

Comparison of Postbaccalaureate and Baccalaureate Graduates' Performance in First and Second Years of Dental School

Gary M. Johnson, Amy F. Buros, Radd W. Lukas

Abstract: Postbaccalaureate programs help predoctoral students strengthen their basic science knowledge and improve their study skills before applying or reapplying for dental school admission. A high percentage of postbac students are admitted to and graduate from dental schools, but gaining greater understanding of how well these students perform in key areas of the first two years' curriculum would be useful for the design of those programs. The aim of this study was to evaluate postbac dental students' performance in the D1 and D2 years at one U.S. dental school compared to dental students with a four-year baccalaureate degree only. Performance assessed was the students' dental school grades in basic science courses, in all D1 and D2 didactic courses, and on preclinical simulation lab practical exams. Didactic and practical scores were gathered anonymously for the Classes of 2013-18 at the College of Dental Medicine-Arizona (CDMA) at Midwestern University, where postbac students with master's degrees from the affiliated College of Health Sciences made up 6-19% of each class. The two cohorts chosen for comparison were students with baccalaureate degrees only and students with one-year Master of Arts degrees from the College of Health Sciences. The scores of these postbac dental students and their non-postbac peers were found to be comparable in the basic science courses. However, for all the didactic courses combined, the non-postbac cohort had significantly higher mean scores than the postbac cohort for the fall quarter 2 and winter quarter 2 in 2013-15 and all years combined. The practical scores for the two cohorts were not significantly different for any year. Overall, this study demonstrated that the MA program in the College of Health Sciences prepared the postbac students to compete on an equal level with the non-postbac students in the CDMA D1 and D2 curriculum.

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The Dental Admission Test (DAT) scores and grade point average (GPA) of students applying to U.S. dental schools continue to increase, making it difficult for applicants without competitive academic scores to be considered.¹ Postbaccalaureate programs provide these students the opportunity to build a stronger foundation in the basic sciences, raise their GPA and/or DAT scores, improve their study skills, and then apply or reapply for dental school admission.^{2,3} In a previous study of postbaccalaureate programs at seven universities with affiliated dental schools, the postbac students were found to have high success rates in gaining acceptance to dental school, doing well there, and graduating.⁴ Gaining greater understanding of the features of postbac programs that help students

compete successfully with non-postbac students in dental school would be useful for the future of those programs.

Our search of the literature found no prior published studies comparing the dental school academic performance of postbac graduates to baccalaureate degree dental students, although some sources addressed the value of postbac programs in enhancing diversity in dental school enrollment.⁵⁻⁹ Two studies have compared the academic performance of postbac medical students with their non-postbac peers. In 2015, Epps concluded, "Overall, participants in the [Meharry Medical College] postbaccalaureate program are just as successful as non-participants with regard to timely graduation, as well as . . . passing the United States Medical Licensure Exam Steps 1 and

2.”¹⁰ In 2008, Reeves et al. reported, “The average GPA after the first-year medical school curriculum for all postbacs accepted into the Texas College of Osteopathic Medicine (TCOM) is slightly higher than the regular TCOM medical students who were accepted through the traditional medical school admissions process. Analysis of overall performance in medical school reveals that the TCOM Class of 2008 postbacs did very well compared with their non-postbac classmates.”¹¹

Johnson et al.’s study found that most dental schools have only a small percentage of postbac graduates in their matriculating classes each year.⁴ At Midwestern University (MWU) College of Dental Medicine-Arizona (CDMA), however, an average of over 10% of each incoming class consists of graduates from postbac programs. This situation results in a measurable sample for assessing the comparative performance of postbac and non-postbac dental students. The aim of this study was to evaluate postbac dental students’ performance in the D1 and D2 years compared to dental students with a four-year baccalaureate degree only. Since postbac programs place substantial emphasis on the basic sciences, the primary performance assessed was students’ dental school grades in basic science courses and on pre-clinical simulation lab practical exams.

Methods

This study was approved by the Institutional Review Board at Midwestern University, AZ#836. The first and second academic years at MWU CDMA each consist of three ten-week quarters in the fall, winter, and spring, for a total of six quarters. First- and second-year students’ didactic and dental lab practical scores were collected anonymously from the office of student affairs for the Classes of 2013-18. Predental educational backgrounds for each student were also collected, and the students were divided into four cohorts: postbac graduates of the one-year Master of Arts (MA) biomedical science program at the MWU College of Health Sciences; postbac graduates of the College of Health Sciences two-year Master of Biomedical Sciences (MBS) program; students with a four-year baccalaureate degree and no postbac education; and students with master’s degrees from other programs.

