2021

Evaluating Academic Performance in Students Who are Underrepresented in Medicine

Alexis Marrin
Wright State University - Main Campus, arrin.3@wright.edu

Evaluating Academic Performance in Students Who are Underrepresented in Medicine

Alexis Marrin

Dr. Amber Todd, Director of Assessment, Medical Education

Medical Education Research

Scholarship in Medicine Final Report

☒ By checking this box, I indicate that my mentor has read and reviewed my draft proposal prior to submission

Abstract

Objective: The purpose of this study was to investigate academic performance throughout the first two years of medical education of students who classify themselves as underrepresented in medicine (URM) as compared to non-URM students. *Methods:* Final exam scores from each course throughout the Foundation phase, Clinical Medicine evaluation scores, CBSE scores, and Step 1 scores from three classes of medical students at Wright State University Boonshoft School of Medicine were analyzed using multiple linear regression models, while controlling for MCAT percentile, undergraduate science GPA, and gender. *Results:* URM students enter medical school with lower entrance data than non-URM students, and their performance continues along this trajectory throughout the Foundations phase. When evaluating all scores except Objective Structured Clinical Examinations (OSCEs), URM status was not found to be statistically significant after controlling for gender, MCAT percentile, and undergraduate science GPA.

Key Words: underrepresented in medicine, medical student education, achievement gap

Introduction/Literature Review

Medical schools undoubtedly value diversity among their student populations. Producing a more diverse physician population is a key element in reducing healthcare disparities and inequities, and the push for change is greater now than ever.[1] However, students who are underrepresented in medicine have yet to reach a level playing field with their non-underrepresented peers.[2] The term "underrepresented in medicine" (URM) was first adopted and defined by the AAMC in 2003 and is used to identify "racial and ethnic populations that are underrepresented in the medical profession relative to their numbers in the general population." URM students have been shown to score lower on Unite States Medical Licensing Examination (USMLE) exams,[3] and have self-reported that bias and lack of social capital in the learning environment have negatively impacted their academic experience. [4,5] While these differences may seem limited to students' medical education experience, they build on one another and lead to significant differences as students begin their medical careers. Consider, for example, that fewer URM students reach threshold USMLE scores for residency interviews. The result is fewer numbers of URM students accepted into certain residency programs, and a subsequent lack of diversity in specialties.[6] The early differences in academic performance between URM and non-URM students must be investigated further in order to ensure medical schools are fostering the growth of all students and creating true diversity in the field of medicine.

When it comes to comparing academic performance among different groups of students, the focus in the last several decades has often been on gender,[7] with studies of the academic performance of underrepresented students lacking in the literature. A number of researchers in recent years have investigated how to help get more URM students *to* med school (for example, pipeline or postbaccalaureate program effectiveness), but not enough have examined what

happens once these students are *in* medical school. Studies that have looked more closely at the experience of URM students in medical school have often done so through the use of questionnaires and come from countries outside the U.S. Some of the most comprehensive and recent investigations comparing URM students to their peers have focused only on USMLE Step scores,[3] leaving the academic performance of URM students inadequately investigated in the U.S., especially in recent years.

This research gives a very necessary closer examination of URM students' academic performance compared to that of their non-URM peers. It goes beyond USMLE Step scores to investigate other academic data points, including Clinical Medicine grades, while also taking medical school entrance data into consideration. Creating a broader, more comprehensive view of how underrepresented students compare to the rest of their class can set the stage for ensuring those early differences in academic performance do not have the opportunity to snowball into larger inequities as students' careers progress.

Hypothesis/Specific Aims/Research Questions

How do students who are underrepresented in medicine perform academically compared to their non-URM peers - considering exam grades, STEP 1 scores, and Clinical Medicine grades/OSCE scores?

How does the academic performance throughout medical school of students who are underrepresented in medicine compare to their entrance data (e.g. MCAT, GPA)?

Methods

Context/Protocol

The data for this study was collected from Wright State University Boonshoft School of Medicine (BSOM), a midwestern medical school located in Dayton, Ohio. The data came from students in BSOM's WrightCurriculum, which began in 2017 and is a "lecture-free" curriculum focused on student collaboration using Peer Instruction, Team-based Learning, and problem-based learning. Underrepresented students made up 26% of the class of 2023 (n=115), 20% of the class of 2022 (n = 121), and 15% of the class of 2021 (n = 121). Overall, 73 students (20.4%) in this study self-identified as URM. This study was deemed exempt by Wright State University's Institutional Review Board.

