2019

Success of Non-Traditional Students in Medical School

Rebecca A. Nowak
Wright State University - Main Campus, nowak.5@wright.edu

Introduction

The demographics of United States medical schools are changing to include an increasing number of older students, men and women who have switched careers into medicine, those with post-graduate degrees before starting medical school, and other diverse backgrounds. These "non-traditional" students today are still a minority (an annual questionnaire sent out to matriculating medical students by the Association of American Medical Colleges last year showed as many as 90% of students knew they wanted to study medicine by the end of undergraduate[1]) but make up a growing slice of the demographics of current U.S. medical students. Much research has been done on defining the demographics of this new population of medical students as well as the unique challenges they face. Recruitment efforts have been made to attract students from non-medical backgrounds to include military experience[2], advanced degrees[3], those from ethnic and social minorities[4], older students with families[5], and those making a switch from non-medical careers[6].

Additionally, many studies have sought to measure the success of this population of student physicians by using different metrices of success, from student performance on standardized examinations[3,6,7], to recruitment of students matriculating into medical school[2,4].

In comparing the success of non-traditional students to traditional students, the results in the literature are mixed. Ellis[8] found non-traditional students in higher education persist and have better outcomes than there traditional colleagues in university courses, but suffer from more attrition in degree programs. Agan and Casarez[5] found non-traditional students flourished in education degrees and out-performed their traditional colleagues. And Arvidson et al[6] found mixed results with non-traditional students. Her research found non-traditional students who for personal reasons take an extended curriculum program to complete their preclinical curriculum had lower Step scores and had to repeat more clinical rotations. This same population however, reported comparable career satisfaction later on in the specialty to which they matched and throughout their medical careers, indicating long-term success[6].

This research attempts to assess how well non-traditional medical students perform in medical school compared to those students who took the traditional path into their medical education. We expect to find differences in academic success and in clinical skills, such as the results found by other researchers in this field[3,6,7]. For the purposes of this research project, success is defined as relative scores and grades between these populations.

Methods

Design

We conducted a retrospective study of medical school success of students who matriculated into Wright State University Boonshoft School of Medicine (WSUBSOM), a public midwestern allopathic medical school, from 2010-2016. The study was reviewed by Wright State University Institutional Review Board and deemed exempt.

Participants

WSUBSOM students (n=718) were classified as traditional and non-traditional students using deidentified demographic data. Inclusion criteria from AAMC applications and WSUBSOM secondary applications was used to establish these populations based on a "non-traditional score" (NT score) assigned to each individual. This score was computed through the following formula: $NT=a+m+w+d$, and one point awarded for each term (a = age greater than 24 years at matriculation, m = prior military service or veteran status, w = full-time work experience or ≥1800 hours/year, and d = post-graduate degree acquired prior to matriculation). This NT score allowed individuals to be categorized, those with $NT=0$ being classified "traditional", $NT\geq 2$ classified "non-traditional", and $NT=1$ were evaluated further. Individuals with NT=1 score were re-classified as "traditional" if the score was solely attributed to the individual holding a graduate degree completed concurrently with their undergraduate degree as no additional was taken post-graduate to complete this additional degree. Individuals in the NT=1 score population who did not get reclassified remained in this unique population ("*NT1*" or "gap-year students" as many of the individuals within this population have a one-year gap between an undergraduate medical institution and matriculation into medical school) for data analysis. The total population of "traditional" students is n=398, "non-traditional" students is n=207, and "NT1" or "gap-year" students is n=113 (Table 1).

Procedures

Demographic data from WSUBSOM admissions and medical education offices, including AAMC applications and WSUBSOM secondary applications, was used to establish study populations. Dependent outcomes variables collected were Medical College Admission Test (MCAT) scores, United States Medical Licensing Examination (USMLE) Step 1 and Step 2 Clinical Knowledge (CK) standardized test scores (*n*=666, 52 students excluded due to missing scores), and WSUBSOM third-year clerkship grades (*n*=695, 23 students excluded due to missing grades). MCAT scores were converted to percentile ranks year by year as this scoring system changed April 2015 and this method allowed us to standardize the scores[9]. Both the MCAT percentiles and USMLE Step 1 and Step 2 scores show standardized metrices of academic success and are major markers of medical student academic mastery, both before and during their medical education. Finally, WSUBSOM provided third-year clerkship grades to assess individual performance during the doctoring phase of the students' medical education. These grades were used as a comparable metric of each student's clinical and personal skills. The combined weight of these standardized test scores and medical school grades provided robust material to study.

