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Martha E. Orozco Cortes

Wright State University - Main Campus, [orozcocortes.2@wright.edu](mailto:orozcocortes.2@wright.edu)

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The relationship between advanced degrees and performance on USMLE Step 1

Martha Orozco Cortes

Wright State University Boonshoft School of Medicine

**Abstract**

While previous studies have analyzed the relationship of pre-admission factors on USMLE Step 1 scores few studies have looked at the effects obtaining a graduate degree prior to medical school matriculation. Therefore, this study sought to determine if there was an advantage between obtaining a graduate degree before medical school when it came to step 1 board scores. This retrospective study analyzed step 1 scores and medical school application data from 718 students who matriculated at a public midwestern medical school between 2014 and 2016. A combination of analyzes of variance, chi-square tests, and multiple regression analyses were used. When controlling for age, gender and MCAT scores, results showed no association between having a graduate degree either in a science or a non-science field before medical school matriculation and step 1 scores.

Key Words: advanced degrees, graduate, medical school, USMLE, step 1

## Introduction

In 2018, only 48.3 percent of men and 51.6 percent of women who applied to an allopathic medical school matriculated.<sup>1</sup> Given the competitive nature of the medical school admission process, it is no wonder that there has been an increase in the number of programs and resources available for the purpose of improving prospective applicant's chances of getting an acceptance. For students who already graduated college or will not start medical school right after graduating college, one of their options is to pursue a graduate degree.

While a prospective medical school applicant can pursue any type of graduate degree, there has been an increase in the number of graduate degrees designed specifically for those looking to start medical school in the future. The Association of American Medical Colleges (AAMC) lists a total of 243 post-baccalaureate programs, 30 granting a master degree or certificate.<sup>2</sup> However, the advantage of pursuing this or any advanced degree before medical school is still uncertain.

Although certain programs publish the percentage of people in their program that get into medical school, there is no published data on the number of medical school matriculates that have already earned a graduate degree. Also, there is no published data suggesting the type and number of graduate degrees that medical students a whole obtained before starting medical school. More importantly, few studies have analyzed the impact that advanced degrees, degrees obtained beyond the bachelors' level, have on actual medical school academic performance.

While studies suggest that the Medical College Admission Test (MCAT) is a better predictor of success in medical school, than undergraduate major, published literature also

suggest that previous exposure to material in medical school can impact academic performance. A study conducted at the University of Michigan found that students who had previous exposure to histology and pathology received better scores in histology in medical school.<sup>3</sup> If previous exposure to certain science topics or subjects is an advantage when it comes to medical education, it is logical to wonder about the effect is of graduate level coursework on academic performance. Is there an academic benefit of earning an advanced degree in medical school? Or, are advanced degrees beneficial only if they involve science?

Few studies have looked at the effects having a graduate degree prior to medical school matriculation. One of those is a study published in 2017 which looked at one type of advanced degree and its effects on Medical School. The study found that Special Masters Programs (SMPs), which are designed specifically for aspiring medical students, increased their board examination scores, USMLE Step 1 (beyond what was predicted by their MCAT scores)<sup>4</sup>. Nonetheless, a gap in the literature exists because SMPs are not the only type of degree that medical students pursue.

In short, published literature has not addressed the percentage of medical students that pursue different types of masters or advanced degrees, or if those degrees give students an advantage academically. Because of that, this study will look at advanced degrees in general, but will also analyze advanced degrees as two separate groups—science or non-science degrees. More specifically, this study will analyze if obtaining an advanced degree prior to medical school matriculation correlates with higher USMLE Step 1 scores. These board examination scores were chosen as a measure of academic success because it is a standardized test required by all allopathic medical schools.

Conducting this study is important for students looking to better prepare for the challenges of medical school, and admission committees trying to select the medical students that are more likely to succeed.

## **Methods**

This is a retrospective study that analyzed data from students who matriculated at Wright State University Boonshoft School of Medicine, a public Midwestern medical school, from 2010-2016. This constituted a sample of 736 students, but 18 were excluded from the study because they were missing the primary outcome, USMLE Step 1 score. Thus, the total number of students included was 718. The sample of students was divided into two main groups based on highest level of education obtained prior to matriculation—bachelor's degree ( $n = 619$ ), and an advanced or postgraduate degree ( $n = 99$ ). The group of those with advanced degrees was also analyzed as two separate groups—those with graduate degrees in a science ( $n = 74$ ) and those with graduate degrees in a non-science discipline ( $n = 25$ ).

