UC Davis

UC Davis Previously Published Works

Title

The Relationships among Self-Designated Disadvantage, Socioeconomic Disadvantage, and Academic Performance in Medical School: A Multi-Institutional Study.

Permalink

<https://escholarship.org/uc/item/66q425j6>

Journal

Journal of health care for the poor and underserved, 31(4S)

ISSN

1049-2089

Authors

Henderson, Mark C
Jerant, Anthony
Unkart, Jonathan
et al.

Publication Date

2020

DOI

10.1353/hpu.2020.0151

Peer reviewed

PROJECT MUSE®

The Relationships among Self-Designated Disadvantage,
Socioeconomic Disadvantage, and Academic Performance in
Medical School: A Multi-Institutional Study

Mark C Henderson, Anthony Jerant, Jonathan Unkart, Erin J Griffin, Andrés
F Sciolla, Carolyn J Kelly, Ellena M Peterson, Theodore Hall, David Wofsy, Tonya
L Fancher

Journal of Health Care for the Poor and Underserved, Volume 31, Number
4, November 2020, Supplement , pp. 208-222 (Article)

Published by Johns Hopkins University Press
DOI: <https://doi.org/10.1353/hpu.2020.0151>

➔ *For additional information about this article*
<https://muse.jhu.edu/article/774201>

The Relationships among Self-Designated Disadvantage, Socioeconomic Disadvantage, and Academic Performance in Medical School: A Multi-Institutional Study

Mark C Henderson, MD
Anthony Jerant, MD
Jonathan Unkart, MD, MPH, MS
Erin J Griffin, PhD
Andrés F Sciolla, MD
Carolyn J Kelly, MD
Ellena M Peterson, PhD
Theodore Hall, MD
David Wofsy, MD
Tonya L Fancher, MD, MPH

Abstract: As medical schools seek to address the growing disparity between the socioeconomic makeup of their students and the general population, it is important to understand the academic trajectory of disadvantaged students. We used a locally-developed multicomponent socioeconomic disadvantage (SED) measure and the self-designated disadvantaged (SDA) question [“yes” (+) or “no” (-)] from the American Medical College Application Service application to examine academic performance of students from three disadvantaged categories (high SED/SDA+, high SED/SDA-, and low SED/SDA+); with low SED/SDA- as the reference group across five California schools. Compared with reference, the DA+ subgroups scored lower on USMLE Step 1 and Step 2 Clinical Knowledge examinations and received fewer clerkship Honors. After adjustment for academic metrics and sociodemographic variables, high SED subgroups performed similarly to reference, but performance gaps for low SED/SDA+ students persisted. Medical schools must better understand the institutional and other drivers of academic success in disadvantaged students.

MARK C HENDERSON, ANTHONY JERANT, ERIN J GRIFFIN, ANDRÉS F SCIOLLA, and TONYA L FANCHER are affiliated with the University of California Davis School of Medicine. **JONATHAN UNKART** and **CAROLYN J KELLY** are affiliated with the University of California San Diego School of Medicine. **ELLENA M PETERSON** is affiliated with the University of Irvine School of Medicine. **THEODORE HALL** is affiliated with the University of California Los Angeles School of Medicine. **DAVID WOFSY** is affiliated with the University of California San Francisco School of Medicine. Please address all correspondence to: Mark C Henderson, University of California Davis School of Medicine, Center for a Diverse Healthcare Workforce, Division of General Medicine, Department of Internal Medicine, 4610 X St., Suite 4200, Sacramento, CA 95817; Email: mchenderson@ucdavis.edu.

Key words: Physician workforce diversity, self-designated disadvantage, socioeconomic disadvantage, medical licensing examinations, medical school academic performance, health disparities.

The growing gap between the racial, ethnic, and socioeconomic makeup of medical school classes and that of the general population means medical education is slipping out of reach for many students from disadvantaged and underrepresented in medicine (URiM) backgrounds.¹ Such inequitable representation may contribute to health disparities as URiM physicians are more likely to provide care for patients of color and to practice in high-need areas with fewer health services.²⁻⁴ In addition, patients from minority backgrounds report better communication and understanding, greater satisfaction, and better adherence when they are cared for by racially and linguistically concordant physicians.⁵⁻⁸ Less than 10% of medical students come from the lowest two quartiles of family income,^{9,10} and Black and Hispanic medical students are three times as likely as their White counterparts to come from families with combined parental incomes of less than \$50,000.¹¹ Low-income students are more likely to attend underfunded and underperforming K-12 schools,¹² to have limited access to academic preparation,¹³⁻¹⁷ and to bear work obligations resulting in additional educational disadvantages.¹⁸ Once in medical school, URiM students continue to experience adversity in the form of unsupportive, racist, or discriminatory learning environments, which may further impair academic performance and increase attrition in this group.^{19,20}