Data Analysis

Data analysis was conducted using IBM SPSS Statistics software and in collaboration with WSUBSOM. Initially, we conducted a cross-tabulation of categorical demographic data (gender, graduate degree, past work experience, military history, and time between last degree and matriculation) across the three populations (traditional, non-traditional, and NT1) and ran Pearson Chi-square tests. Next, we conducted independent samples t-tests of outcomes on the basis of categorical demographics (gender, past work experience, and graduate degrees). One-way ANOVA was run to assess outcomes on the basis of time between last degree and matriculation with age and outcomes.

Next, we analyzed continuous scale data (age at matriculation, clerkship grades, MCAT percentiles, and USMLE Step 1 and 2 CK scores) with a test of homogeneity of variances, followed by a Welch test a one-way ANOVA. Post-hoc tests were also conducted and we computed multiple comparisons via Games-Howell or Bonferroni tests.

Finally, we computed multiple regression models between populations for age, gender, MCAT percentiles, clerkship grades, and USMLE Step exams, first assessing Pearson correlation coefficients for significance, then computing R-square values controlling for each of condition.

Results

The common medical students included in this study from WSUBSOM are female (50.4%), 23.9 years old, entered medical school within one year of graduating from their previous educational institution (67.3%), attained no higher than a bachelor's degree (86.2%), have never worked full-time or in another career field (89%), and never served in the armed forces (98.2%) (Table 1, Graph 1).

Pearson's Chi-square test showed significant difference ($p<0.005$) between populations for gender, graduate degree, work experience, military history, and time duration between last degree and matriculation. The difference in gender between populations was particularly striking among gap-year students, the only population with a higher percentage of males to females, and among traditional students with the highest proportion of female students (Table 1). Unsurprisingly, the difference in age appeared to be normally split between populations. The time taken between a student's last degree program and matriculation also is a strong descriptive factor differentiating populations with traditional students typically taking less than one year (98%), non-traditional students taking two or more years (65.7%), and NT1 students taking a gap year or less than one year (65.6%) (Table 1). The only students with full-time work experience or military experience are non-traditional students. These students are also the majority of those with advanced degrees.

Graph 1: Age at matriculation for total population.

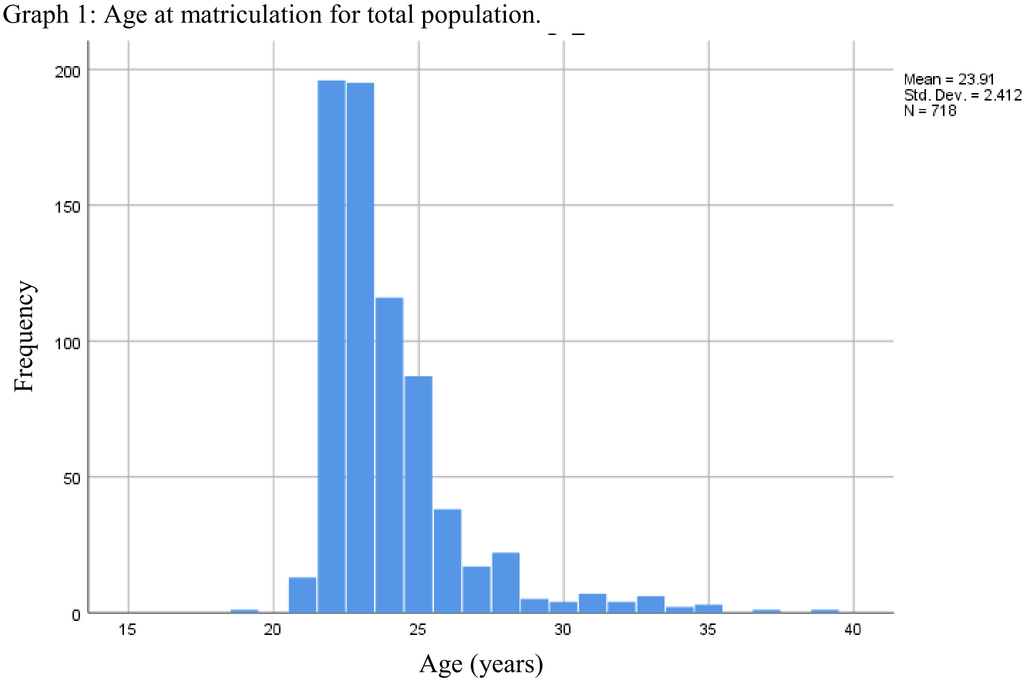


Table 1: Population demographics.

