Research

Predictors of Success in Dental Hygiene Education: A Follow–Up Study

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Abstract

Purpose: In 2002, a 6 year review of dental hygiene graduates from the Medical College of Georgia (1996 through 2001) was conducted to determine which criteria were the best predictors of success. Success was defined in terms of National Board Dental Hygiene Examination (NBDHE) score and dental hygiene GPA at graduation. The purpose of this follow–up study was to determine if a relationship exists between predicted success (using 2002 models) and actual success of entry–level baccalaureate degree students who graduated from 2002 through 2007.

Methods: Two probability models of success were developed from a previous study of MCG dental hygiene graduates (1996 to 2001). Academic information from students (n=156) in the 2002 to 2007 classes was inserted into the two 2002 models to determine if there was a correlation between their actual and predicted success.

Results: Moderate correlation (r=.581, p=.01) was found when using the established MODEL 1 to predict dental hygiene GPA at graduation and moderate correlation (r=.465, p=.01) was found when using the established MODEL 2 to predict NBDHE scores.

Conclusions: The authors concluded incoming GPA and total SAT® Program score remain useful in predicting the success of students. However, when substituting incoming GPA with dental hygiene GPA at the end of the first year, even stronger correlations resulted in MODEL 1 (r=.957, p=.01) and in MODEL 2 (r=.694, p=.01). Based on these results, recommendations were made to keep current admissions criteria and to implement formal remediation for academically weaker students after completing the first year of the dental hygiene program.

Key Words: dental education, National Board Dental Hygiene Examination, College Admission Test (SAT® Program)

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Introduction

Selecting the most qualified applicants remains a significant challenge for dental hygiene program admissions committees. Qualified applicants are those who will successfully complete program requirements and licensing examinations to become competent health care providers ready for entry into the profession.[1]

When predictors of success were first studied at the Medical College of Georgia, there was a scarcity of literature related specifically to dental hygiene. Most studies assessed success of dental students[2–6] and other health professionals[7–17] including occupational therapy, physical therapy, respiratory therapy and nursing. The only study that was specific to dental hygiene was published by Syme and DeVore.[18] They researched admissions committee members' opinions regarding dental hygiene applicant interviews.

Review of the Literature

Since 2002, there has been an increase in publications related to predictors of success specific to dental hygiene. Numerous dental hygiene programs have used a variety of data (cognitive and non–cognitive) to predict success of students in dental hygiene school. Edenfield and Tanenbaum studied the Admission Point Index as a predictor of success for retention, successful completion of the National Board Dental Hygiene Examination (NBDHE) and graduation of dental hygiene students.[19] Their descriptive study employed the ex post facto design, utilizing the Admission Point Index scores, NBDHE scores, retention rates and graduation rates of dental hygiene applicants (n=80) accepted for the years of 1995–1997. The authors concluded the Admission Point Index can be used as a predictor of success for entry into the profession.[19]

DeAngelis compared use of an

atypical, non–cognitive predictor of academic achievement, the Problem Solving Inventory, with the traditional cognitive measures of the American College Testing® Program (ACT®) score and GPA of 28 dental hygiene students.[20] The preliminary findings of this study indicated the Problem Solving Inventory moderately enhanced the predictive capacity of the traditional cognitive measures of entering GPA and ACT score.[20]

Williams et al examined the degree to which 207 dental hygiene students' pre–existing critical thinking skills and critical thinking disposition uniquely predicted early clinical reasoning ability.[21] The results of their investigation suggested critical thinking skills, as measured by the California Critical Thinking Skills Test (CCTST), explained a statistically significant proportion of variance in initial clinical performance as measured by the 3 outcome measures. Additionally, the degree to which the CCTST explained variance in the outcomes exceeded that predicted by entering GPA, number of college hours and students' age. The CCTST was especially effective as a predictor of acquired knowledge. Critical thinking disposition did not play a comparable role in predicting initial student outcomes.[21]