The academic trajectory of disadvantaged students in medical school has not been well characterized.²¹ A recent qualitative study highlighted the problematic definition of *disadvantaged* in the American Medical College Application Service (AMCAS) application and the challenges it poses for applicants.²² In a previous simulation using data from applicants to the University of California Davis School of Medicine (UC Davis), we assembled eight indicators from the AMCAS application to create a continuous, multi-component scale of socioeconomic disadvantage (SED), a granular and potentially more reliable measure of disadvantage.²³ Students scoring 20 or greater on this 0-100 scale were considered socioeconomically disadvantaged (high SED) based on the receiver operating characteristics (ROC) as described below (see Methods). Subsequently, we examined associations of SED and URiM status (Black or African American, Hispanic, Native American, or Pacific Islander race and ethnicity) with U.S. Medical Licensing Examination (USMLE) Step 1 and Step 2 Clinical Knowledge (CK) performance and number of third-year clerkship Honors at UC Davis. Although URiM status was not associated with academic performance, high SED students had lower Step 1 scores and fewer Honors than their low SED counterparts, even after adjustment for demographics, undergraduate grade point average (GPA), and Medical College Admissions Test (MCAT) performance.²⁴

The AMCAS application also includes a single Yes/No question asking whether applicants wish to *self-designate* as disadvantaged (SDA+). In a previous analysis, high SED scores and SDA+ were highly correlated; however, there was a subset of students with discordant disadvantaged categories (high SED/SDA- and low SED/SDA+).²³ In another single-institution study, we examined three disadvantaged categories (high

SED/SDA+, high SED/SDA-, and low SED/SDA+; with low SED/SDA- as the non-disadvantaged reference group), and found all categories of disadvantaged students received fewer third-year clerkship Honors than the reference group. USMLE Step 1 and 2 CK scores were also lower for both high SED/SDA+ and low SED/SDA+ students but not for high SED/SDA- students, suggesting the SED and SDA designations might variably predict medical school performance.²⁵ In that study, there were too few SDA+ students to fully evaluate their differential performance.

To characterize the academic trajectory of disadvantaged students, we examined performance of students from all three disadvantaged categories in a larger sample from five University of California medical schools. This multi-institutional, longitudinal dataset is particularly appropriate due to the rich racial and ethnic diversity of the applicant pool, in which approximately 20% are URiM and 15% SDA+.²³

Methods

We conducted this retrospective study from June 18, 2018 to March 15, 2019 using data from the California Longitudinal Evaluation of Admission Practices (CA-LEAP) consortium, which has been fully described elsewhere.^{26,27} The CA-LEAP consortium includes the David Geffen School of Medicine at UCLA; UC Davis; UC Irvine School of Medicine; UC San Diego School of Medicine; and UC San Francisco School of Medicine. We obtained ethics approval from the institutional review boards of the participating schools via the UC Reliance Registry (protocol #605118-6).

The study population included a total of 1,460 medical students who matriculated to CA-LEAP schools during the three-year study period from 2011 to 2013. Although the vast majority of California applicants apply to all CA-LEAP schools (confidential unpublished data), complete AMCAS application data was available only for the 1,262 students (86.4%) who applied to UC Davis; thus, the final study cohort included 1,262 matriculants. The 198 students (13.5%) with missing AMCAS data had higher undergraduate GPA and MCAT scores (data not reported).

Data collection. The University of California, Davis provided the following anonymized information from each AMCAS application: age; self-designated gender, race and ethnicity; cumulative undergraduate GPA and MCAT score; and application year. Students were classified as URiM if they had indicated Black or African American, Hispanic, Native American, or Pacific Islander race and ethnicity. We also included the answer (yes or no) to the aforementioned AMCAS SDA question. The instructions regarding SDA status from the AMCAS Instruction Manual state, "You might consider yourself disadvantaged if you grew up in an area that was medically underserved or had insufficient access to social, economic, and educational opportunities. If you answer Yes, you'll have 1,325 characters to explain why you consider yourself a disadvantaged applicant."²⁸ Self-reported disadvantage (SDA+) was defined as an affirmative response to the AMCAS SDA question.

