Dental Admission Test Scores and Performance on NBDE Part I, Revisited

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Abstract: The purpose of this study was to examine the relationship between performance on the Dental Admission Test (DAT) and Part I of the National Board Dental Examination (NBDE Part I) for students at the Harvard School of Dental Medicine (HSDM). This study was a retrospective cohort study, examining HSDM students over an eight-year period. Data regarding DAT and NBDE Part I scores were obtained from the Office of the Registrar. Descriptive statistics were computed for all study variables. Multiple linear regression analyses were subsequently computed to examine the relationship between DAT subtest scores and performance on NBDE Part I subtests. Goodness of fit for the models was evaluated using the R-squared value. Statistically significant associations were those with p-value ≤ 0.05. Data were available for 244 students who matriculated at HSDM during the period of 1995-2002. DAT reading comprehension scores were statistically significantly associated with performance on all four subsections of the NBDE Part I. DAT general and organic chemistry scores were associated with performance on the microbiology and pathology subtest of NBDE Part I. Performance on the perceptual ability test was associated with performance on the dental anatomy and occlusion subtest. Performance on the DAT reading comprehension subtest was the most reliable predictor of performance on the NBDE Part I. However, the variability in NBDE Part I scores is not accounted for significantly by variability in DAT scores.

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Admission to graduate programs in the health professions is based on a number of factors, including undergraduate/pregraduate academic performance, extracurricular and research activities**,** and interviews, with varying degrees of emphasis placed on the importance of these factors by different institutions. The degree of emphasis placed on different factors is often based on a notion regarding the correlation between such factors and achievement in professional school. Most mainstream professional disciplines such as medicine, dentistry, and law have standardized examinations that, in addition to grade point averages and extracurricular activities, are used to evaluate candidates' fitness for professional education. For dentistry and medicine in particular, the necessity of continued standardized written examinations (NBDE Parts I and II and USMLE Steps I-III, respectively) allows for an opportunity to evaluate the relationship between preprofessional academic benchmarks and standardized professional examinations. While a number of studies have examined the relationship between MCAT scores and scores on the USMLE exams,[1-4] the assumption that DAT scores effectively evaluate the skill sets required for success in dental school has been rarely tested.[5-8]

One of the few studies to rigorously examine the relationship between performance on the Dental Admission Test (DAT) and performance on Part I of the National Board Dental Examination (NBDE I) was completed at the University of Mississippi School of Dentistry.[6] The authors examined the relationships between the subtest scores on the DAT (biology, general chemistry, organic chemistry, reading comprehension, quantitative reasoning, and perceptual ability) and the subtest scores on the NBDE Part I (anatomical sciences, biochemistry and physiology, microbiology and pathology, and dental anatomy and occlusion). Their analyses revealed that the reading comprehension subtest of the DAT was a statistically significant predictor of performance on all four subtests of the NBDE Part I, while organic chemistry and biology were statistically significant predictors of performance on the biochemistry and physiology subtest, and quantitative reasoning was a predictor of performance on the dental anatomy and occlusion subtest. While these results indicated that there was a relationship between

DAT scores and performance on the NBDE Part I, the authors also demonstrated that the DAT scores exerted little influence over the NBDE Part I scores, with 70-80 percent of the variability in NBDE Part I subtest scores unaccounted for by the variability in DAT scores.[6] These recent data are consistent with those reported previously, regarding the limited predictive ability of DAT scores on NBDE Part I scores in aggregate and for specific disciplines.[7]

The purpose of our study was to examine the relationship between the DAT subtest and NBDE Part I subtest scores for students at the Harvard School of Dental Medicine (HSDM). Since the experience of one institution may not be sufficient evidence to make generalizations about all dental students and dental schools, we sought to provide additional data regarding these relationships, based on experiences at our institution. Our specific aims in this regard were to compare the results at our dental school, a private institution with problem-based learning and integrated medical school education, to the results of a similar study completed at the University of Mississippi, a public dental school with a traditional curriculum. Both institutions have comparatively small class sizes (approximately thirty-five students/year at HSDM, thirty students/year at the University of Mississippi). We hypothesized that the results from our institution would be consistent with those provided by De Ball et al., namely that reading comprehension would be statistically significantly associated with performance on all four subtests of the NBDE Part I and that the variability in NBDE Part I scores is not substantially accounted for by variability in DAT scores.