Data Collection

The data in this study includes the incoming students set to be in the graduating classes of 2021, 2022, and 2023 (357 students, matriculating in 2017-2019). Students at BSOM are classified as underrepresented in medicine based on how they choose to self-report their race and ethnicity on the AMCAS application when applying to medical school. Groups considered by BSOM to be underrepresented include Black, African/African American, Puerto Rican, Mexican American, Native American, Native Alaskan, Native Hawaiian, and Pacific Islander. In addition to determining which students' URM status, entrance data from AMCAS was also used to compile MCAT scores and percentiles. Final exam data from each section of the WrightCurriculum was also collected, along with Clinical Medicine grades, including scores from three different Objective Structured Clinical Examinations (OSCEs). Exam scores from Comprehensive Basic Science Examination (CBSE) exams taken at the conclusion of the first and second years were collected, along with USMLE Step 1 scores for applicable students.

Data Analysis

Students were grouped as either underrepresented in medicine or non-underrepresented in medicine based on AMCAS self-identification data. Chi-square tests were used to compare the proportion of URM students by gender and across the three cohorts. The two groups (URM and non-URM) were initially compared using one way analysis of variance (ANOVA) with dependent variables including course final exam grades, OSCE scores from years 1 and 2, CBSE exams from years 1 and 2, and Step 1 scores. Differences between men and women on all dependent variables were also analyzed with ANOVA. Associations between MCAT percentile and undergraduate science GPA with all dependent variables were determined with Pearson correlation coefficients. Gender, MCAT percentile, and undergraduate science GPA were found to be associated with the dependent variables (analyses not shown), so these variables were controlled for in multiple linear regression models to determine the independent associations between URM status and each dependent variable. To compare academic performance over time, a two way repeated analysis of variance was performed using whether or not students were classified as URM as the first independent variable, course classification as the second independent variable, and final exam grade for each course as the dependent variable. This allowed for comparison between URM students and non-URM students over the course of the first two years of medical education.

The sample size for each group may vary slightly depending on the variable in question. For MCAT scores, 9 students were excluded, because their scores came from before the 2015 changes to the MCAT. Class size may also vary slightly from course to course, due to students needing to repeat a year. Rather than comparing data by class, all students with data available for a particular variable were included in a group together. For example, final exam grades for a

second year course, “Beginning to End,” consisted of data grouped together from the classes of 2021 and 2022, but not the class of 2023, because the class of 2023 has yet to take the course.

Results

The proportion of students in each class who identified as URM increased from 2021 to 2023, but the increase was not statistically significant (P=0.083). A higher percentage of URM students were women (78.1%) compared to non-URM students (53.2%, P<0.001). Mean and SD based on URM classification, gender, and overall for each of the evaluated scores in this study can be found in Table 1. Mean scores were consistently lower for URM vs. non-URM students, and women scored lower than men on all exams except for the three OSCE evaluations, which made gender an important variable to control for.

Results of the multiple linear regressions are shown in Table 2. For each exam or evaluation, URM status was used to evaluate the significance of performance differences, while also controlling for gender, MCAT score, and undergraduate science GPA. For exam scores in years 1 and 2, with the exception of the course Host and Defense, URM status was not found to be statistically significant after controlling for these additional factors. However, Clinical Medicine OSCE scores showed that URM status was significant (P=0.004, P=0.005, and P=0.001, on each of the three OSCEs, respectively), while MCAT and undergraduate science GPA were not found to be significant (Table 2).

Two way repeated ANOVA did not show a significant change in performance over time when comparing URM and non-URM students. URM students began medical school with lower MCAT scores and GPAs than non-URM students, and this discrepancy is maintained throughout the NBME exams taken in the Foundations phase, as represented by Figure 1. Figure 2 shows the

mean performance of URM vs. non-URM students throughout the course of the Foundations phase, with little change in the performance gap between URM and non-URM students over time.