For this study, we chose two of these cohorts for comparison: postbac graduates of the MA program (the MA cohort) and students with a four-year

baccalaureate degree only (the BA/BS cohort). This decision was based on two main factors. The MWU College of Health Sciences MA program has a basic science curriculum similar in content to the MWU CDMA first- and second-year basic science program, so the outcomes of those programs are more directly comparable than would be the case with other master’s programs. Also, the percentage of dental students from the other master’s degree cohorts was very low.

To compare the performance of the two selected cohorts, dental students’ scores from the nine basic sciences courses in the fall, winter, and spring quarters of the D1 year and the two pharmacology courses in the fall and winter quarters of the D2 year were used for comparison. To further compare the performance of these two cohorts, we used students’ scores in all didactic courses in the first and second years and their lab practical exam scores.

The grades were calculated using the simple mean of all courses of interest for that quarter. Students’ scores across quarters were compared between the two cohorts using a two-factor mixed design ANOVA. This model considers three effects: the between-subject factor evaluating the difference between cohorts across all time points combined; the within-subject factor evaluating the difference in scores across the different quarters regardless of cohort; and the interaction of these two factors, evaluating if scores differed between the two cohorts across all five quarters. If the interaction or between subject main factor was significant, we used post hoc tests to compare the cohorts at each time point. The false discovery rate (FDR) method was used to adjust for multiple comparisons. We considered models for each year and class separately, except the 2013 to 2015 classes. A final model was built combining all students from years 2013-18, after testing if year had a significant effect in a separate model. The threshold for statistical significance was $p < 0.05$. Analysis was done using R version 3.4.1 (R Foundation for Statistical Computing, Vienna, Austria).

Results

Among the total 658 BA/BA and MA dental students in those years, 89% (N=583) were in the baccalaureate degree-only cohort, and 11% (N=75) were in the postbac MA cohort (Table 1). The CDMA Admissions Committee collects gender and academic information for students in each class year. For all

Table 1. Dental students with a postbaccalaureate degree from the Master of Arts biomedical science program (MA students) and with a four-year baccalaureate degree only (BA/BS students), by number and percentage of total MA plus BA/BS students in each class year

Graduating Class	Combined MA and BA/BS Students	MA Students Number (%)	BA/BS Students Number (%)
2013	102	6 (6%)	96 (94%)
2014	100	8 (8%)	92 (92%)
2015	100	6 (6%)	94 (94%)
2016	103	11 (11%)	92 (89%)
2017	124	24 (19%)	100 (81%)
2018	129	20 (16%)	109 (84%)
Total	658	75 (11%)	583 (89%)

726 matriculating dental students in the Classes of 2013-18, 59% were men, 41% were women, the mean age was 25.33, the average GPA was 3.52, and the average DAT was 19.92. Demographic statistics regarding race, age, and gender for individuals in the two cohorts were not available from the College of Health Sciences or the College of Dental Medicine. Students with missing scores in at least one of the quarters, generally because of a leave of absence, were omitted from the analysis. As students in the MA cohort for 2013 to 2015 were very small, those three years were aggregated into one measure.

In the two-factor mixed ANOVA model for the basic science and pharmacy courses (Table 2),

the effect of quarter was highly significant every year ($p < 0.0001$). The interaction effect between cohort and quarter was significant for 2013-15 ($F[4,12016]=2.99$, $p=0.018$), for 2017 ($F[4,492]=2.89$, $p=0.022$), and for all years combined ($F[4,2648]=5.16$, $p=0.0004$; Figure 1). Post hoc analysis of the two groups for each quarter for 2013-15, 2017, and all years combined showed no differences. The cohort main effect was insignificant for every individual year and all years combined.