The demographic information (gender, age at matriculation, race) along with MCAT scores (converted to percentiles) and degrees earned prior to medical school matriculation was obtained from the matriculates' medical school applications submitted through the American Medical College Application Service (AMCAS). USMLE STEP 1 scores came from Wright State Boonshoft School of Medicine records. Data was de-identified to preserve the privacy of the students. The study was reviewed by Wright State University Institutional Review Board and deemed exempt.

There were no exclusion criteria besides missing USMLE Step 1, as mentioned above. However, other missing data included a response for race. Out of the sample of 718 included in

the data analysis, 58 did not specify a race in their AMCAS application. These students remained in the analysis because race was not a primary outcome.

### **Data Analysis**

Analysis of the data was conducted using SPSS, version 25 (IBM, Armonk, NY). Descriptive statistics were summarized by percentage for gender and race and by mean and standard deviation for all other variables. A Pearson's Chi-Square test was used to determine if there were gender differences between the group that had a bachelor's degree as the highest degree earned, and the group with advanced degrees. A second Pearson's Chi-Square test was performed to determine if there were gender differences between the three groups—those who only had a bachelor's degree, those with a science graduate degree, and those with a non-science graduate degree. A Pearson's Chi-Square test was also used to determine if there were racial differences between the group that had a bachelor's degree as the highest degree earned, and the group with those with advanced degrees. A Fisher's Exact Chi-Square test was used to determine if there were racial differences between the groups of those who only had a bachelor's degree, those with a science graduate degree, and those with a non-science graduate degree. Also, independent sample t-tests were used to determine if there were differences between the study groups in terms of age of matriculation, MCAT scores (percentiles) and Step 1 scores. Multiple regression analyses were used to determine if there was a relationship between the highest degree earned and STEP 1 score. Multiple regression analyses controlling for MCAT, age of matriculation and gender were also used to analyze possible relationships between step 1 score and highest degree earned.

## Results

Out of the 718 students included in the study, most students, 86.2 percent, had a bachelor's degree as their highest degree obtained prior to medical school matriculation, and 13.8 percent has a graduate degree. 10.3 percent out of the total number of students had a graduate degree in a science, and 3.5 percent had a graduate degree in a non-science field.

The number and percent of students from each study group that selected male or female as their gender on their AMCAS application is shown in Table 1, as well as the percent in each group that selected one of the specified races. From the 718 students in the study, 50.7% were female and 49.3% were male. From the Pearson's Chi Square test, it was determined that there was no significant difference in the gender distribution between the group that had only a bachelor's degree and the group with the graduate degree  $\chi^2(1, N = 718) = 0.31, p = .861$ . Also, from a Pearson's Chi-Square test, it was determined that there was no significant difference in gender distribution between the groups with a bachelor's, graduate degree in science, and graduate degree in a non-science field  $\chi^2(2, N = 718) = 5.646, p = .059$ . In terms of race, there was a significant difference in distribution between the groups. Pearson's Chi-Square test showed that the group with the students who had just a bachelor's and the group with students had a graduate degree were different in terms of their racial composition  $\chi^2(3, N = 660) = 10.972, p = .012$ . Fisher's Exact Test also showed that there was a significant difference in race reported by the groups of students who had a bachelor's, the group of students who had a graduate degree in science and the group of students who had a graduate degree in a non-science field as the highest degree completed prior to matriculation ( $\chi^2 = 20.024, p = .002$ ). No further tests were conducted to determine where the exact difference in race distribution

was because of the large number of missing responses when it came to race—58 out of the 718 students in the sample failed to report a race in their AMCAS application.