Using methods described previously,^{23,29} we employed the following eight self-reported indicators from the AMCAS application to derive a composite SED score: (1) AMCAS fee waiver received for medical school application; (2) childhood spent

in an underserved area; (3) family assistance program recipient; (4) family income level (categorized as <\$25,000, \$25,000–\$49,999, \$50,000–\$74,999, or ≥\$75,000); (5) applicant contribution to family income; (6) any financial need-based scholarship for post-secondary education; (7) percentage of post-secondary education costs contributed by family; and (8) parents' highest level of educational attainment (categorized as less than high school graduate, high school graduate, some college (did not graduate), or college graduate). All missing data were coded as the most advantaged category. In a factor analysis, we found that these eight variables loaded onto a single underlying construct (each variable loaded greater than 0.25 onto the main factor; Eigenvalue = 2.60 for main factor, 0.17 for next factor).³⁰ The factor score was rescaled from 0 to 100, with higher scores indicating greater socioeconomic disadvantage. Apart from the AMCAS fee waiver element, all elements of the SED score were self-reported. Socioeconomic disadvantage (high SED) was defined as a SED score of ≥20 based on the ROC of the relationship between the SED score and SDA+; sensitivity of this cutoff in predicting SDA+ was 93.8% and the specificity was 83.8%. Because distribution of the SED score was bimodal, with most scores clustering under 15 or over 50, varying the cutoff score made little difference to the sensitivity and specificity.

USMLE Step 1 and Step 2 scores and failures. The three-part USMLE examination is sponsored by the Federation of State Medical Boards and the National Board of Medical Examiners (NBME). In the U.S., individuals with a doctor of medicine (MD) degree are required to pass all three USMLE Step exams before being permitted to practice medicine. Step 1 assesses understanding and application of basic science concepts relevant to medical practice (score range 1–300).³¹ Step 2 CK assesses the ability to apply the medical knowledge, skills, and understanding of clinical science needed to provide patient care under supervision (score range 1–300).³² Before January 2014, the minimum passing score for Step 1 was 188; it was subsequently increased to 192. Before July 2014 the minimum passing score for Step 2 CK was 203; it was subsequently increased to 209.³¹ The USMLE statistically adjusts for differences in difficulty in both exams across years using statistical procedures and considers scores to be comparable across years within a three to four-year window.³¹ We chose these measures of academic performance because they influence residency matching and career choices. Step 3 (not reported here) is the final examination leading to a license to practice medicine without supervision.

Third-year clerkship grades. We considered final grades (Honors, Pass, or Fail) in all required clinical clerkships. The number of required clerkships varied from six to eight across the schools and grading formulas varied among clerkships and schools. However, key components for all clerkships included supervising residents' and attending physicians' subjective ratings, as well as the students' score on the corresponding NBME Clinical Science subject examination (widely referred to as the "shelf examination"). According to the NBME, the subject examinations "are achievement tests in a broad sense, requiring medical students to solve scientific and clinical problems."³²

Analyses. Analyses were conducted using Stata (version 15.1, StataCorp, College Station, TX). We employed the chi-square test (for categorical variables) and ANOVA

test (for continuous variables) to compare characteristics of students across the four combined SED/SDA categories.

Using three disadvantaged categories (high SED/SDA+, high SED/SDA−, and low SED/SDA+; with low SED/SDA− as the reference group), we developed four sequential sets of regression models to examine different SED/SDA associations with USMLE Step 1 and Step 2 CK score (linear regressions) and total number of third-year clerkship Honors (negative binomial regression, to adjust for overdispersion in the count of Honors). For each set of outcomes, the models were sequentially adjusted for: (a) school (to adjust for unmeasured medical school differences) and matriculation year (to adjust for extraneous differences due to matriculation year); (b) SED score (from 0–100 to account for differences in mean SED scores within each SED/SDA category, particularly between high SED/SDA+ and high SED/SDA− students); (c) the variables in (b) plus age, gender, and URiM status to examine the extent to which observed differences among groups reflected differences in demographic characteristics; and (d) the variables in (c) plus pre-medical school academic metrics (undergraduate GPA and MCAT score) to examine the extent to which observed differences between groups reflected prior academic performance.

Results

Table 1 shows the personal characteristics of the 1,262 students who matriculated to the five CA-LEAP medical schools over three consecutive years, by combined SED/SDA categories and overall. Just over half were female, approximately 20% were URiM, and nearly 22% (275) were SDA+. Among the SDA+ group, 222 students (81%) also had a high SED score (≥ 20), indicating socioeconomic disadvantage; the remainder were considered low SED. Among the 987 (78%) who did not self-report disadvantage (SDA−), nearly all (923 or 94%) were low SED. SDA+ students were more likely to be URiM than their SDA− counterparts, regardless of SED score. Students from URiM groups were overrepresented in both high SED/SDA+ (49%) and low SED/SDA+ (70%) groups.