Discussion

Students at Boonshoft School of Medicine who classify themselves as URM enter medical school with lower entrance data, as shown by MCAT percentile and undergraduate science GPA, and continue to score lower on exams and evaluations throughout the foundations phase of medical school, including on Step 1. This aligns with the findings of previous studies in which URM students consistently perform lower academically than their non-URM peers.[8] However, in all course final exams except for one, URM status was not considered statistically significant after controlling for MCAT percentile, undergraduate science GPA, and gender, indicating that these other variables may explain the differences between URM and non-URM students. This is a finding that has been seen in previous studies as well,[3] but certainly does not diminish the fact that there is a significant difference in performance between URM and non-URM students that must be addressed.

Perhaps the most interesting finding in this study is the difference between Clinical Medicine performance (OSCEs) and strictly "book learning"-style courses. In Clinical Medicine evaluations, URM status is statistically significant, even when gender, MCAT percentile, and undergraduate science GPA are taken into consideration. This finding indicates something else is happening with URM students in OSCEs that results in lower performance. Moving forward, it is critically important to continue to investigate why URM status is statistically significant in OSCEs. A closer examination of the specifics of the grading components and how students performed will shed further light on what this difference may be attributed to. It is important to

identify whether the grade differences may have to do with standardized patient grading bias, as studies have found examiner bias still persists in medical school examinations,[9,10] so that this can be addressed immediately.

A number of studies have shown that students tend to group themselves with peers who look like them and have similar backgrounds, and these self-formed peer groups tend to perform similarly in medical school, which can lead to lower overall scores in some groups of students and higher overall scores in others.[5,11] When students are randomly assigned groups instead of choosing for themselves, they tend to form more diverse peer groups, leading to higher overall performance, particularly in URM students.[12] BSOM's curriculum has a strong focus on collaboration among classmates, with students expected to problem-solve together frequently in diverse groups. This type of active learning, along with randomly assigned groupings of students, has the potential to contribute to increased success of URM students. [13] However, the data in this study from the start of medical school through Step 1 does not indicate that the curriculum played any role in narrowing the gap between URM and non-URM students.

Conclusion

The results of this study suggest that though many medical schools are willing to put in the work to create diverse student bodies, the gap in academic performance between URM and non-URM students continues to linger. Addressing this disparity is crucial, because patients do best when they have doctors who look like them and share similar backgrounds.[14] If URM students are not performing as well as non-URM students in medical school, they are less likely to secure a residency in a more competitive specialty, leaving fields like dermatology and orthopedics with a glaring lack of diversity.[15,16] The upcoming transition to a pass/fail Step 1 exam may help alleviate this, but may also create other challenges for URM students,[17] so will need to be

monitored closely in the coming years. Overall, the topic of medical school academic performance in students who are underrepresented in medicine is one that urgently needs and deserves further consideration. Medical schools need to meticulously and purposefully monitor student performance in order to ensure they are using evidence-based practices to foster student success in a diverse student body.

References

1. Thomas BR, Dockter N. Affirmative Action and Holistic Review in Medical School Admissions: Where We Have Been and Where We Are Going. *Academic Medicine*. 2019;94(4):473-476. doi:10.1097/ACM.0000000000002482

2. Teherani A, Hauer KE, Fernandez A, King TE, Lucey C. How small differences in assessed clinical performance amplify to large differences in grades and awards: A cascade with serious consequences for students underrepresented in medicine. *Academic Medicine*. 2018;93(9):1286-1292. doi:10.1097/ACM.0000000000002323

3. Rubright JD, Jodoin M, Barone MA. Examining Demographics, Prior Academic Performance, and United States Medical Licensing Examination Scores. *Academic Medicine*. 2019;94(3):364-370. doi:10.1097/ACM.0000000000002366

4. Chandauka RE, Russell JM, Sandars J, Vivekananda-Schmidt P. Differing perceptions among ethnic minority and Caucasian medical students which may affect their relative academic performance. *Education for primary care : an official publication of the Association of Course Organisers, National Association of GP Tutors, World Organisation of Family Doctors*. 2015;26(1):11-15. http://ezproxy.libraries.wright.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=cmedm&AN=25654797&site=ehost-live&scope=site

5. Vaughan S, Sanders T, Crossley N, O'Neill P, Wass V. Bridging the gap: The roles of social capital and ethnicity in medical student achievement. *Medical Education*. 2015;49(1):114-123. doi:10.1111/medu.12597

6. Green M, Jones P, Thomas JX. *Residency Programs' Selection Criteria Selection Criteria for Residency: Results of a National Program Directors Survey*. Vol 84.; 2009.

