for an entire group of applicants. The authors used data from two groups of students at Jefferson Medical College: 415 students who entered Jefferson in 1985 and 1986, and 396 who entered in 1987 and 1988. They used undergraduate GPA scores as one of the predictors on the NBME Part I. They found age and gender did not contribute to a prediction bias and that an entire-group prediction model can be used without serious concern for over- or underestimating the predicted scores.

A limited amount of literature exists on the accuracy of using GPA test scores for predicting success in chiropractic students and in the profession. In one study, a moderate statistical correlation ($r = .517$, $p < .001$) was reported between entry GPA and NBCE test scores (3). In the same study, the authors found that students' class performance was a better predictor of NBCE scores with moderate to strong correlation of $r = .662$, $p < .001$ (16). Although students' class performance in chiropractic school was a stronger predictor for the NBCE score, it has no value in students' admission selection unless recent class performance or GPA is available at the time of application to a chiropractic school.

Academic performance is believed to reflect the students' understanding of class content and learning skills. This can be modified to suit the needs for

admission criteria. Students' most recent academic performance record may predict success better than GPA. National Medical Board Examination scores have been shown to relate to GPA figures of applicants and SAT scores. As a part of good quality control in education, qualified applicants who can complete a program and acquire a license are assets to the background statistics of any institution of higher learning. Thus, it is part of the application process of a professional school to attempt to predict which applicants are capable of succeeding in the school program and in the practice of the chosen profession.

One limitation of the study is that the students' scores were converted from letter grade to numeric grade, which may have led to missing some of the fine details of the scores in the analysis. This was due to the limitations of the data collection process not by design. This may introduce bias to reduce the accuracy of the regression analysis. However, it is unlikely that the overall results or trend have been affected by the conversion. It is recommended for future study that class numeric scores be used. A new recording system has been adopted in the Sherman College of Straight Chiropractic Registrar's office to record both numeric and letter grade for students who complete any subjects of study. This will facilitate a further research project in this regard.

This study confirmed our previous study that the GPA is a good predictor of students' class performance ($r = .720$) and a moderate predictor of students' NBCE scores ($r = .515$). This study, by including all subjects in the basic science deviation, broadened the perspective of using GPA to predict students' performance in a small school setting. It has eliminated the suspicion that the predictive value of GPA for one basic science subject might hold no true predictive value to other subjects of study in basic science divisions. It was demonstrated in the study that GPA could be used to predict all basic science subjects reliably. This also suggests to the author that the wide use of GPA in the student selection process from medical school to chiropractic school has its merit.

CONCLUSIONS

Students' entry-level GPA is correlated to their academic performance and the NBCE in most basic science subjects, and may be used to predict their academic performance and NBCE scores. Students'

entry-level GPA is a good predictor of students' academic performance ($r = .720$) ($p < .001$). Students' entry-level GPA is also a moderate to good predictor of students' NBCE scores on basic science subjects ($r = .515$) ($p < .001$).

It is concluded from this study that GPA is a moderate to good predictor for students' academic and NBCE performance. Since this study was not compared to any other predictors, a further comparative study is recommended to investigate the predictive value of GPA and other predictors on students' academic and NBCE performance.

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