DeWald et al examined data from 168 students such as entering GPA, exiting GPA and taking a board review course to predict performance on the NBDHE.[22] Results of their study did not find entering GPA to be a predictor of NBDHE performance. A strong correlation was found, however, between exiting dental hygiene GPA and performance on the NBDHE. The authors also noted students who took the review course did not perform any better than those who did not take the course.[22]

In another study of 132 graduates, Bauchmoyer et al found overall entering GPA had the strongest correlation with cumulative dental hygiene GPA, followed by GPAs in biology, chemistry I and chemistry II courses. The strongest correlation for NBDHE success was the cumulative dental hygiene GPA.[23]

In 2006, Williams et al studied whether preexisting critical thinking skills and critical thinking disposition predicted student (n=76) performance on the NBDHE.[24] The predictive value of critical thinking skills scores and disposition (habits of mind, attitudes and character attributes) scores were examined in addition to that provided by traditional predictors such as entering GPA, age and total number of college hours at entry into the dental hygiene program. Preexisting general critical thinking skills and disposition were assessed using the CCTST and California Critical Thinking Disposition Inventory (CCTDI). These tests were administered the first week of classes and again at the completion of the 2 year educational program. The authors concluded critical thinking skills, as measured by the CCTST, explained a statistically significant proportion of variance in the multiple–choice and case–based component scores of the NBDHE. Additionally, the degree to which the CCTST explained a variance in the outcomes exceeded that predicted by entering GPA, number of college credit hours and students' age. The CCTST was significant as a predictor of the case–based portion of the NBDHE. The CCTDI was not significant as a predictor of board examination scores.[24]

In 2007, Alzahrani et al examined a variety of factors to assess students (n=235) who were most likely to graduate and be successful in passing the NBDHE.[25] Based on the results, the authors concluded the final course grade in oral pathology was a significant predictor of successful graduation. The final course grade in oral pathology, final course grade in oral anatomy and histology and the admissions criteria points rating predicted NBDHE. However, while the admissions criteria points score was determined to be a significant predictor of NBDHE success, it was not found to be a predictor of successful graduation from the program. No statistically significant relationship was found between incoming college GPA (I–GPA) and GPA in prerequisite college science courses (S–GPA) and graduation and NBDHE success.[25]

Probability models generated from results are specific to the program and cannot be generalized to other programs. This is a limitation with predictor studies, primarily due to differences in admissions criteria, prerequisite courses, teaching methodology and dental hygiene curriculum sequence and length. Predictor studies are an example of action research which can be useful for historical perspective and for comparison of research methodologies. However, caution must be used when comparing results across programs.

In 2002, a 6 year review of the Medical College of Georgia's (MCG) dental hygiene program graduates (classes of 1996 to 2001, n=134) was completed to determine predictors of academic success.[1] Predictors of success were defined as the student's ability to complete program requirements and pass the NBDHE. Using multiple regression analysis, 2 predictor models were established. The authors concluded knowledge of incoming GPA (I–GPA) and total SAT® Program (T–SAT) score was most helpful in developing models to predict success of students in MCG's dental hygiene program.[1]

The purpose of this follow–up study was to determine if a relationship existed between the predicted success and the actual success of entry–level baccalaureate degree students who graduated in the classes of 2002 through 2007 by using models established in the 2002 study.[1]

Methodology

Approval to conduct this study was obtained from the institution's Human Assurance Committee. In this retrospective investigation, aca-

demic transcripts and admissions documents of dental hygiene graduates (n=156) from 2002 to 2007 were reviewed.

Demographic information such as age, gender, race and prior degrees were recorded. Academic information was also collected and included the following:

- Incoming college GPA (I–GPA) of all previous college coursework. Minimal preparation included 60 semester hours of college courses required for program admissions. These prerequisite hours were established by the University System of Georgia and included classes in 6 subject areas
- Total SAT® Program score, verbal and math sections (T–SAT)
- GPA including courses completed during the first 3 semesters of the dental hygiene curriculum (DH1–GPA)
- Final dental hygiene GPA at graduation, after completing all 5 semesters of the dental hygiene curriculum (DH2–GPA)
- National Board Dental Hygiene Examination score (NBDHE)

All information collected from academic records was documented by 2 investigators on a spreadsheet using non–traceable identifiers. Success in dental hygiene education was defined by 2 variables, NBDHE and dental hygiene GPA at graduation (DH2 – GPA).