Table 1. Descriptive statistics for study population

	Sample (n=244 HSDM Students)
DAT Scores	
Biology	20.76 ±2.2 (16.00-28.00)
General Chemistry	22.67 ±2.70 (17.00-28.00)
Organic Chemistry	22.60 ±2.62 (16.00-28.00)
Reading Comprehension	21.74 ±2.69 (16.00-30.00)
Quantitative Reasoning	20.82 ±2.93 (14.00-29.00)
Perceptual Ability Test	19.11 ±2.58 (13.00-29.00)
Overall GPA	3.63 ±0.23 (3.05-4.15)
Science GPA	3.60 ±0.26 (2.91-4.20)
NBDE Part I Scores	
Anatomical Sciences	91.64 ±4.62 (78.00-99.00)
Biochemistry and Physiology	93.66 ±3.71 (81.00-99.00)
Microbiology and Pathology	94.48 ±3.70 (83.00-99.00)
Dental Anatomy and Occlusion	93.63 ±4.96 (63.00-99.00)

Note: All data are reported as mean ±SD (Range).

Materials and Methods

This study was a retrospective cohort study, examining data from students at the Harvard School of Dental Medicine. Data regarding performance on the Dental Admission Test and Part I of the National Board Dental Examination were obtained from the Office of the Registrar. To protect student confidentiality, all subjects were assigned random identification numbers by the registrar prior to dissemination of records to the study authors. No identifying data (name, social security number, etc.) were provided.

The predictor variables were scores on the Dental Admission Test: biology (DAT-BIO), general chemistry (DAT-GC), organic chemistry (DAT-OC), reading comprehension (DAT-RC), quantitative reasoning (DAT-QR), and perceptual ability (PAT). The outcome variables were scores from the different subtests that constitute the NBDE Part I: anatomical sciences (AS), biochemistry and physiology (BCP), microbiology and pathology (MP), and dental anatomy and occlusion (DA). Descriptive statistics were computed for all study variables. Four different multiple linear regression analyses were computed with the DAT subtest scores as predictors and the subtest NBDE score as the outcome. For all analyses, a p-value ≤ 0.05 was considered statistically significant. Goodness of fit was evaluated using the R-squared value for each model. The R-squared values for the multiple linear regression models were used to quantitatively assess the degree to which variations in NBDE scores could be explained by variations in individual DAT subtest scores.

Results

The sample included 244 students from the Harvard School of Dental Medicine who matriculated into the four-year D.M.D. program during the period of September 1995-September 2002. The total potential sample was 249 students; five students (2 percent) had missing or incomplete data.

Descriptive statistics for Dental Admission Test predictors are summarized in Table 1. The mean biology, general chemistry, organic chemistry, read-

ing comprehension, quantitative reasoning, and perceptual ability scores were 20.76 ±2.2 (range: 16.00-28.00), 22.67 ±2.70 (range: 17.00-28.00), 22.60 ±2.62 (range: 16.00-28.00), 21.74 ±2.69 (range: 16.00-30.00), 20.82 ±2.93 (range: 14.00-29.00), and 19.11 ±2.58 (range: 13.00-29.00), respectively.

Descriptive statistics for the National Board Dental Examination Part I outcomes are summarized in Table 1. The mean anatomical sciences, biochemistry and physiology, microbiology and pathology, and dental anatomy and occlusion scores were 91.64 ±4.62 (range: 78.00-99.00), 93.66 ±3.71 (range: 81.00-99.00), 94.48 ±3.70 (range: 83.00-99.00), and 93.63 ±4.96 (range: 63.00-99.00), respectively.

Table 2a summarizes the multiple linear regression model for the anatomical sciences subtest. The only statistically significant predictor in this model was the reading comprehension score ($p<0.01$). Variations in DAT predictor variables explained roughly 6 percent of the variability in anatomical sciences scores ($R^2=0.063$).

Table 2b summarizes the multiple linear regression model for the biochemistry and physiology subtest. In this model, reading comprehension was statistically significantly associated with the biochemistry subtest score ($p<0.01$), and general chemistry was near statistically significantly associated ($p=0.06$). The DAT scores explained approximately 8 percent of the variability in biochemistry and physiology subtest scores ($R^2=0.08$).

The multiple linear regression model for the microbiology and pathology subtest score is summarized in Table 2c. Reading comprehension ($p<0.01$), general chemistry ($p=0.05$), and organic chemistry ($p=0.03$) were statistically significant predictors of the subtest score. Variations in the DAT predictor variables explained approximately 11 percent of the variability of scores on the microbiology and pathology subtest.