| <i>Table 1: Gender and Race Distribution Across Groups</i> |           |         |                  |         |                      |         |                |         |       |         |
|------------------------------------------------------------|-----------|---------|------------------|---------|----------------------|---------|----------------|---------|-------|---------|
|                                                            | Bachelors |         | Graduate Science |         | Graduate Non-Science |         | Total Graduate |         | Total |         |
|                                                            | N         | Percent | N                | Percent | N                    | Percent | N              | Percent | N     | Percent |
| <i>Gender</i>                                              |           |         |                  |         |                      |         |                |         |       |         |
| Male                                                       | 306       | 49.43   | 41               | 55.41   | 7                    | 28      | 48             | 48.48   | 354   | 49.30   |
| Female                                                     | 313       | 50.57   | 33               | 44.59   | 18                   | 72      | 51             | 51.52   | 364   | 50.70   |
| <i>Race*</i>                                               |           |         |                  |         |                      |         |                |         |       |         |
| White                                                      | 414       | 72.50   | 41               | 62.12   | 9                    | 39.13   | 50             | 56.18   | 464   | 70.30   |
| Black                                                      | 60        | 10.51   | 7                | 10.61   | 7                    | 30.43   | 14             | 15.73   | 74    | 11.21   |
| Asian                                                      | 65        | 11.38   | 12               | 18.18   | 7                    | 30.43   | 19             | 21.35   | 84    | 12.73   |
| Bi/Muti/Other                                              | 32        | 5.60    | 6                | 9.09    | 0                    | 0       | 6              | 6.74    | 38    | 5.76    |

*Table 1* shows the number and percent of students that selected each specified gender or race within a group.  
\*There was a significant difference across groups in terms of race.

Independent samples t-tests were used to compare the groups of those with only a bachelor's degree and those with a graduate degree prior to medical school matriculation. T-tests showed that the groups differed in terms of their age at matriculation and Step 1 score, but not MCAT score. The average age at matriculation for those without a graduate degree was 23.54 years ( $M = 23.54, SD = 2.041$ ) and 26.24 ( $M = 26.24, SD = 3.15$ ) years for those with a graduate degree;  $t(111.523) = 8.270, p < .001$ . Step 1 score was higher in the bachelor's degree only group ( $M = 230.72, SD = 17.751$ ) compared to the graduate degree group ( $M = 225.43, SD = 18.928$ );  $t(716) = 2.727, p = .007$ . MCAT score did not differ significantly between the bachelor's degree only group ( $M = 70.543, SD = 15.8239$ ) and the group with those with a graduate degree ( $M = 70.003, SD = 18.9833$ ).  $t(120.755) = 0.269, p = .789$ . Likewise, a one way ANOVA showed that there were differences in terms of age at matriculation,  $F(2,725) = 64.356,$

$p < .001$  and Step 1 scores  $F(2,725) = 4.290$ ,  $p = .014$ , but not between MCAT scores  $F(2,725) = 0.751$ ,  $p = .472$  between the 3 groups – those without a graduate degree, those with a science graduate degree and those with a non-science graduate degree. Post hoc Games-Howell multiple comparison analysis showed that there was a significant difference in age at matriculation between the group of those with just a bachelor's and the group of those with a science graduate degree ( $MD = -2.503$ ,  $SE = 0.311$ ,  $p < .001$ ), and between the group of those with just a bachelor's and the group of those with a non-science degree ( $MD = -3.302$ ,  $SE = 0.892$ ,  $p = .003$ ). There was no significant difference between the group of those with a science graduate degree and those with a non-science graduate degree ( $MD = -0.799$ ,  $SE = 0.938$ ,  $p = .674$ ). Using post hoc Bonferroni multiple comparison analysis, it was revealed that there was not a significant difference between those in the bachelor's degree group and the graduate science degree group ( $MD = 4.168$ ,  $SE = 0.057$ ,  $p = .177$ ), between the bachelor's group and graduate in non-science group ( $MD = 8.603$ ,  $SE = 3.655$ ,  $p = .057$ ) and between the two groups of those with a graduate degree ( $MD = 4.434$ ,  $SE = 4.144$ ,  $p = .855$ ).