Two probability models of success were determined from a previous study of MCG dental hygiene graduates (1996 to 2001), in which authors defined program success or success in dental hygiene education by 2 variables: NBDHE score and Dental Hygiene GPA at the end of second year (DH–GPA).[1] Five cognitive admissions criteria variables were identified as potential predictors of dental hygiene success: incoming college grade point average (I–GPA), incoming math/science college grade point average (MS–GPA), total SAT® Program score (T–SAT), verbal SAT® score (V–SAT) and math SAT® score (M–SAT).

A forward, step–wise, multiple linear regression was used to analyze the data. In predicting DH–GPA, the most efficient model included I–GPA ($p<.001$) and T–SAT ($p< .004$). The 2002 model justified the following observations:

- Knowledge of T–SAT in addition to the I–GPA added significantly to the ability to predict the DH–GPA
- Knowledge of non–math/science GPA in addition to the math/science GPA added significantly to the ability to predict the DH–GPA
- Knowledge of V–SAT in addition to the M–SAT added significantly to the ability to predict the DH–GPA

The most efficient model to predict Dental Hygiene National Board performance at this institution included only the I–GPA. T–SAT did not add significantly to the ability to predict performance on the National Board. The 2002 study justified the following observation:

- Knowledge of non–math/science GPA in addition to the math/science GPA added significantly to the ability to predict performance on the Dental Hygiene National Board Examination

The 2002 study concluded the dependent variables, DH–GPA and NBDHE, could be predicted using 2 models. In this follow–up study, academic information from dental hygiene students in the 2002 to 2007 classes was inserted into the two 2002 models to determine if there was a correlation between their actual and predicted success:

- Dental Hygiene GPA at Graduation (DH2–GPA) = 1.689 + (incoming college GPA X 0.375) + (total SAT score X .000603)
- National Board Dental Hygiene Examination Score (NBDHE) = 65.545 + (incoming college GPA X 5.984)

Data were analyzed using SPSS® 14.0 statistical software. Actual and predicted variables were paired for each member of the 2002 to 2007 dental hygiene classes and then correlated. The resulting correlation coefficient (r) indicated the degree of relationship between the actual and predicted variables. The magnitude of the correlation was defined according to the coefficient value as low ($r<0.35$), moderate ($r=0.35–0.65$), or high ($r>0.65$).[26]

Results

The population consisted of dental hygiene graduates (n=156) at the Medical College of Georgia. Subjects ranged from 19 to 47 years of age, with a mean age of 23. One hundred fifty–three (98%) were female and 3 (1.9%) were male. One hundred twenty–two (78%) were Caucasian, 22 (14.1%) were African American, 6 (3.8%) were Hispanic and 6 (3.8%) were Asian/Pacific Islander.

A total of 46 (29.5%) had earned a certificate or degree in another area at the time of matriculation in the dental hygiene program. Twenty–three (14.7%) had previously earned an associate degree, 16 (10.3%) had previously earned a baccalaureate degree and 7 (4.5%) had previously earned a dental assistant certificate. A composite academic profile revealed that the dental hygiene students enrolled from 2002 through 2007 had an average incoming college GPA of 3.20 (n=155), an average incoming college math/science GPA of 2.85 (n=155) and an average T–SAT score of 930 (n=59).

Correlations between actual and predicted GPA at the end of the dental hygiene program are shown in Table 1. When using MODEL 1, moderate correlation (r=.581) was found between actual DH2–GPA and predicted DH2–GPA, significant at p=.01. When substituting DH1–GPA for I–GPA in MODEL 1, high correlation (r=.957) was found with similar significance (p=.01).

Correlations between actual and predicted NBDHE scores are shown

in Table 2. When using MODEL 2, moderate correlation (r=.465) was found between actual NBDHE and predicted NBDHE, significant at p=.01. When substituting DH1–GPA for I–GPA in MODEL 2, high correlation (r=.694) was found with similar significance (p=.01).