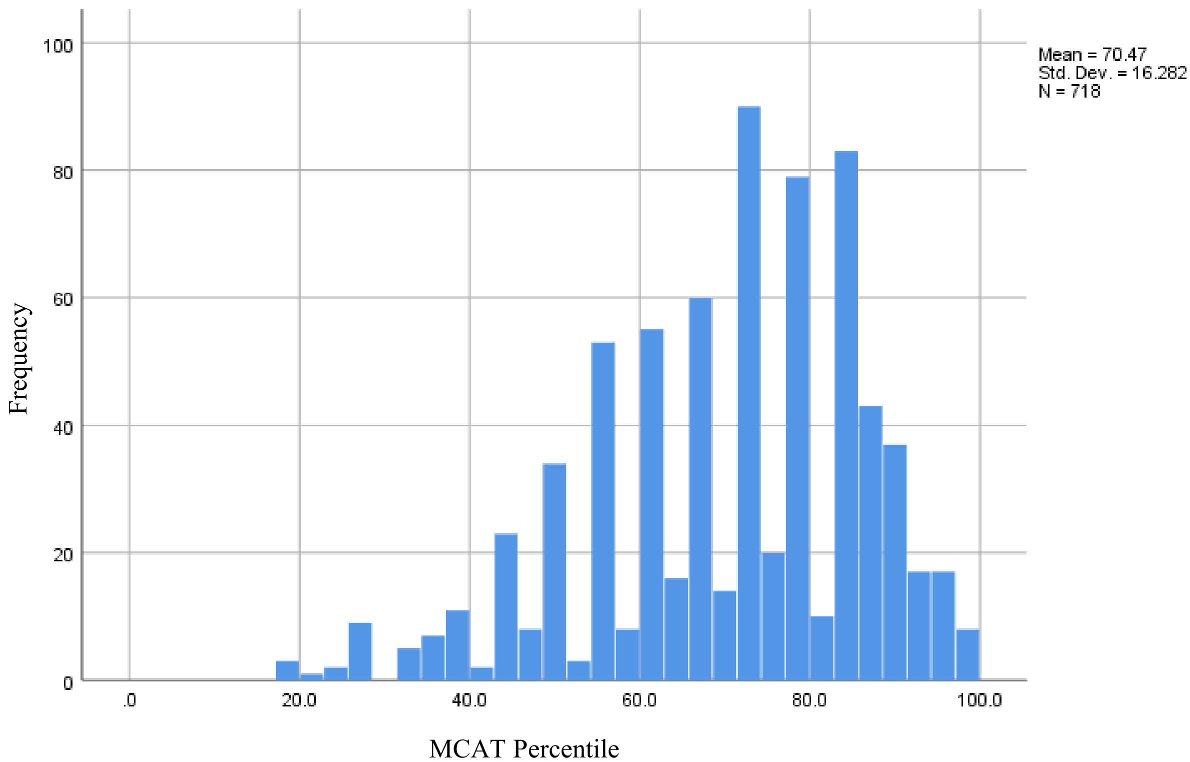
		Total Population	**Traditional Students**	**Non-Traditional Students**	**NT1 (Gap-Year Students)**
Sample size (*n*)		718	398 (55.4%)	207 (28.8%)	113 (15.7%)
Age		**Mean=23.91** Median=23.00 St dev=2.412 Range=19-39	**Mean=22.44** St dev=0.581 Range=19-23	**Mean=26.57** St dev=2.824 Range=23-39	**Mean=24.21** St dev=0.687 Range=21-26
Gender	**Female**	**50.7%** *n*=364	**55.8%** *n*=222	**50.2%** *n*=104	33.6% *n*=38
	Male	49.3% *n*=354	44.2% *n*=176	49.8% *n*=103	**66.4%** *n*=75
Time (*t*) between last degree attained and matriculation	**$0 \leq t \leq 1$ years**	*n*=483 67.3% of total	***n*=390** **98%** within pop 80.7% of total	***n*=19** **9.2%** within pop 3.9% of total	***n*=74** **65.5%** within pop 15.3% of total
	$1 < t \leq 2$ years	*n*=99 13.8% of total	***n*=8** **2%** within pop 8.1% of total	***n*=52** **25.1%** within pop 52.5% of total	***n*=39** **34.5%** within pop 39.4% of total
	$t > 2$ years	*n*=136 18.9% of total	***n*=0**	***n*=136** **65.7%** within population	*n*=0
Work experience	**No full-time work or unknown**	*n*=639 89% of total	*n*=398	***n*=128** 61.8% within pop	*n*=113
	Full-time work experience	*n*=79 11% of total	*n*=0	***n*=79** 38% within pop	*n*=0
Graduate degree	**Yes**	*n*=99 13.8% of total	*n*=0	***n*=93** **44.9%** within pop 93.9% of Yes total	***n*=6** **5.3%** within pop 6.1% of Yes total
	No	*n*=619 86.2% of total	*n*=398	*n*=114 55.1% within pop	*n*=107 94.7% within pop
Military history	**Not prior military**	*n*=705 98.2%	*n*=398 100% within pop	***n*=194** 93.7% within pop	*n*=113 100% within pop
	Active duty prior to matriculation	*n*=8 1.1%	*n*=0	***n*=8** 3.9% within pop	*n*=0
	Current military, prior status unknown	*n*=5 0.7%	*n*=0	***n*=5** 2.4% within pop	*n*=0

