Impact of Gender on Dental State Licensure Examination Performance


Abstract: The purpose of this study was to identify performance differences in subgroups of dental students during dental school and on state dental licensure examinations. One of the specific aims was to determine if gender is predictive of performance in dental school and on state licensure examinations. The study consisted of a retrospective analysis of 416 graduates (136 females and 280 males) from the University of Florida College of Dentistry (UFCD) between 1996 and 2003. Four categories of variables were assessed: academic measures, clinical productivity measures, performance on a senior mock board examination, and performance on the state licensure examination. The academic measures consisted of the Dental Admission Test (DAT) academic average, DAT Perceptual Ability Test (PAT), and dental school entering and graduating grade point average (GPA). Based on univariate analyses, males had significantly higher DAT academic averages and PAT scores than females. More importantly, males had significantly higher state board clinical scores. Using stepwise regression and the maximum R² procedure, factors most predictive for the performance on the state licensure clinical exam were the PAT, numbers of amalgams completed, and the UFCD senior mock board clinical score. Each factor was highly significant (p<0.001). After controlling for these three factors, the difference in genders was no longer statistically significant. With increasing enrollment of females in dental schools, it is important to periodically assess student performance to determine whether instructional modifications are needed to accommodate gender differences. Due to consistency of our findings with similar recent reports, it might be reasonable to think the gender gap is narrowing. Additional studies from other regions would provide support for this concept.

Dr. Stewart is Associate Professor, Division of Oral Diagnostic Sciences, Department of Oral and Maxillofacial Surgery and Diagnostic Sciences, University of Florida College of Dentistry; Dr. Bates is Associate Professor, Department of Prosthodontics, and Senior Associate Dean of Operations and Clinical Affairs, University of Florida College of Dentistry; Dr. Smith is Professor, Department of Operative Dentistry, University of Florida College of Dentistry; and Dr. Young is Professor, Department of Statistics, University of Florida Institute of Food and Agricultural Sciences. Direct correspondence and requests for reprints to Dr. Carol Stewart, University of Florida College of Dentistry, P.O. Box 100414 JHMHC, Gainesville, FL 32610-0414; 352-392-2505 phone; 352-392-2507 fax; cstewart@dental.ufl.edu.

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While the question regarding the existence of gender-related performance differences is yet unresolved, it is the responsibility of dental schools to assess the outcomes of their programs to identify potential gender differences. A preliminary assessment of state board performance at the University of Florida College of Dentistry (UFCD) for graduates between 1996 and 2003 indicated that males performed better than females. This was based on two preliminary findings. The first attempt pass rate on the state board exam was 86.8 percent for males and 79.8 percent for females. Also, the mean score on the state board clinical exam portion was 3.39 for males and 3.26 for females. This prompted us to conduct a detailed retrospective analysis of performance differences among dental subgroups to determine whether preliminary findings had statistical significance and to further investigate predictors for performance in dental school and on the Florida state licensure examination. Studies have been published regarding the Dental Admission Test (DAT) as a predictor of success in dental school, gender differences in National Board Dental Examination Parts I and II performance, gender differences in the Perceptual Ability Test (PAT), and performance in preclinical technique courses; others have assessed academic parameters and performance on a dental licensure examination. However, no reports have looked simultaneously at the relationship of students’ gender to academic parameters, clinical productivity measurements, senior mock board examination performance, and licensure examination performance. Triggered by the gender differences in Florida state dental board performance, this retrospective analysis was conducted to further explore whether gender predicts performance on several standard outcome measures in dental education.
A review of the relevant literature published in the past forty years revealed multiple findings and differing opinions concerning the abilities of the Dental Admission Test (DAT) and specific subscores of the DAT to predict success in dental school. Manhold and Manhold in 1965 concluded that the best predictor of dental student performance was the academic aptitude composite score of the DAT. Kreit and McDonald in 1968 reported that the academic average composite score and the DAT reading comprehension had predictive value for graduating GPA. Other authors—Phipps et al. in 1968, Dworkin in 1970, and Wood in 1979—reported that the DAT had little predictive value for dental school success.