Dental anatomy and occlusion subtest scores were statistically significantly associated with perceptual ability test scores ($p<0.01$) and reading comprehension scores ($p=0.03$). Variations in the DAT scores explained 10 percent of the variability in dental anatomy and occlusion subtest scores. These data are summarized in Table 2d.

Table 2a. Multiple linear regression model for anatomical sciences

Variable	Coefficient	t-statistic	p-value
Constant	75.73	16.31	<0.01
DAT-BIO	-0.02	-0.15	0.88
DAT-GC	0.18	1.46	0.15
DAT-OC	0.06	0.48	0.63
DAT-RC	0.37	3.34	<0.01
DAT-QR	0.06	0.58	0.57
PAT	0.09	0.76	0.45

	Sum of Squares	df	F-statistic	p-value
Regression	343.19	6	2.79	0.01
Residual	4872.92	238		
Total	5216.11	244		

R	R-Square
0.25	0.06

Table 2b. Multiple linear regression model for biochemistry and physiology

Variable	Coefficient	t-statistic	p-value
Constant	78.37	21.15	<0.01
DAT-BIO	0.02	0.22	0.83
DAT-GC	0.19	1.91	0.06
DAT-OC	0.14	1.53	0.13
DAT-RC	0.23	2.64	0.01
DAT-QR	0.08	1.00	0.32
PAT	0.03	0.32	0.76

	Sum of Squares	df	F-statistic	p-value
Regression	252.41	6	3.23	<0.01
Residual	3104.79	238		
Total	3357.20	244		

R	R-Square
0.27	0.08

Discussion

The purpose of this study was to examine the relationship between performance on the Dental Admission Test and performance on Part I of the National Board Dental Examination. The results of our study partially confirm the results put forth in the study by De Ball

et al. Namely, we found that performance on the reading comprehension subtest of the DAT was the most consistent predictor of performance on the NBDE. We also found that scores on the chemistry DAT subtests (general chemistry and organic chemistry) were statistically significantly associated with performance on the MP NBDE Part I subtest. In addition, performance on the PAT was statistically significantly associated with performance on the DA subtest of NBDE Part I, even after controlling for other covariates.

While these results indicate that there are associations between performance on the DAT and Part I of the NBDE, the proportion of the variability in NBDE scores that is explained by variability in DAT subtest scores in our study was one-third of the value in the previously published study. The markedly low R-square value for our models can potentially be explained by the relatively small variability in NBDE and DAT scores for our study population. On average, HSDM students have DAT and NBDE scores that rank among the top in the nation. It is possible that, given the negatively skewed distributions of DAT and NBDE scores for the population of students at HSDM and the relatively narrow range of scores, there is a diminishing marginal effect at play. That is, the ability of DAT scores to predict NBDE subtest performance is less for scores that are further from the national average and do not encompass the full range of possible scores.

While our study has served to confirm the notion that DAT scores are relatively poor predictors of NBDE Part I subtest performance, there is a need for a large-scale study across various populations of dental students to make definitive generalizations about this relationship. In addition, other covariates, such as undergraduate general and science GPAs and undergraduate majors should be evaluated as potentially important determinants of NBDE Part I performance. Such studies may help to redefine the importance placed upon such factors in considering dental school admissions.

Table 2c. Multiple linear regression model for microbiology and pathology

Variable	Coefficient	t-statistic	p-value
Constant	77.21	21.23	<0.01
DAT-BIO	0.07	0.63	0.53
DAT-GC	0.18	1.94	0.05
DAT-OC	0.21	2.26	0.03
DAT-RC	0.32	3.72	<0.01
DAT-QR	0.08	0.94	0.35
PAT	-0.08	-0.89	0.38

	Sum of Squares	df	F-statistic	p-value
Regression	358.61	6	4.76	<0.01
Residual	2988.56	238		
Total	3347.17	244		

R	R-Square
0.33	0.11

Table 2d. Multiple linear regression model for dental anatomy and occlusion

Variable	Coefficient	t-statistic	p-value
Constant	74.47	15.20	<0.01
DAT-BIO	-0.07	-0.50	0.62
DAT-GC	0.21	1.66	0.10
DAT-OC	0.01	0.05	0.96
DAT-RC	0.26	2.26	0.03
DAT-QR	0.14	1.28	0.20
PAT	0.37	2.89	<0.01

	Sum of Squares	df	F-statistic	p-value
Regression	573.53	6	4.20	<0.01
Residual	5424.41	238		
Total	5996.94	244		

R	R-Square
0.31	0.10

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