Discussion

In the 1996 to 2001 and 2002 to 2007 cohorts, the average age was 23 and the minimum age was 19. Maximum age in the current and previous studies only differed by 2 years, 47 and 45 respectively. Fewer males were represented in the current study when compared to the 2002 study, 1.9% and 5% respectively. Enrollment of African American students increased from 6% to 14.1% and enrollment of Hispanics increased slightly from 3% to 3.8%. Enrollment of Asian/Pacific Islanders decreased from 6% to 3.8%. In both studies, approximately 30% of students enrolled with a certificate or prior degree. Overall, the demographics of both cohorts have strong similarities and demonstrate that student characteristics have not changed drastically over the past 12 years.

Models established using the classes of 1996 to 2001 were useful in showing moderate correlations between actual and predicted dental hygiene GPA at the end of the curriculum and NBDHE scores. However, when substituting dental hygiene GPA at the end of the first year (DH1–GPA) with incoming GPA (I–GPA) in both models, the correlations were higher. Implications of this finding include the need to focus remediation efforts at the end of the first year for students who are not performing well academically.

In the current and previously published studies, entering dental hygiene GPA provided lower correlation with NBDHE performance than exiting dental hygiene GPA.[22,23,25] Higher correlation was found with NBDHE performance when using dental hygiene GPA at the end of the first year. Implication of these similar findings increases the reliability and validity regarding the importance of dental hygiene GPA at the end of the first year.

Probability models generated from results of this study are limited to the MCG dental hygiene program and cannot be generalized to other programs. Based on the results of this study, the authors made the following recommendations for the entry–level baccalaureate dental hygiene program at the Medical College of Georgia:

- Keep the current admissions criteria since failures on national boards have been consistent with students who were academically weaker in the dental hygiene curriculum
- Implement a formal remediation program after completion of the first–year curriculum for those students with DH1–GPA less than 3.0. The DH1–GPA of all students in the classes of 2002 to 2007 who were not successful on the NBDHE (n=7) was less than 3.0

Further investigation of remedial options for dental hygiene students is needed. Continuous evaluation of admissions criteria, both cognitive and non–cognitive, is also needed to capture impending changes among future generations of students which may impact their success in dental hygiene education.

Conclusion

Results of the current study show that the 2 models established using student data from the classes of 1996 to 2001 were useful for predicting the success of subsequent classes of 2002 to 2007. Incoming GPA and Total SAT® Program scores remain helpful in predicting the success of students in the entry–level baccalaureate degree program at the Medical College of Georgia. Alternatively, when using GPA at the end of the first year of dental hygiene curriculum instead of incoming college GPA, a stronger correlation of success resulted. Finding

Table 1. Correlations Between Actual and Predicted GPA at End of DH Program

DH2–GPA Actual (n=155)		DH2–GPA Predicted (n=59)
MODEL 1: DH2–GPA = 1.689 + (I–GPA X 0.375) + (T–SAT X .000603)		
DH2–GPA Actual	____	.581**
DH2–GPA Predicted	.581**	____
MODEL 1: DH2–GPA = 1.689 + (DH1–GPA X 0.375) + (T–SAT X .000603)		
DH2–GPA Actual	____	.957**
DH2–GPA Predicted	.957**	____
**Pearson correlation is significant at the 0.01 level (2–tailed)		

Table 2. Correlations Between Actual and Predicted NBDHE Score

NBDHE Actual (n=154)		NBDHE Predicted (n=154)
MODEL 2: NBDHE = 65.545 + (I–GPA X 5.984)		
NBDHE Actual	____	.465**
NBDHE Predicted	.465**	____
MODEL 2: NBDHE = 65.545 + (DH1–GPA X 5.984)		
NBDHE Actual	____	.694**
NBDHE Predicted	.694**	____
**Pearson correlation is significant at the 0.01 level (2–tailed)		

strong correlates of success at the end of the first year of the dental hygiene curriculum, rather than at the end of the exiting year, is more useful and timely for implementing remediation.

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