Initial inspection of outcomes (clerkship average grades and USMLE test scores) shows what appears to be gradual decreases in outcomes with increasing NT score (Table 2). For instance, clerkship grades decrease from traditional students (mean=87.2770, st dev=2.84145), to gap-year students (mean=86.9079, st dev=3.56621), to non-traditional students (mean=86.2425, st dev=2.84563) (Table 2). This trend appears to continue with standardized test scores as well, despite the normal distribution of these scores and grades in the total population (Graphs 2-5).

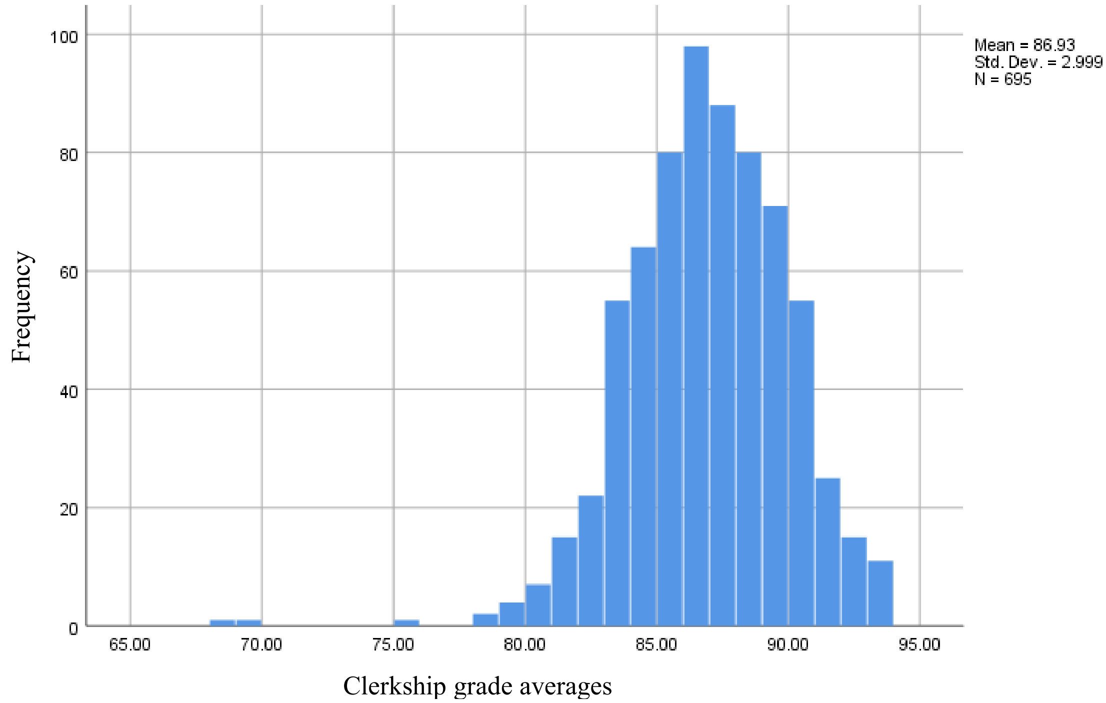
Table 2: Outcomes of academic success for medical student populations.