In the two-factor mixed ANOVA model for all didactic courses (Table 3), the effect of quarter was highly significant every year ($p < 0.0001$). The interaction effect between cohort and quar-

Table 2. The two cohorts' scores in all basic science courses by mean (standard deviation) and comparison (p-value) by cohort, quarter, and interaction

Comparison	2013-15	2016	2017	2018	All Years
Cohort	0.178	0.642	0.734	0.354	0.706
Quarter	0.0017	0.0025	0.014	<0.0001	<0.0001
Interaction	0.018	0.109	0.022	0.303	0.0004

Quarter of Courses	2013-15		2016		2017		2018		All Years	
	MA	BA/BS	MA	BA/BS	MA	BA/BS	MA	BA/BS	MA	BA/BS
Fall D1	3.21 (0.50)	3.25 (0.53)	3.24 (0.46)	3.18 (0.57)	3.32 (0.52)	3.21 (0.52)	3.42 (0.44)	3.39 (0.49)	3.30 (0.48)	3.23 (0.52)
Winter D1	3.32 (0.44)	3.34 (0.52)	3.21 (0.61)	3.16 (0.57)	3.26 (0.49)	3.20 (0.57)	3.49 (0.43)	3.39 (0.49)	3.33 (0.49)	3.29 (0.54)
Spring D1	3.06 (0.60)	3.23 (0.55)	3.48 (0.40)	3.24 (0.59)	3.03 (0.57)	3.15 (0.54)	3.30 (0.47)	3.19 (0.55)	3.18 (0.55)	3.21 (0.55)
Fall D2	3.02 (0.93)	3.26 (0.67)	3.25 (0.41)	3.12 (0.62)	3.15 (0.86)	3.28 (0.61)	3.38 (0.53)	3.24 (0.62)	3.19 (0.75)	3.24 (0.64)
Winter D2	2.93 (0.66)	3.26 (0.65)	3.17 (0.63)	3.29 (0.59)	3.13 (0.64)	3.24 (0.63)	3.20 (0.63)	3.22 (0.57)	3.10 (0.64)	3.25 (0.62)

MA=students with a postbaccalaureate degree from the Master of Arts biomedical science program
BA/BS=students with a four-year baccalaureate degree only

Note: Because the numbers of MA students were small in the 2013-15 years, those years were combined for both the MA and BA/BS students.

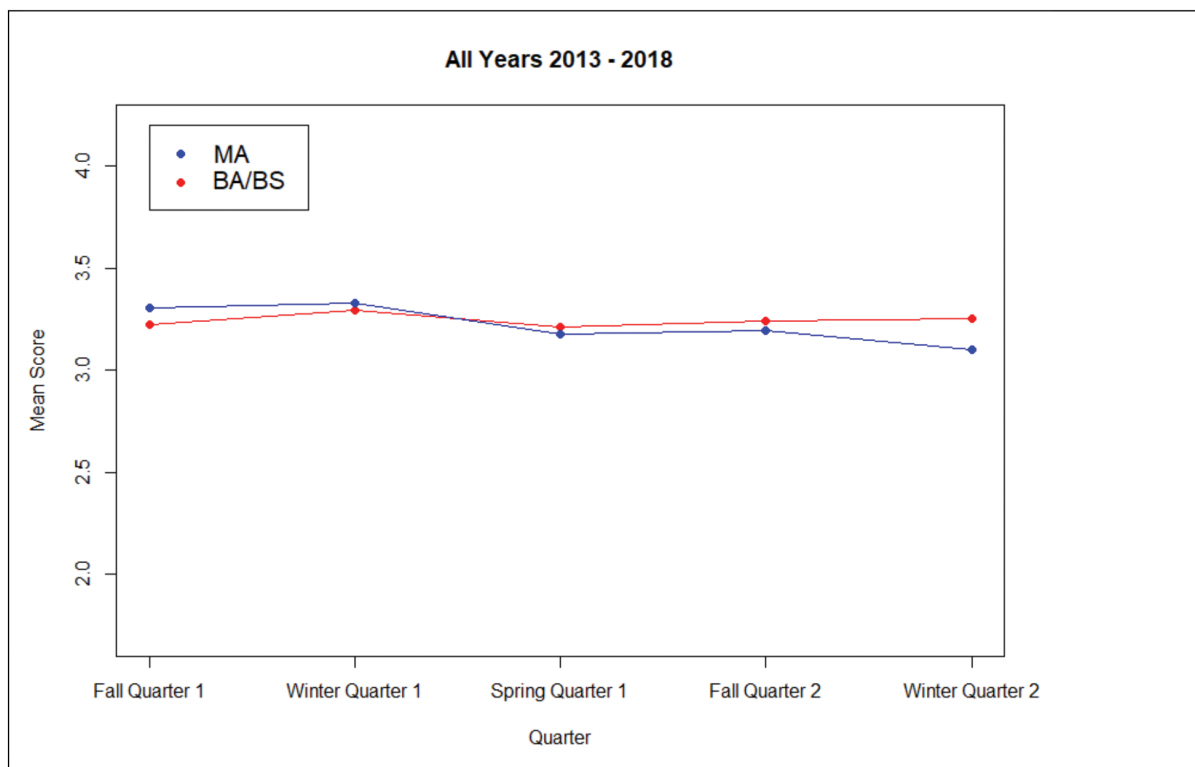


Figure 1. The two cohorts' mean scores in basic science courses for all years combined