| Variable             | Bachelors |                | Graduate Science |                | Graduate Non-Science |                | Graduate Total |                | Total |                |
|----------------------|-----------|----------------|------------------|----------------|----------------------|----------------|----------------|----------------|-------|----------------|
|                      | N         | Mean (SD)      | N                | Mean (SD)      | N                    | Mean (SD)      | N              | Mean (SD)      | N     | Mean (SD)      |
| Age at Matriculation | 619       | 23.54 (2.041)  | 74               | 26.04 (2.58)*  | 25                   | 26.84 (4.44)*  | 99             | 26.24 (3.15)   | 718   | 23.91 (2.41)   |
| MCAT                 | 619       | 70.54 (15.82)  | 74               | 71.13 (19.57)  | 25                   | 66.66 (17.02)  | 99             | 70 (18.98)     | 718   | 70.47 (16.28)  |
| USMLE                | 619       | 230.72 (17.75) | 74               | 226.55 (19.10) | 25                   | 222.12 (18.40) | 99             | 225.43 (18.93) | 718   | 229.99 (18.00) |

\* The group of those with a graduate degree in a science and the group with graduate degree in a non-science are significantly different than those in a group with only a bachelor's degree

with respect to age of matriculation. However, there group with a science graduate degree was not different from the group with a non-science graduate degree.

Also, the data was analyzed to see if there were differences in the age at matriculation, MCAT scores and Step 1 scores between males and females. The average age at matriculation, MCAT score, and USMLE Step 1 scores are presented in table 3, along with the corresponding standard deviations. In comparison to males, females matriculated at a younger age, but had lower MCAT and Step 1 scores. These differences were found to be significant based on independent sample t-tests.

| Variable             | Female |                    | Male   |                    | Overall         |         |
|----------------------|--------|--------------------|--------|--------------------|-----------------|---------|
|                      | Mean   | Standard Deviation | Mean   | Standard Deviation | Mean Difference | p-Value |
| Age at Matriculation | 23.68  | 2.37               | 24.14  | 2.44               | -0.46           | .011    |
| MCAT                 | 67.44  | 15.89              | 73.58  | 16.12              | -6.14           | < .001  |
| USMLE STEP 1         | 227.46 | 18.08              | 232.59 | 17.56              | -5.129          | < .001  |

After that, a multiple regression model was used to analyze the relationship between having a graduate degree before medical school matriculation, gender, MCAT score and age at matriculation with the dependent variable, Step 1 score. The model was significant ( $F_{4,713} = 33.303$ ,  $p < .001$ ,  $R^2 = 0.157$ ). From the analyses, it was found that there was no significant association between having a graduate degree and Step 1 score ( $B = -1.527$ ,  $t = -0.784$ ,  $p = .433$ ). However, there were significant associations between Step 1 scores and gender, MCAT score, and age of matriculation. The regression analysis suggests that males have a higher Step 1 score than females by a factor of 3.671 ( $B = 3.671$ ,  $t = 2.890$ ,  $p = .004$ ). Also, the model

predicts that for every 1 percentile increase in MCAT score, there is an 0.334 increase in Step 1 score ( $B = 0.334$ ,  $t = 8.565$ ,  $p < .001$ ), and that for every year increase in age at matriculation, Step 1 score decreases by 1.311 ( $B = -1.311$ ,  $t = -4.644$ ,  $p < .001$ ).

Another multiple regression model was constructed setting the age at matriculation, gender, MCAT score, having a graduate degree in a science and having a graduate degree in a non-science field as predictors and Step 1 as the dependent variable. The model was significant ( $F_{5,712} = 26.618$ ,  $p < .001$ ,  $R^2 = 0.157$ ), but showed that when controlling for age at matriculation, gender and MCAT score, there was no significant association between having a graduate degree, science or non-science, and Step 1 score. For the group of graduate degree in science  $B = -1.313$ ,  $t = -0.608$ , and  $p = 0.543$ . For those with a graduate degree in a non-science discipline  $B = -2.209$ ,  $t = -0.627$ , and  $p = .531$ . Similar to previous model, there were significant associations between Step 1 scores and gender, MCAT score, and age of matriculation. The regression analysis suggests that males have a higher Step 1 score than females by a factor of 3.644 ( $B = 3.644$ ,  $t = 2.856$ ,  $p = 0.004$ ). Also, similar to previously discussed model, this one predicts that for every 1 percentile increase in MCAT score, there is an 0.334 increase in Step 1 score ( $B = 0.334$ ,  $t = 8.554$ ,  $p < .001$ ), and that for every year increase in age at matriculation, Step 1 score decreases by 1.307 ( $B = -1.307$ ,  $t = -4.616$ ,  $p < .001$ ).