	Total Population	Traditional Students	Non-Traditional Students	NT1 (Gap Year Students)
MCAT percentile	*n*=718 **Mean=70.469** St dev=16.2822 Range=18.7-99.3	*n*=398 **Mean=71.016** St dev=0.7788 Range=18.7-99.3	*n*=207 **Mean=68.997** St dev=1.2856 Range=19.4-97.4	*n*=113 **Mean=71.238** St dev = 1.3520 Range=27.2-98.2
Doctoring phase clerkship grades	*n*=695 (23 missing) **Mean=86.9278** St dev=2.99895 Range=68.72-93.98	*n*=389 **Mean=87.2770** St dev=2.84145 Range=75.13-93.98	*n*=195 **Mean=86.2425** St dev=2.84563 Range=79.50-93.11	*n*=111 **Mean=86.9079** St dev=3.56621 Range=68.72-93.47
Step 1 scores	*n*=718 **Mean=229.99** St dev=17.997 Range=189-270	*n*=398 **Mean=231.69** St dev=17.618 Range=189-270	*n*=207 **Mean=225.00** St dev=18.645 Range=190-266	*n*=113 **Mean=233.18** St dev=16.345 Range=192-262
Step 2 CK scores	*n*=666 (52 missing) **Mean=243.32** St dev=15.626 Range=204-278	*n*=378 **Mean=245.14** St dev=15.357 Range=209-278	*n*=182 **Mean=239.21** St dev=15.927 Range=204-273	*n*=106 **Mean=243.86** St dev=14.862 Range=207-271

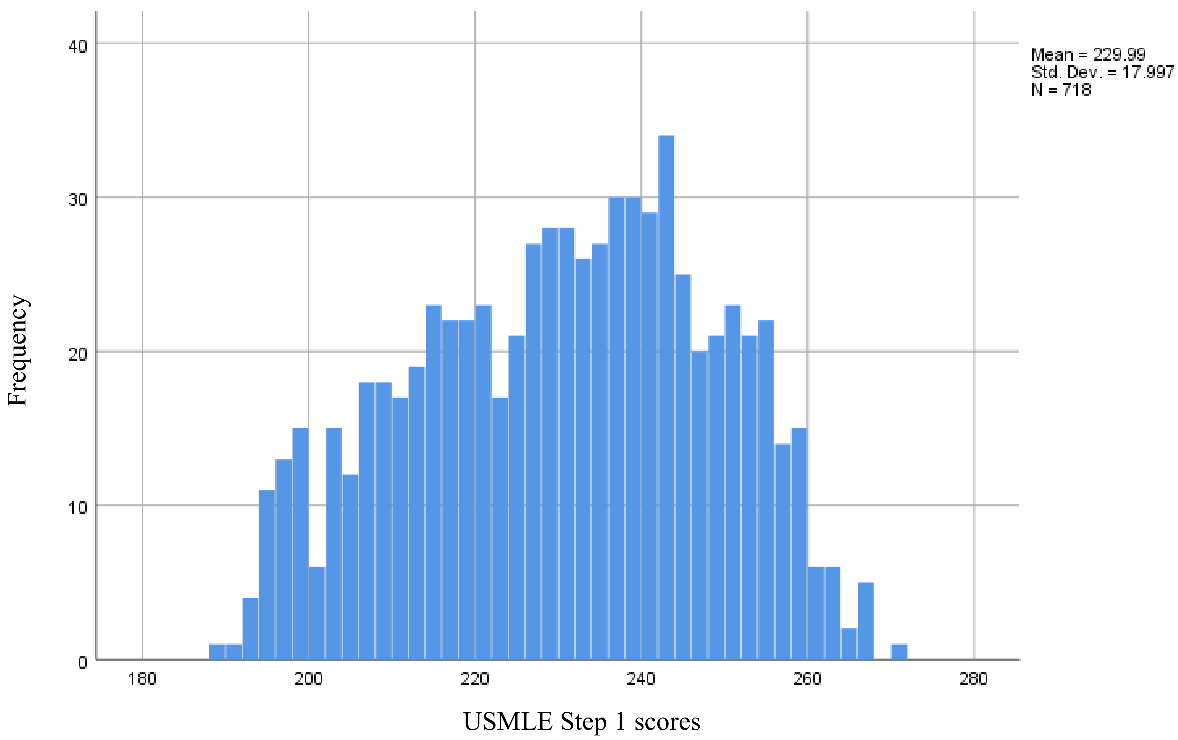
Graph 2: MCAT percentiles for total population.