MA=students with a postbaccalaureate degree from the Master of Arts biomedical science program
 BA/BS=students with a four-year baccalaureate degree only

ter was significant in 2013-15 ($F[5,1500]=5.61$, $p<0.0001$), in 2017 ($F[5,610]=5.6$, $p<0.0001$), in 2018 ($F[5,630]=3.16$, $p=0.0079$), and in all years combined ($F[5,3275]=10.88$, $p<0.0001$). A post hoc analysis comparing the scores from the two groups in the entire two-year, six-quarter curriculum, on the years with significant interaction, showed the BA/BS cohort having significantly higher mean scores than the MA cohort for the fall quarter 2 and winter quarter 2 in 2013-15 (adjusted $p=0.0013$ and 0.0008) and all years combined (adjusted $p=0.0006$ and 0.0036 ; Figure 2).

For the lab practical scores, in the two-factor mixed ANOVA (Table 4), the quarter main effect was highly significant for every year ($p<0.0001$). The interaction effect was only significant in 2016 ($F[5,505]=2.72$, $p=0.0192$), and post hoc analysis in that year showed no significant difference at any time point between the two cohorts. The cohort main effect was insignificant for every individual year and all years combined.

Discussion

The results showed there was not a significant difference in basic science scores between the postbac (MA) and baccalaureate degree (BA/BS) cohorts. For every single year individually and all years combined, there was never a significant difference for any one quarter between the two cohorts. The quarter effect was significant every year, but that simply means that the students' scores varied across the different quarters, which is expected. In 2013-15, 2017, and all years combined, the interaction effect was significant, but the comparisons between the MA and BA/BS cohorts were insignificant. Thus, we conclude there was no significant difference in scores between the MA and BA/BS cohorts in the basic science core classes.

The majority of the MWU postbac students were not successful in their initial attempts to enter dental school because their GPAs or DAT scores were

Table 3. The two cohorts' scores in all D1 and D2 didactic courses by mean (standard deviation) and comparison (p-value) by cohort, quarter, and interaction

Comparison	2013-15	2016	2017	2018	All Years
Cohort	0.0217	0.663	0.184	0.952	0.073
Quarter	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Interaction	<0.0001	0.248	<0.0001	0.0079	<0.0001

Quarter of Courses	2013-15		2016		2017		2018		All Years	
	MA	BA/BS	MA	BA/BS	MA	BA/BS	MA	BA/BS	MA	BA/BS
Fall D1	3.27 (0.44)	3.35 (0.45)	3.36 (0.35)	3.26 (0.52)	3.33 (0.45)	3.27 (0.46)	3.43 (0.40)	3.29 (0.43)	3.35 (0.42)	3.31 (0.46)
Winter D1	3.37 (0.39)	3.43 (0.44)	3.43 (0.42)	3.29 (0.49)	3.29 (0.46)	3.30 (0.48)	3.49 (0.42)	3.45 (0.43)	3.39 (0.42)	3.39 (0.46)
Spring D1	3.17 (0.50)	3.36 (0.43)	3.52 (0.34)	3.34 (0.50)	3.13 (0.46)	3.30 (0.46)	3.40 (0.40)	3.34 (0.46)	3.26 (0.46)	3.34 (0.45)
Fall D2	3.18 (0.47)	3.50 (0.40)	3.36 (0.39)	3.34 (0.46)	3.02 (0.40)	3.25 (0.46)	3.33 (0.45)	3.36 (0.47)	3.19 (0.45)	3.40 (0.44)
Winter D2	3.07 (0.49)	3.43 (0.45)	3.11 (0.42)	3.17 (0.48)	3.35 (0.54)	3.59 (0.43)	3.33 (0.44)	3.42 (0.45)	3.23 (0.49)	3.41 (0.47)
Spring D2	3.19 (0.51)	3.40 (0.42)	3.27 (0.50)	3.26 (0.52)	3.44 (0.49)	3.59 (0.39)	3.43 (0.39)	3.53 (0.36)	3.35 (0.47)	3.44 (0.44)

MA=students with a postbaccalaureate degree from the Master of Arts biomedical science program
 BA/BS=students with a four-year baccalaureate degree only

Note: Because the numbers of MA students were small in the 2013-15 years, those years were combined for both the MA and BA/BS students.