Table 1 also shows the unadjusted associations of the four SED/SDA categories with academic metrics. Regardless of SED score, SDA+ students had lower mean undergraduate GPA, MCAT scores, and Step 1 and Step 2 CK scores and fewer clerkship Honors than their SDA− counterparts. Among all subgroups, the low SED/SDA− students (the reference group) had the highest academic metrics and most clerkship Honors.

Adjusted academic performance. Table 2 shows the results of four sets of regression models examining the associations of the four SED and SDA combinations with academic performance outcomes. For USMLE Step 1 (Table 2, top panel), compared with the reference group, scores were lower for the three disadvantaged groups in model (a). In models (b) and (c), scores were lower for both self-reported disadvantaged groups (high SED/SDA+ and low SED/SDA+). In model (d) with full adjustment including demographics and cumulative undergraduate GPA, and total MCAT score, only low SED/SDA+ students had lower Step 1 scores.

For USMLE Step 2 CK (Table 2, middle panel), compared with the reference group, all disadvantaged groups had lower scores in model (a). After adjusting for SED in model (b) and demographic characteristics and undergraduate GPA and MCAT score

Table 1.
STUDENT CHARACTERISTICS BY COMBINED SED AND SDA CATEGORY AND OVERALL

Characteristic	Combined SED and SDA Category					p value ^b	Total N=1262
	High SED/SDA+ N=222	High SED/SDA- N=64	Low SED/SDA+ N=53	Low SED/SDA- ^a N=923			
Age, mean (SD)	25.9 (3.2)	25.1 (3.6)	24.9 (2.3)	24.3 (2.6)	<.001	24.7 (2.8)	
Female, no. (%)	118 (53.2%)	33 (51.6%)	28 (52.8%)	466 (50.5%)	.90	645 (51.1%)	
URiM, no. (%)	109 (49.1%)	6 (9.4%)	37 (69.8%)	98 (10.6%)	<.001	250 (19.8%)	
SED score, mean (IQR) ^c	92.0 (73.4, 97.5)	49.5 (28.2, 70.6)	5.0 (1.6, 7.3)	1.6 (1.4, 2.2)	<.001	1.6 (1.6, 12.1)	
Undergraduate GPA, mean (SD)	3.5 (0.3)	3.8 (0.2)	3.5 (0.2)	3.7 (0.2)	<.001	3.7 (0.2)	
Total MCAT score, mean (SD)	29.4 (3.7)	33.8 (2.7)	29.4 (3.4)	33.8 (3.0)	<.001	32.8 (3.6)	
Medical school academic performance							
USMLE Step 1, mean (SD), N=1247	219.1 (20.9)	232.4 (17.6)	217.7 (17.5)	237.0 (17.2)	<.001	232.8 (19.4)	
USMLE Step 2 CK, mean (SD), N=1173	234.9 (15.8)	242.1 (16.6)	233.9 (15.7)	248.2 (14.1)	<.001	245.1 (15.6)	
Third-year Clerkship Honors, median (IQR), N=1262	0 (0, 2)	1 (0, 2)	0 (0, 1)	2 (0, 3)	<.001	1 (0, 3)	

Notes:

^a Non-Disadvantaged reference group

^b p values refer to the unadjusted comparisons of each characteristic across the 4 SED/SDA categories. For categorical variables, the groups were compared with chi-squared tests and for continuous variables the groups were compared using one-way analysis of variance.

^c SED score range 0–100, scores greater than or equal to 20 considered high SED. See Methods for score calculation.

CK= Clinical Knowledge; GPA = Grade Point Average; IQR= Interquartile Range; MCAT= Medical College Admission Test; SDA= Self-Designated Disadvantaged on American Medical College Application Service Application; SED= Socioeconomic Disadvantage; URiM= Under-Represented in Medicine; USMLE= US Medical Licensing Examination

Notes:

^a Non-Disadvantaged reference group

^b p values refer to the unadjusted comparisons of each characteristic across the 4 SED/SDA categories. For categorical variables, the groups were compared with chi-squared tests and for continuous variables the groups were compared using one-way analysis of variance.

^c SED score range 0–100, scores greater than or equal to 20 considered high SED. See Methods for score calculation.