Several reports have supported gender differences in performance on critical benchmark examinations such as the DAT, the Perceptual Ability Test (PAT), and the National Board Dental Exam Part II. The Perceptual Ability Test of the DAT is reported to be a valid cognitive measure for spatial reasoning and ability. Gray and Deem reported on relationships between performance on the PAT and performance in eight preclinical technique courses for 1998-2001 graduates of Temple University School of Dentistry. They hypothesized that general cognitive ability is a major component of general psychomotor ability and that PAT performance might correlate with performance in technique courses. They reported that students with high PAT scores were the best performers based on final preclinical technique course grades, regardless of their entering GPA or DAT academic average subtest scores. Their results showed that PAT scores accounted for a significantly high proportion, approximately 25 percent, of the variance of the final grades in preclinical technique courses. These studies suggest a possible relationship between technical performance and PAT scores. In 2002, Sandow et al. reported that PAT scores had some predictive value for dental school performance. In a study correlating admission criteria with dental school performance for UFCD graduating classes 1994-99, Sandow et al. reported that undergraduate science GPA and the PAT were the only indicators of programmatic progress in their multivariate analysis. In addition, Sandow et al. reported that low PAT scores were the only admission criteria associated with students who were dismissed from the program.

A study by Potter in 1986 reported a relationship between PAT scores and gender. Potter’s analysis of six classes at Indiana University showed male applicants had a higher mean score than females on the three-dimensional PAT of the DAT. Relationships among gender, PAT scores, and technical performance have been reported as well. In 2003, Coy et al. reported performance differences by male and female students on the PAT. A correlational analysis of 492 University of Oklahoma College of Dentistry graduates over a ten-year period showed that the PAT maintained a statistically significant capacity for predicting technical performance in dental school. Coy et al.’s analysis indicated that males performed better than females on the PAT. In addition, the PAT was predictive of male performance in practical technique examinations but not female performance. While males performed better than females, Coy et al. also stated the practical predictive capacity was limited because the PAT accounted for only 5-9 percent of the variance on practical examinations. Coy et al. concluded that PAT scores did not predict development of technical skills for males versus females and appeared to have little value beyond a gross screening tool.

Success in dental school should provide a foundation for successful performance on a licensure examination. Performance on a dental licensure exam is important for several reasons. It is often used as an outcome indicator to university administration and to ADA accreditation site visitors regarding the effectiveness of a clinical program. Of greater significance is the outcome for the graduate. Board examination failure often results in a delay in the graduate’s ability to begin generating income for self-support and for repayment of educational loans and may result in a loss of self-confidence.

It is feasible that some performance predictors for dental school could correlate with predictors for a state licensure examination. Only two studies have discussed the correlation among benchmark examinations, gender, and performance on dental licensure exams. Fields et al. analyzed data from six consecutive graduating classes of 128 women and 323 men. Variables included entering and graduating GPAs, DAT scores, National Board Dental Examination Part I (NBDE I) and Part II (NBDE II) scores, and North East Regional Board of Dental Examiners (NERB) pass/fail status. Men outperformed women in all ar-
areas of the DAT except reading comprehension and biology. NBDE I results favored men, and men significantly outscored women on the NBDE II. A comparison of raw data by gender for pass rates on the NERB, NBDE I, and NBDE II showed mean scores for males slightly higher than females. The mean score for the NERB was 56.72 for females and 65.74 for males out of a possible 100 points. However, after controlling for academic performance, the difference in pass rates for males and females was not statistically significant. Fields et al. attributed gender differences to women performing less well on “gatekeeper” board exams.