7. Reis Discussant DC, Robins L, Cuddy MM, Swanson DB, Clauser BE. *Learner Needs and Environments A Multilevel Analysis of Examinee Gender and USMLE Step 1 Performance*. https://journals.lww.com/academicmedicine

8. Jones AC, Nichols AC, McNicholas CM, Stanford FC. Admissions Is Not Enough. Academic Medicine. 9000;Publish Ahead of Printdoi: 10.1097/ACM.0000000000003837.

9. Chong L, Taylor S, Haywood M, Adelstein BA, Shulruf B. The sights and insights of examiners in objective structured clinical examinations. *Journal of educational evaluation for health professions*. 2017;14:34. doi:10.3352/jeehp.2017.14.34

10. Low D, Pollack SW, Liao ZC, et al. Racial/Ethnic Disparities in Clinical Grading in Medical School. *Teaching and Learning in Medicine*. 2019;31(5):487-496. doi:10.1080/10401334.2019.1597724

11. Orom H, Semalulu T, Underwood W. The social and learning environments experienced by underrepresented minority medical students: A narrative review. *Academic Medicine*. 2013;88(11):1765-1777. doi:10.1097/ACM.0b013e3182a7a3af

12. Woolf K, Potts HWW, Patel S, McManus IC. The hidden medical school: A longitudinal study of how social networks form, and how they relate to academic performance. In: *Medical Teacher*. Vol 34. Informa Healthcare; 2012:577-586. doi:10.3109/0142159X.2012.669082

13. Active learning narrows achievement gaps for underrepresented students in undergraduate science, technology, engineering, and math. 2020;117(12). doi:10.1073/pnas.1916903117/-/DCSupplemental

14. Silver JK, Bean AC, Slocum C, et al. Physician Workforce Disparities and Patient Care: A Narrative Review. *Health Equity*. 2019;3(1):360-377. doi:10.1089/heq.2019.0040

15. Pritchett EN, Pandya AG, Ferguson NN, Hu S, Ortega-Loayza AG, Lim HW. Diversity in dermatology: Roadmap for improvement. *Journal of the American Academy of Dermatology*. 2018;79(2):337-341. doi:10.1016/j.jaad.2018.04.003

16. Harrington MA, Rankin EA, Ladd AL, Mason BS. The Orthopaedic Workforce Is Not as Diverse as the Population It Serves: Where Are the Minorities and the Women?: AOA Critical Issues Symposium. *Journal of Bone and Joint Surgery - American Volume*. 2019;101(8). doi:10.2106/JBJS.18.01010

17. William M, Vela ;, Md MB, Sánchez ;, Md JP. Title: Anticipating the Impact of the USMLE Step 1 Pass/Fail Scoring Decision on Underrepresented-in-Medicine Students. doi:10.1097/ACM.0000000000003490