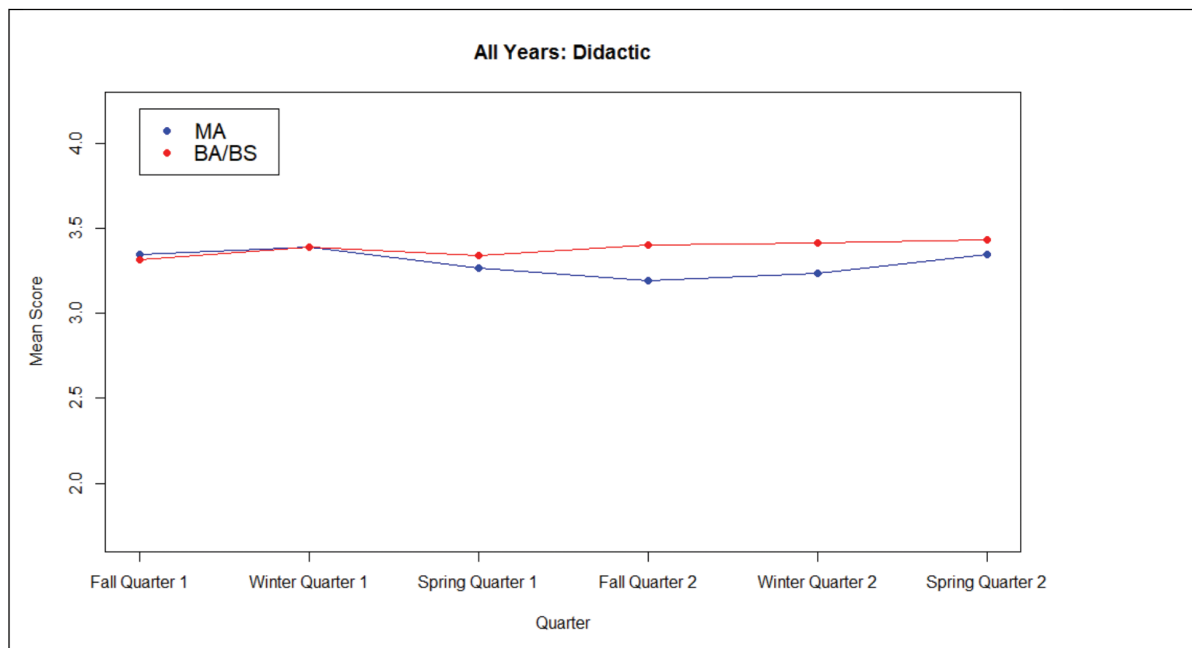


Figure 2. The two cohorts' mean scores in all D1 and D2 didactic courses for all years combined

MA=students with a postbaccalaureate degree from the Master of Arts biomedical science program
 BA/BS=students with a four-year baccalaureate degree only

Table 4. The two cohorts' scores on all D1 and D2 dental lab practical exams by mean (standard deviation) and comparison (p-value) by cohort, quarter, and interaction

Comparison	2013-15	2016	2017	2018	All Years
Cohort	0.813	0.322	0.281	0.705	0.214
Quarter	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Interaction	0.546	0.0192	0.234	0.303	0.934