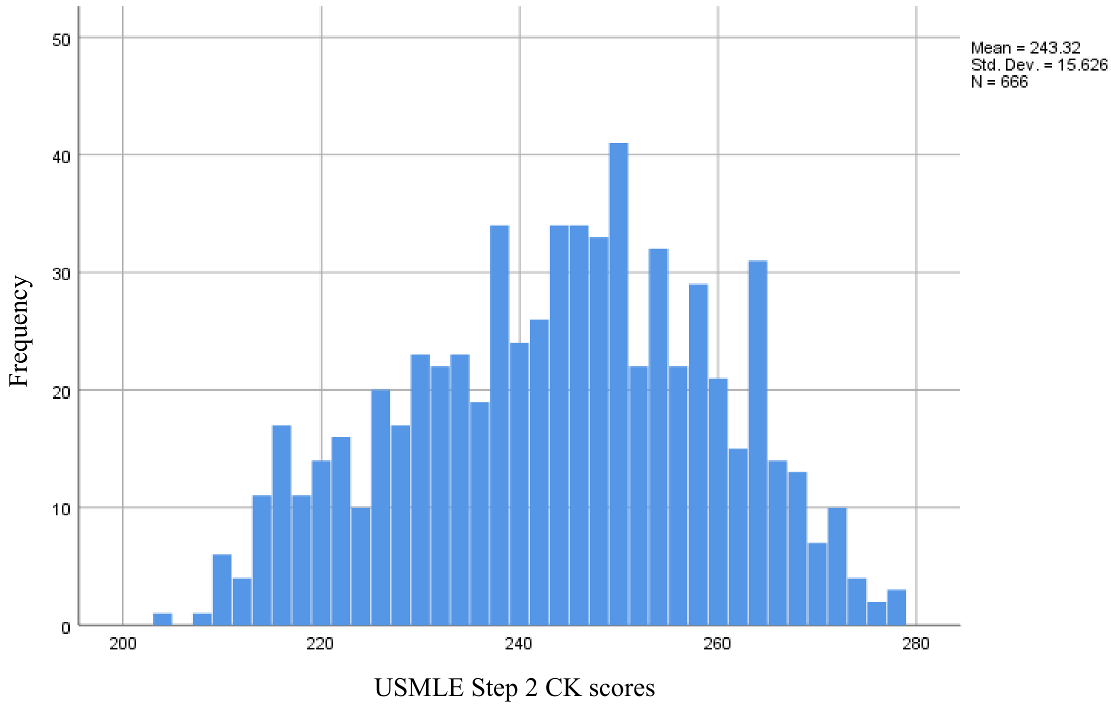
Graph 3: Clerkship grades for total population.



Graph 4: USMLE Step 1 scores for total population.



Graph 5: USMLE Step 2 CK scores for total population.



A test of homogeneity of variances found age and MCAT percentiles to have $p<0.005$ (variances not equal). As a result, we followed up with a Welch test which showed significance for age but not for MCAT percentile ($p=0.359$). USMLE Step scores and clerkship grades were found to have $p>0.005$ (equal variances), so we computed a one-way ANOVA for these metrices which showed significance ($p<0.0005$) between groups for clerkship grades, Step 1 and Step 2 CK scores.

Post-hoc tests were also conducted. We computed multiple comparisons for age and MCAT percentile with a Games-Howell test and the remaining test scores and grades via a Bonferroni test. Unsurprisingly, age differences between all populations were significant ($p<0.0005$). Games-Howell test showed MCAT percentiles were not significantly different between any of the three population. Bonferroni multiple comparisons showed significance in clerkship grades between traditional and non-traditional students ($p<0.005$) as well as significance in both Step 1 and Step 2 CK scores between traditional and non-traditional, and NT1 and non-traditional students ($p<0.05$).

Next, we conducted independent samples t-tests to assess significance in outcomes (scores and grades) on the basis of gender, work experience, graduate degrees. One the basis of gender, Levene's test showed equal variance for all variables except clerkship grades ($p=0.005$) which were slightly higher for females (mean=86.9887) than for males (mean=86.8668). The two-tailed p-value was significant ($p<0.05$) for age at matriculation (males were older than females), Step 1 scores (males scored slightly higher than females), and MCAT percentiles (males scored slightly higher than females). However, Step 2 CK scores were not significantly different between genders ($p=0.263$).

On the basis of past work experience, Levene's test found equal variance for MCAT percentiles, clerkship grades, and Step 1 and 2 CK scores, but not for age ($p<0.0005$) (those with full-time work experience were older). Assuming equal variance, there was significance in the t-test for clerkship grades and Step 1 scores ($p<0.05$) (those who didn't work scored higher than those who previously worked full-time) but not in MCAT percentiles or Step 2 CK scores ($p>0.05$). When computing an independent t-test for graduate degrees prior to matriculation, Levene's test found equal variance for clerkship grades, Step 1, and Step 2 CK scores, but not for age (those with degrees were older) and MCAT percentiles (those with graduate degrees tended to have lower MCAT scores) ($p<0.05$). A 2-tailed t-test for clerkship grades, Step 1, and Step 2 CK scores was significant ($p<0.05$) (those without graduate degrees outperformed those with graduate degrees).