Table 1

	URM	N	Mean (sd)	Gender	N	Mean (sd)
MCAT Percentile	No	278	74.30 (13.35)	Female	203	67.41 (15.54)
	Yes	70	52.06 (13.06)	Male	145	73.21 (16.07)
	Total	348	69.82 (16.00)	Total	348	69.82 (16.00)
Undergraduate Science GPA	No	283	3.62 (0.29)	Female	207	3.53 (0.35)
	Yes	73	3.24 (0.37)	Male	149	3.56 (0.33)
	Total	356	3.54 (0.34)	Total	356	3.54 (0.34)
Origins 1 and 2 NBME Exam	No	284	83.39 (7.35)	Female	206	79.94 (8.23)
	Yes	71	75.56 (7.30)	Male	149	84.44 (6.80)
	Total	355	81.83 (7.97)	Total	355	81.83 (7.97)
Human Architecture Final Exam	No	284	84.76 (6.54)	Female	207	82.73 (7.15)
	Yes	72	79.81 (7.81)	Male	149	85.18 (6.77)
	Total	356	83.76 (7.10)	Total	356	83.76 (7.09)
Host and Defense Final Exam	No	284	83.35 (9.56)	Female	202	80.41 (10.15)
	Yes	67	75.57 (9.40)	Male	149	83.84 (9.45)
	Total	351	81.87 (9.99)	Total	351	81.87 (9.99)
Staying Alive NBME Exam	No	280	80.95 (8.13)	Female	199	78.26 (8.33)
	Yes	67	76.60 (8.08)	Male	148	82.60 (7.58)
	Total	347	80.11 (8.29)	Total	347	80.11 (8.29)
Beginning to End NBME Exam	No	194	83.77 (6.93)	Female	129	81.10 (7.66)
	Yes	39	78.36 (7.79)	Male	104	85.058 (6.33)
	Total	233	82.87 (7.35)	Total	233	82.87 (7.35)
Balance, Control and Repair NBME Exam	No	194	85.38 (6.20)	Female	129	82.86 (7.05)
	Yes	39	79.46 (8.19)	Male	104	86.28 (6.29)
	Total	233	84.39 (6.92)	Total	233	84.39 (6.82)
CM1 Int OSCE	No	283	89.09 (5.74)	Female	201	88.85 (5.61)
	Yes	67	86.41 (5.67)	Male	149	88.21 (6.08)
	Total	350	88.57 (5.82)	Total	350	88.57 (5.82)
CM1 PE OSCE	No	195	91.47 (3.42)	Female	129	90.86 (3.52)
	Yes	39	89.05 (3.99)	Male	105	91.31 (3.75)
	Total	234	91.06 (3.63)	Total	234	91.06 (3.63)
CM2 OSCE	No	194	76.05 (6.32)	Female	129	76.68 (6.31)
	Yes	39	72.92 (6.20)	Male	104	74.10 (6.24)
	Total	233	75.53 (6.39)	Total	233	75.53 (6.39)
CBSE Exam 1	No	195	52.16 (6.74)	Female	129	50.34 (6.49)
	Yes	39	47.85 (5.93)	Male	105	52.80 (6.94)
	Total	234	51.44 (6.79)	Total	234	51.44 (6.79)

CBSE Exam 2	No	194	74.30 (9.49)	Female	129	69.20 (9.26)
	Yes	39	65.03 (8.77)	Male	104	77.14 (9.10)
	Total	233	72.75 (9.98)	Total	233	72.75 (9.98)
Step 1	No	183	231.93 (15.65)	Female	109	225.68 (16.44)
	Yes	26	219.69 (15.37)	Male	100	235.56 (14.08)
	Total	209	230.41 (16.10)	Total	209	230.41 (16.10)

Table 2

Year 1 Exams			
Origins 1 and 2 NBME exam R squared = 0.400 *First course taken during M1 year, focus on biochemistry and foundational knowledge*			
	B	SE	p-value
Underrepresented in Medicine	-1.532	1.107	.167
Gender	3.221[a]	.695	.000
MCAT Percentile	.192	.025	.000
Undergraduate Science GPA	4.875[b]	1.097	.000
Human Architecture Final Exam R squared = 0.159 *Second course taken during M1 year, focus on human anatomy, exam consists of written and lab practical components*			
	B	SE	p-value
Underrepresented in Medicine	-1.698	1.165	.146
Gender	1.751	.733	.017
MCAT Percentile	.094	.027	.000
Undergraduate Science GPA	2.973	1.157	.011
Host and Defense Final Exam R squared = 0.153 *Third course taken during M1 year, focus on immunology*			
	B	SE	p-value
Underrepresented in Medicine	-3.529	1.655	.034
Gender	2.377	1.035	.022
MCAT Percentile	.046	.038	.223
Undergraduate Science GPA	6.627	1.646	.000
Staying Alive NBME Exam R squared = 0.203 *Final course taken in M1 year, focus on cardio, pulmonary, and renal*			
	B	SE	p-value
Underrepresented in Medicine	-.465	1.332	.727
Gender	3.769	.835	.000
MCAT Percentile	.117	.030	.000
Undergraduate Science GPA	2.288	1.337	.088
CBSE 1 Exam R squared = 0.371 *Comprehensive Basic Science Examination from NBME, taken at conclusion of M1 year*			
	B	SE	p-value
Underrepresented in Medicine	-1.304	1.313	.322
Gender	1.770	.747	.019
MCAT Percentile	.118	.028	.000