## **Discussion**

The main question that this study tried to answer was the following: Does having a graduate degree confer an advantage when it comes to Step 1? The analysis conducted of the data from students matriculating at a Midwestern medical school from 2010-2014 suggests that

there is a negative association between having a graduate degree prior to medical school and USMLE Step 1 score, but the association disappears when you control for other factors.

When comparing the group of those with a bachelor's degree as highest degree earned and the group of those with a graduate degree as the highest degree earned, there was a significant difference in the average step scores, as calculated with an independent sample t-test. Those with a graduate degree has a lower average score. However, when we controlled for age at matriculation, MCAT Score and gender, there was no significant association between having a graduate degree and USMLE Step 1 scores. In other words, even though the average Step 1 score is different between the bachelor's and the graduate degree group, the difference cannot be explained by having or not having a graduate degree before matriculation alone. Instead, the significantly lower scores on the graduate degree group might be explained by other factors such as the fact that those who obtain a graduate degree are significantly older than those who do not have a graduate degree, and age is negatively associated with Step 1 scores.

On the other hand, when we compared the following 3 study groups based on highest degree earned prior medical matriculation, bachelor's, graduate science, and graduate non-science, there was no significant difference between the groups. However, it should be noted the p-value for the comparison between bachelor's and graduate degree in a non-science field, was equal to 0.057, is close to being significant. Given that there were only 25 people in the graduate non-science group, it is possible that the test sample is underpowered and that there is a truly a difference between those two groups, and that those with a graduate degree in a non-science field have a significantly lower Step 1 score. In addition to the before mentioned

regarding the comparison of this three groups and USMLE step 1 scores, it should be noted that when we controlled we controlled for age at matriculation, MCAT Score and gender, there was no significant association between having a graduate degree (science or non-science) and USMLE Step 1 scores.

Although this study did not find that having a graduate degree could not predict a higher Step 1 score, it does not mean that there having a graduate degree is other aspects of medical school education. Further studies are needed that investigate if having a graduate degree has an advantage in the medical admission process, or in other academic measures in medical school (e.g. OSCEs, Step 2 scores). Previous study found that special master programs, or master's degrees specially designed for students planning on attending medical school was associated with an increase in step 1 scores, beyond what is predicted by MCAT score<sup>1</sup>. Given this, it could also be the case that only those graduate degrees which involved material similar or closely related to what is expected to be learned in medical school confer an advantage when it comes to board examinations.

Besides answering the main study question, this study further confirmed previously published findings regarding Step 1 and its relationship to MCAT scores, age and gender.<sup>5-</sup><sup>8</sup>Through multiple regression analysis this study found that MCAT itself is positively associated with Step 1 score, while the female gender, and older age at matriculation was associated with lower step 1 scores.

As stated above, a limitation of the study is the small subset of individuals that were in the graduate non-science group. The small sample size and a marginally significant p-value when comparing the bachelor's degree and master's degree in non-science suggest that there

might be a significant difference between the groups but that the study is underpowered. Other limitations include the fact that the study looked at students that looked at graduate degrees earned before medical school and it does not include information as to whether those students completed a bachelor's degree was in a science or non-science subject, or information on other undergraduate measures, besides MCAT, which might affect the values measured and needs to be investigated in future research. Moreover, it should be mentioned that MCAT scores came from tests taken before and after 2015, which means that they differed in content and scoring. Although scoring was standardized in this study by converting it to percentiles, there is a possibility that the difference in test format would have led to different outcomes.

### **Conclusions**

This study examined the data AMCAS and the Step 1 score data from the classes matriculating at a Midwestern Medical school from 2010-2014 in order to determine if there is a relationship between having a graduate degree prior to medical school matriculation and Step 1 scores. Results showed that there is no association between having a graduate degree and Step 1 scores when controlling for age, gender and MCAT scores. Results also showed no association between having a graduate degree either in a science or a non-science field and Step 1 scores when controlling for age, gender and MCAT scores. Further research is needed to determine if earning a graduate degree prior to matriculation confers any advantage when it comes to other aspects of medical education.

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