Quarter of Courses	2013-15		2016		2017		2018		All Years	
	MA	BA/BS	MA	BA/BS	MA	BA/BS	MA	BA/BS	MA	BA/BS
Fall D1	3.59 (0.55)	3.54 (0.50)	3.71 (0.35)	3.50 (0.44)	3.38 (0.41)	3.33 (0.38)	3.90 (0.15)	3.86 (0.24)	3.62 (0.44)	3.56 (0.46)
Winter D1	3.35 (0.52)	3.40 (0.41)	3.58 (0.34)	3.43 (0.34)	3.45 (0.33)	3.52 (0.28)	3.90 (0.15)	3.86 (0.23)	3.56 (0.41)	3.51 (0.39)
Spring D1	3.46 (0.37)	3.45 (0.43)	3.68 (0.26)	3.46 (0.37)	3.51 (0.32)	3.60 (0.34)	3.87 (0.15)	3.84 (0.26)	3.62 (0.33)	3.55 (0.41)
Fall D2	3.36 (0.40)	3.38 (0.39)	3.49 (0.35)	3.59 (0.35)	3.76 (0.26)	3.85 (0.26)	3.56 (0.35)	3.65 (0.34)	3.56 (0.37)	3.54 (0.40)
Winter D2	3.19 (0.37)	3.32 (0.36)	3.62 (0.30)	3.56 (0.35)	3.87 (0.25)	3.95 (0.14)	3.57 (0.34)	3.65 (0.37)	3.57 (0.40)	3.53 (0.41)
Spring D2	3.52 (0.50)	3.49 (0.43)	3.62 (0.30)	3.64 (0.26)	3.65 (0.30)	3.70 (0.26)	3.83 (0.27)	3.84 (0.22)	3.66 (0.37)	3.62 (0.38)

MA=students with a postbaccalaureate degree from the Master of Arts biomedical science program
 BA/BS=students with a four-year baccalaureate degree only

Note: Because the numbers of MA students were small in the 2013-15 years, those years were combined for both the MA and BA/BS students.

too low.⁴ The baccalaureate students were accepted in their initial admission attempts usually with higher GPAs and DAT scores, at least partly as a result of better study skills and demanding basic science undergraduate coursework. The MWU postbac program with its rigorous basic science curriculum may have improved the knowledge and study skills of the postbac graduates sufficiently for them to compete academically on par with the baccalaureate degree dental students.

In fact, one may ask if the postbac students actually had an advantage in basic science courses in dental school over the baccalaureate students, considering the intense basic science preparation in their master's program. These results show that was not the case since the two groups' basic science course average scores demonstrated no significant difference. Clearly, both groups were able to take the basic science knowledge gained in their previous education and apply it in the more clinically focused dental school basic science courses. According to the director of the Basic Science Division at MWU, although the basic science courses in both the dental school and the MA program have similar topics (human anatomy, biochemistry, molecular cell biology, human physiology, microbiology, histology,

immunology and pharmacology), the content of the courses is different since the dental school basic science courses have an integrated human organ systems-based approach.

When we compared the MA and BA/BS cohorts' performance for the entire first and second years, there was no significant difference in the average D1 didactic scores. However, for the combined years in the D2 fall and winter quarters, the didactic mean scores of the BA/BS cohort were significantly higher than those of the MA cohort. An explanation for this discrepancy could be that the postbac program did not provide the MA cohort with any courses of similar content to the D2 non-basic science courses, so the postbac students had not received preparation in those areas as they did in the basic sciences.

We also found no significant difference between the MA and BA/BS cohorts in mean scores on the lab practical exams for the combined years. This finding suggests the MA students were also competing successfully in this part of the curriculum, even though their MA curriculum had no psychomotor training component which could have improved the visualization or hand skills required to perform dental school lab activities.

This study was limited to comparing the academic and preclinical lab performance of two groups of D1 and D2 students at only one university, so the results may not be generalizable to students in other dental schools. A study of postbac graduates' performance at other dental schools with affiliated postbac programs would be useful, although the numbers of postbac students in other dental schools are smaller than at MWU CDMA,⁴ so the sampling would be much smaller for comparison purposes. Regarding other limitations of this study, the CDMA recorded demographics only for the entire student population of each class year, so statistics regarding race, age, and gender for the two cohorts in our study were not available. Those demographics may have provided additional insights to our comparison.

Conclusion

The Midwestern University College of Dental Medicine-Arizona admits an average of over 10% of its first-year classes from the Midwestern University College of Health Sciences master's degree postbac programs, which are rigorous and rich in basic science courses similar in content to those of the dental school. Our study comparing dental students who were graduates of the postbac MA program with students with baccalaureate degrees found no significant difference in performance between the two cohorts in the basic science courses, the lab practical exams, and most of the entire D1 and D2 didactic curriculum. Our conclusion was that the basic science program in the College of Health Sciences prepared the postbac graduates to compete on an equal level with the non-postbac students in the CDMA D1 and D2 basic science curriculum. All of the postbac students accepted to the College of Dental Medicine-Arizona in the years covered by this study were successful in graduating from the program.

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