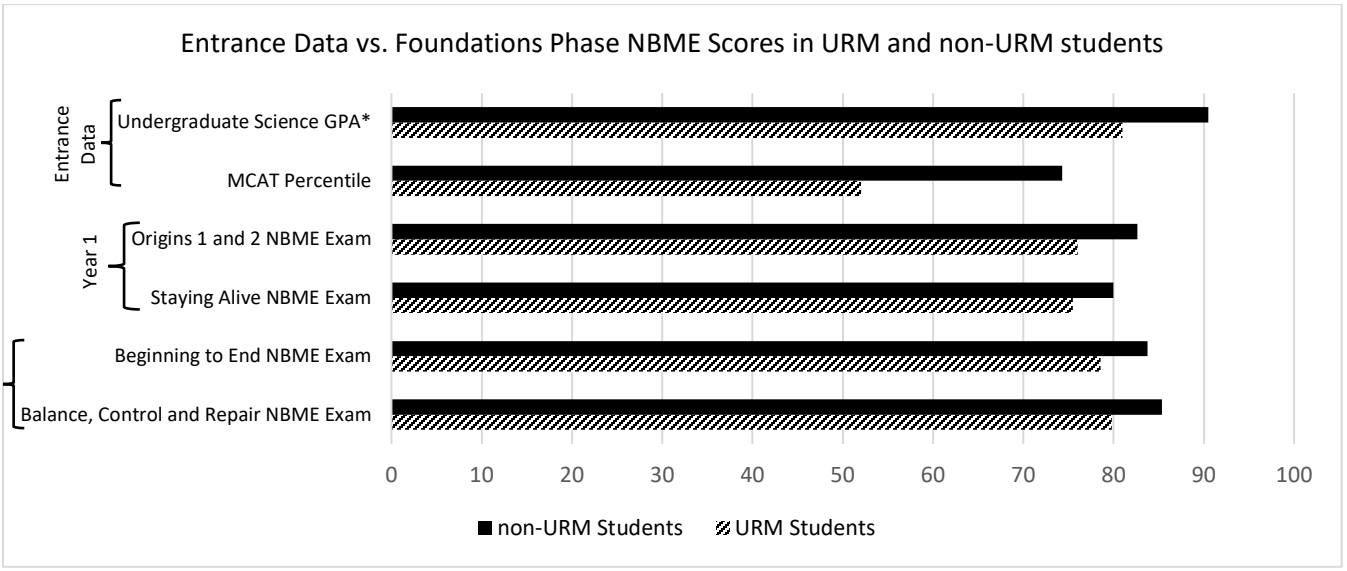
Year 2 Exams			
Beginning to End NBME Exam R squared = 0.195 *Course taken at beginning of M2 year, focus on endocrine, gastrointestinal, and reproductive systems*			
	B	SE	p-value
Underrepresented in Medicine	-.507	1.585	.750
Gender	2.964	.904	.001
MCAT Percentile	.131	.035	.000
Undergraduate Science GPA	3.522	1.580	.027
Balance, Control and Repair NBME Exam R squared = 0.211 *Final course taken in M2 year, focus on nervous, musculoskeletal and integumentary systems*			
	B	SE	p-value
Underrepresented in Medicine	-.781	1.471	.596
Gender	2.275	.839	.007
MCAT Percentile	.121	.032	.000
Undergraduate Science GPA	4.402	1.467	.003
CBSE 2 Exam R squared = 0.388 *Comprehensive Basic Science Examination from NBME, taken at conclusion of M2 year, prior to Step 1*			
	B	SE	p-value
Underrepresented in Medicine	-2.083	1.854	.262
Gender	6.372	1.057	.000
MCAT Percentile	.194	.040	.000
Undergraduate Science GPA	4.815	1.848	.010
Clinical Medicine Evaluations			
CM1 Int OSCE R squared = 0.062 *Objective Structured Clinical Examination focused on interviewing skills, evaluated during M1 year*			
	B	SE	p-value
Underrepresented in Medicine	-2.977	1.026	.004
Gender	-1.031	.642	.109
MCAT Percentile	-.018	.023	.451
Undergraduate Science GPA	.946	1.022	.355
CM1 PE OSCE R squared = 0.067 *Objective Structured Clinical Examination focused on physical exam skills, evaluated at conclusion of M1 year*			
	B	SE	p-value
Underrepresented in Medicine	-2.423	.846	.005
Gender	.253	.481	.600
MCAT Percentile	-.018	.018	.339
Undergraduate Science GPA	.610	.845	.471
CM2 OSCE R squared = 0.088 *Objective Structured Clinical Examination focused on physical exam skills, evaluated at conclusion of M2 year*			
	B	SE	p-value