Casada et al. reported on performance predictors for the Texas State Dental Board Examination analyzing data from five consecutive years of graduates (372) from the University of Texas Dental Branch at Houston. Independent variables included gender, age at graduation, DAT score, admission rank, NBDE I and II scores, class rank in dental school, entering and graduating GPAs, and ethnic background. The licensure exam failure rate for the 230 males was 19.6 percent. For the 142 females, the failure rate was 25.4 percent. However, gender was not found to be a statistically significant predictor of licensure exam failure rates. Only class rank in dental school and ethnic background were included in the final regression equation. There was a significant but weak association between class rank and passing the board examination. In addition, candidates of Asian origin demonstrated lower odds of passing the examination compared with other ethnic groups (Caucasian, Hispanic, and African American). The other variables including gender, age at graduation, DAT score, admission rank, NBDE I and II scores, and entering and graduating GPAs were not found to be statistically significant predictors of licensure exam performance.

These reports indicate a variety of variables have been examined to determine whether they predict performance on various tests and outcomes used in dental education. To provide additional insight and answer our questions about the role of gender, we conducted an analysis of performance variables including benchmark preadmission and academic performance parameters, numbers of clinical experiences or procedures completed, senior mock board examination performance, and licensure examination performance. The focus of this analysis was the identification of performance predictors for success on the state licensure examination.

Methods

Data from 416 University of Florida College of Dentistry (UFCD) graduates from eight successive classes (1996-2003) were assessed. The study population consisted of 136 females and 280 males who completed the senior mock board examination, graduated in sequence, and attempted the Florida dental licensure examination immediately upon graduation. Via written signatures, senior students authorized the College of Dentistry to utilize the licensure board scores for curricular review and improvement. The University of Florida Institutional Review Board granted approval for this project.

Four categories of response variables were considered: academic measures, clinical productivity, senior mock board examination, and Florida dental licensure examination. The academic variables included composite academic average of the Dental Admission Test (DAT), the Perceptual Ability Test (PAT) of the DAT, grade point average (GPA) upon entering dental school, and dental school GPA upon graduating. Clinical productivity measures were the numbers of specific restorative and periodontal procedures completed during the clinical curriculum. These included numbers of clinical amalgam restorations, Class II composite restorations, Class IV composite restorations, periodontal scaling and root planing procedures, endodontic root canal procedures, and fixed prosthodontic units completed. These were selected because they were consistent with the type of procedures required on the state licensure exam. The senior mock board exam variables consisted of performance on two portions: the clinical portion and the written state laws and rules examination. Performance variables on the state licensure examination consisted of the same clinical and written components. The clinical sections included a patient-based Class II amalgam preparation and restoration (weighted at 25 percent), clinical periodontal scaling and root planing on five teeth (15 percent), dentoform procedures (60 percent) consisting of a Class II composite restoration, a Class IV composite restoration, a Class II amalgam restoration, two fixed prosthodontic preparations, and a root canal procedure on an extracted tooth. Scoring for the clinical mock board and clinical state board exam ranged from “0” for failing to “5” for excellent performance, with an average ≥3.0 required for “passing” the clinical portion of the examinations. The
The initial analysis was to determine whether performance, as measured by the four groups of variables, differed with gender, both individually and collectively. A one-way analysis of variance was conducted with gender as the explanatory variable. A univariate analysis was conducted for each response variable, and a multivariate analysis of variance was used to determine whether, collectively, the response variables differed with gender. The gender means and standard errors for each variable, as well as the p-value associated with the test for the equality of the means for the genders, were calculated. To gain further insight into factors that were most predictive of the score on the state licensure examination, a stepwise regression using the maximum $R^2$ procedure was used.

### Results

As shown in Table 1, females had significantly higher total entering GPAs (3.41 vs. 3.33, $p=0.0125$) and graduating GPAs (3.64 vs. 3.57, $p=0.0105$) than males. In addition, females completed more periodontal procedures (41 vs. 36, $p=0.0114$) than males. However, males had significantly higher DAT academic averages than females (18.60 males vs. 18.14 females, $p=0.0125$) and significantly higher PAT scores than females (18.01 males vs. 16.87 females, $p<0.0001$). Of greater importance to the focus of this analysis was that males demonstrated significantly higher state board clinical examination scores than females (3.40 males vs. 3.28 females, $p=0.0119$).