One-way ANOVA was run to assess significance within population for time between a student's last degree and matriculation with outcomes (clerkship grades, Step 1 score, and Step 2 CK score). This found significant difference between age and MCAT percentiles (variances not equal, $p<0.05$). ANOVA showed significant difference ($p<0.05$) between groups for clerkship grades (≤1 year average = 87.15; 1+ to 2 years=86.67; 2+ years=86.93), Step 1 scores (≤1 year=231.58; 1+ to 2 years=229.45; 2+ years=224.76), and Step 2 CK scores (≤1 years=244.83; 1+ to 2 years=242.42; 2+ years=238.48).

We ran a multiple regression model between populations with the following variables: age at matriculation, gender, clerkship grades, MCAT percentiles, and Step 1 and Step 2 CK scores. This model showed MCAT percentiles positively correlated with clerkship grades (β or "standardized coefficient" = 0.245; $p<0.0005$). That is, for every 1 percentile increase in MCAT score, students earned 0.245 points higher on their clinical clerkship grades. Another multiple regression model also found MCAT percentiles and Step 1 scores positively correlated ($\beta=0.341$, or for every 1 percentile increase in MCAT score, students earned a 0.341 increase in Step 1 score; $p<0.0005$). And a third model showed MCAT percentiles and Step 2 CK scores positively correlated ($\beta=0.227$; $p<0.0005$).

There was also a strong positive correlation between clerkship grades and Step 1 scores ($\beta=0.729$) and between clerkship grades and Step 2 CK scores ($\beta=0.779$). Additionally, we found a correlation between gender and several other factors. Male gender was positively correlated with increasing MCAT percentile ($\beta=0.192$), increasing age ($\beta=0.117$), and males were more likely to be members of the NT1 ("gap year") population than the traditional student population ($\beta=0.146$).

Pearson correlation coefficients showed negative correlation between age and clerkship grades ($\beta=-0.188$) and age and MCAT percentile ($\beta=-0.091$). Additionally, when students between the non-traditional population were compared with the traditional medical students there was a negative correlation in clerkship grades ($\beta=-0.143$).

When controlling for gender, age, population group, and MCAT percentile, we ran a model with clerkship grades as the dependent variable. This model showed an R Square value of 0.091, or about 9% of variance in clerkship grades explained by these variables. The next model we ran was a multiple regression with Step 1 scores as the dependent variable controlling for age, gender, population group, and MCAT percentile which found an R Square value of 0.161, or that about 16% of the variance in Step 1 scores can be explained by these variables. The final multiple regression with Step 2 CK scores as the dependent variable and controlling for the other factors showed R Square value of 0.092, or about 9% of variance in Step 2 CK scores explained by these variables.

Discussion

The central research question of this study was whether non-traditional medical students have different levels of success in medical school compared to their traditional colleagues. The results from this research suggest non-traditional students may be at a disadvantage in medical school based on the metrices of success we chose to analyze, outcomes which may have long-term consequences for post-graduate medical education, residency, and future career prospects.

In comparing non-traditional students with traditional students, the multiple comparisons tests and multiple regression models showed significant differences in clerkship grades, Step 1 and Step 2 CK scores. There was also a significant difference between non-traditional and NT1 students in Step 1 and Step 2 CK scores.

Age is negatively correlated with outcomes, from MCAT percentile ranks through Step 2 scores, as is previous work experience. Age has the strongest negative correlation with clinical clerkship grades (from the multiple regression model, $\beta = -0.118$), and a slightly lower negative correlation with MCAT percentiles ($\beta = -0.091$). Those who never worked full-time have higher clinical clerkship grades and higher Step 1 scores compared to those who worked full-time. Graduate degrees appear to give a boost in outcomes to the NT1 or "gap-year" population, but not to non-traditional students. In general, those with a graduate degree have worse outcomes, lower MCAT scores, clerkship grades, and Step 1 and Step 2 CK scores. These non-traditional students are, however, also older and increasing age is also associated with these outcomes.

Gender was shown to be correlated with certain outcomes, with females doing slightly better in clinical clerkship grades and males having greater success on the MCAT and Step 1 examination. Interestingly, males tend to be older (multiple regression model) and are more likely to fall within the NT1 or "gap year" population.

MCAT percentile seems to be negatively correlated with time duration between one's last degree and matriculation into medical school. Those who matriculate into medical school within one year of their last degree program scored an average of 70.6^{th} percentile. Those who took greater than one year to 2 years before matriculating into medical school scored in the 71.7^{th} percentile. And those who took greater than two years post-graduation scored at the 68.99^{th} percentile. This appears to give those who took a "gap year" an advantage in taking the MCAT, however this advantage does not appear to carry through to the rest of medical school. The ANOVA test computed showed gradual declines in clerkship grades, Step 1 scores, and Step 2 CK scores with increasing time separating the students' last degree programs and matriculation. In general, this appears to translate into a penalty, a loss of about 7 points, on both Step 1 and Step 2 with two or more years separation.