Undergraduate Science GPA	1.522	1.312	.247

Underrepresented in Medicine	-4.894	1.493	.001
Gender	-2.579	.851	.003
MCAT Percentile	-.043	.033	.187
Undergraduate Science GPA	-.954	1.489	.522
Step 1[c] R squared = 0.282			
	B	SE	p-value
Underrepresented in Medicine	-.857	3.650	.815
Gender	8.710	1.945	.000
MCAT Percentile	.348	.076	.000
Undergraduate Science GPA	9.181	3.529	.010

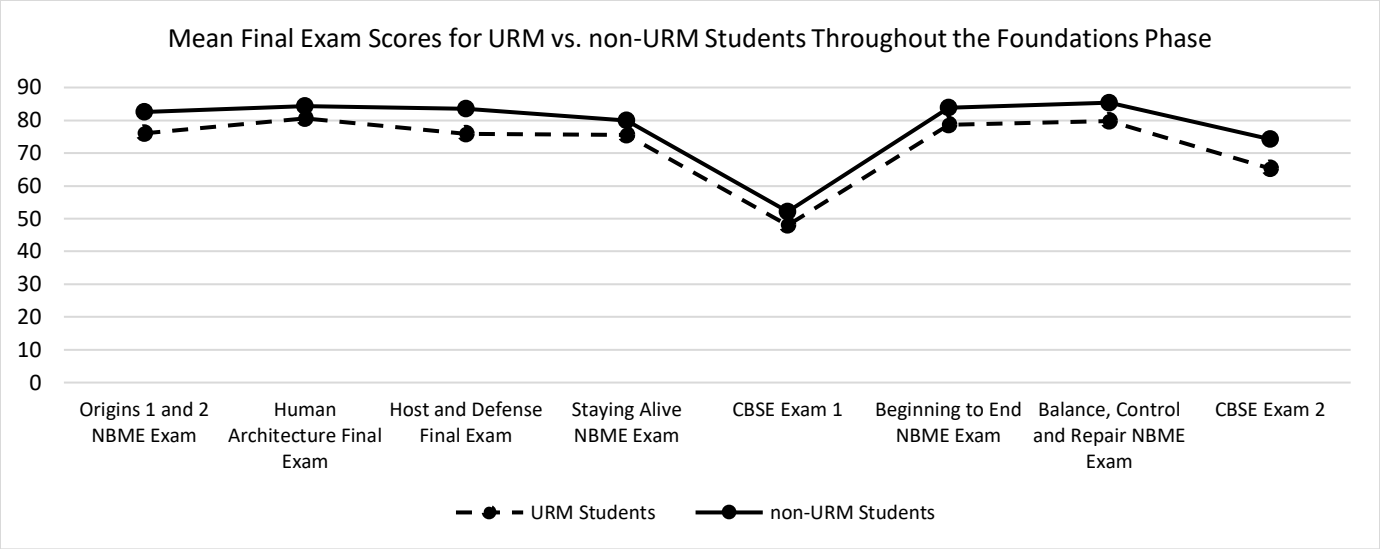
a. Referring to male vs female, so in this case, men scored 3.2% higher than women.
b. For every 1 point increase in undergraduate science GPA, test score goes up by 4.8%.
c. Step 1 results consist of a sample size that includes the class of 2021 and members of the class of 2022 who 1. did not choose to delay Step 1 and 2. had a testing date prior to the closure of testing centers as a result of Covid-19.

Figure 1



*GPA values have been converted to a percentile

Figure 2


Mean Final Exam Scores for URM vs. non-URM Students Throughout the Foundations Phase
90
80
70
60
50
40
30
20
10
0
Origins 1 and 2 NBME Exam
Human Architecture Final Exam
Host and Defense Final Exam
Staying Alive NBME Exam
CBSE Exam 1
Beginning to End NBME Exam
Balance, Control and Repair NBME Exam
CBSE Exam 2
URM Students
non-URM Students