To further assess factors most predictive of performance on the high-stakes dental state licensure clinical exam, stepwise regression using the maximum $R^2$ procedure was conducted. The PAT, numbers of amalgam restoration completed, and the mock board exam clinical scores were the three factors most predictive of the state board clinical score. Each factor was highly significant ($p<0.001$). Controlling for these three factors, the effect of gender on state board clinical score was no longer significant ($p=0.2300$). The estimated mean state board clinical scores, adjusted for the PAT, amalgams completed, and the mock clinical scores, were 3.33 for females and 3.39 for males.

Although only marginally significant, males scored lower on the state board examination on laws governing the practice of dentistry. A similar process was undertaken to try to adjust for the gender effect. After adjusting for academic average, numbers of clinical procedures completed, the estimated mean state law scores were 89.62 for females and 88.81 for males, and these were not significantly different ($p=0.1881$).

### Discussion

The results of this study provide the third report to assess academic benchmarks and performance on
licensure exams. It is the first to include clinical productivity and mock board performance with gender.

Of particular interest were our findings related to the PAT. As mentioned in this report, many perceive the PAT has some relationship to technical performance while others do not. In our analysis, males performed significantly better than females on the PAT subtest of the DAT. In addition, the PAT was a predictor for success on the Florida licensure examination. Could the PAT predict performance in clinical settings and on licensure examinations? The design of this study was not constructed to answer that question, but it is an interesting concept. While these results do not recommend the PAT as a performance predictor for licensure examinations, the results could be used to encourage faculty to devote more attention to students who have the combination of low PAT scores and poor performance in preclinical technique courses. This attention would help ensure that they develop cognitive and technical skills at the same pace as their peers.

Hypotheses for gender gaps on high-stakes examinations have been provided by psychologists. Some would attribute differences in performance to low self-esteem among females. This theory, originally proposed by Bandura,14 is known as self-efficacy expectations and refers to a person’s beliefs concerning his or her ability to successfully perform a given task or behavior. Applying the self-efficacy theory, Hackett and Betz15 found gender differences with respect to male-dominated careers. Another theory suggested that mere knowledge of cultural stereotypes could affect test performance in high-stakes examinations. Steele16 found this could be true for racial, ethnic, or gender identity. A 2005 report by Minter et al.17 indicated that women in general surgical and plastic surgical residency programs tended to underestimate their abilities compared with their male counterparts. On objective measures employed in the Minter et al. study, the males and females performed equivalently. Males and females underestimated their abilities compared with faculty assessments, but female residents demonstrated a greater degree of underestimation. This difference was small and not statistically significant.

Controlling for academic performance, one would expect prepared students to perform similarly. The slight differences in female performance found in this study, though not statistically significant, might have relevance for attending dental faculty who provide technical feedback and constructive comments.

The results of our analysis showed relationships between performance on the licensure examination and performance on the mock board clinical exam and numbers of amalgams completed. This would seem reasonable as the Class II amalgam preparation and restoration comprise 25 percent of the grade on the senior mock board exam and on the Florida dental licensure exam. Completing a higher number of Class II amalgam restorations could improve the skill level and self-confidence of the graduate.

Conclusion

The results of this analysis contribute to the understanding of gender differences in dental performance and predictors for the Florida state dental licensure examination. In comparing genders, differences were not large. When controlling for PAT scores, numbers of amalgams completed, and mock board performance, the effect of gender on state board performance was not significant.

Due to consistency of our findings with similar recent reports,12,13 it might be reasonable to think the gender gap on standard performance measures/outcomes used in dental education is narrowing. Additional studies from other regions would provide support for this concept.

REFERENCES