The greatest change incurred in dependent variable outcomes occurred in Step 1 scores. When controlling for age, gender, population group, and MCAT percentile, we were able to explain up to 16% of score variation. However, as the other 84% of score variation cannot be attributed to these factors, this finding shows there may be other factors helping or hindering medical students, both traditional and non-traditional. If anything, this underscores the immense ability of individual students to affect their own fortunes.

Study Limitations

Due to the large sample size of this project, there is a risk of finding meaningless significance in the data. That is, the differences are so small so as be meaningless.

Although we received a large sample size to work with, the demographic data from years past was incomplete for many individuals. This was due to changes in question wording and selection on AMCAS applications, and the ability of applicants to leave questions blank. This resulted in many unknowns, for instance, many of the individuals included in the NT1 population did not have any listed work experience or graduate degrees however they were older than the average medical student (>24 years old). This lack of data required certain individuals to remain classified as NT1, however additional information on their backgrounds could have changed this population makeup significantly. Additionally, changes in the wording and selection on AMCAS for military history proved problematic in analyzing outcomes of this subset of non-traditional students. Applicants were able to indicate they were "military" on AMCAS without any information of prior service. Given the ability of middle school, high school, and undergraduate students to participate in J/ROTC (Junior/ Reserve Officers' Training Corps) without commissioning or enlisting and ever serving active duty in the armed forces, individuals who checked this box without further explanation were not included in this study as "prior military". Because of this, we had a much smaller population of military non-traditional students and were underpowered to conduct a robust analysis of these individual's outcomes.

Conclusion

One of the reasons we chose to use the different metrices of success we did was to attempt to paint a more holistic picture of medical student success. Standardized test scores were a stand-in for academic success and knowledge, and clinical clerkship grades as a stand-in for more patient-centric skills. The strong positive correlation between both kinds of success (both Step 1 and Step 2 CK test scores with clerkship grades) suggests there is not a great difference in the success of medical students in these two areas. Specifically, the data suggests that those who excel in the academic realms of medical school also excel in their clinical rotations.

This research highlights some of the disparities between populations of medical students at U.S. medical schools, disparities that can have long-term consequences for the next generation of physicians. There is a need now for additional research to be done to identify what if any systemic weaknesses exist in graduate medical education that can disproportionately affect non-traditional students, within the academic realm and beyond. Novel approaches to medical education are also an option, such as those described by Arvidson et al[6], as are identifying and implementing these best practices on a wider scale in the U.S.

References

1. Matriculating Student Questionnaire: 2018 All Schools Summary Report. AAMC (Association of American Medical Colleges); © 2018; 5.
2. Green AC. Nontraditional military-enlisted student: increasing diversity in medical school cohorts. *ProQuest LLC*. January 2018.
3. Feeley AM, Biggerstaff DL. Exam success at undergraduate and graduate-entry medical schools: Is learning style or learning approach more important? A critical review exploring links between academic success, learning styles, and learning approaches among school-leaver entry ('traditional') and graduate-entry ('nontraditional') medical students. *Teaching and Learning in Medicine*, 2015;27(3),237-244.
4. Stegers-Jager KM, Steyerberg EW, Lucieer SM, Themmen APN. Ethnic and social disparities in performance on medical school selection criteria. *Medical Education.* 2015;49: 124-133.
5. Agan TL, Casarez LL. How to enhance the success of nontraditional candidates while clinical teaching. *The Delta Kappa Gamma bulletin: International journal for professional educators*. 2018. 36-44.
6. Arvidson CG, Green WD, Allen R, Reznich C, Mavis B, Osuch JR, Lipscomb W, O'Donnell J, Brewer P. Investing in success: student experiences in a structured, decelerated preclinical medical school curriculum. *Medical Education Online*. 2015,20(1); 29297.
7. Tucker RP. Performance in a prematriculation gross anatomy course as a predictor of performance in medical school. *Anatomical Sciences Education*. 2008;1(5): 224-227.
8. Ellis H. A nontraditional conundrum: the dilemma of nontraditional student attrition in higher education. *College Student Journal.* 2019. 24-32.
9. Changing the MCAT Exam. AAMC (Association of American Medical Colleges); © 1995-2019. https://students-residents.aamc.org/applying-medical-school/article/changing-mcat-exam/. Accessed June 26, 2019.