CK= Clinical Knowledge; GPA= Grade Point Average; IQR= Interquartile Range; MCAT= Medical College Admission Test; SDA= Self-Designated Disadvantage on American Medical College Application Service Application; SED= Socioeconomic Disadvantage; URiM= Under-Represented in Medicine; USMLE= US Medical Licensing Examination

Table 2.

ASSOCIATIONS OF COMBINED SED AND SDA CATEGORIES WITH ACADEMIC PERFORMANCE MEASURES^a

Model adjustors	Model a School and Matriculation year	Model b Model a + SED ^b	Model c Model b + age, gender, URiM	Model d Model c + GPA, MCAT
USMLE Step 1 (N=1247)				
High SED/SDA+	PE (95% CI) -16.3 (-19.0,-13.6)	PE (95% CI) -11.0 (-18.5,-3.4)	PE (95% CI) -8.4 (-15.7,-1.2)	PE (95% CI) -1.7 (-8.5,5.2)
High SED/SDA-	-5.1 (-9.7,-0.5)	-1.9 (-8.2,4.3)	-2.2 (-8.2,3.8)	-2.3 (-7.9,3.3)
Low SED/SDA+	-19.1 (-24.0,-14.2)	-18.9 (-23.9,-14.0)	-14.5 (-19.5,-9.6)	-7.5 (-12.2,-2.8)
Low SED/SDA- ^c				
USMLE Step 2 Clinical Knowledge (N=410)				
High SED/SDA+	PE (95% CI) -13.0 (-15.4,-10.7)	PE (95% CI) -7.5 (-14.1,-1.0)	PE (95% CI) -4.3 (-10.6,2.0)	PE (95% CI) -0.8 (-6.9,5.4)
High SED/SDA-	-6.8 (-10.7,-3.0)	-3.4 (-8.8,1.9)	-3.1 (-8.2,2.1)	-3.3 (-8.3,1.7)
Low SED/SDA+	-14.5 (-18.7,-10.3)	-14.4 (-18.6,-10.1)	-10.5 (-14.8,-6.3)	-6.6 (-10.8,-2.4)
Low SED/SDA- ^c				
Total clerkship Honors (N=528)				
High SED/SDA+	IRR (95% CI) 0.5 (0.4,0.6)	IRR (95% CI) 0.7 (0.4,1.1)	IRR (95% CI) 0.8 (0.5,1.3)	IRR (95% CI) 0.9 (0.6,1.5)
High SED/SDA-	0.5 (0.4,0.7)	0.7 (0.5,1.0)	0.7 (0.5,1.0)	0.7 (0.5,1.0)
Low SED/SDA+	0.3 (0.2,0.4)	0.3 (0.2,0.4)	0.3 (0.2,0.5)	0.4 (0.3,0.6)
Low SED/SDA- ^c				

Notes:

^a Statistically significant associations (p < .05) are indicated by **bold font**

^b adjusted for difference in SED score on a continuous 0–100 scale

^c Non-Disadvantaged reference group

SDA= Self-Designated Disadvantage on American Medical College Application Service Application; GPA= Grade Point Average; IRR= Incidence Rate Ratio; MCAT= Medical College Admission Test; PE= Parameter Estimate; SED= Socioeconomic Disadvantage; URiM= Under-Represented in Medicine; USMLE= US Medical Licensing Examination

in models (c) and (d), only low SED/SDA+ students had significantly lower USMLE Step 2 CK scores.

Regarding total number of clerkship Honors (Table 2, bottom panel), all combinations of SED and SDA students had fewer Honors than the reference group in model (a). After adjustment in the other models as described above, only low SED/SDA+ students had fewer clerkship Honors.

Discussion

Across five public California medical schools, students who self-reported being disadvantaged (SDA+) on their AMCAS application scored lower on USMLE Step 1 and Step 2 CK and received fewer clerkship Honors than non-disadvantaged students in unadjusted analyses. After adjustment for academic metrics and sociodemographic characteristics, high SED/SDA+ students performed similarly to the low SED/SDA–reference group, whereas among low SED students, the performance gap between SDA+ and SDA– students remained. Stated differently, students who self-designate as disadvantaged, but do not demonstrate high socioeconomic disadvantage, may be at heightened risk for academic difficulties in medical school—more evidence of the need for medical schools to identify and address systemic barriers limiting the success of disadvantaged students.

What is the nature of self-designated disadvantage and how does it relate to academic performance? The study's design and dataset cannot answer these questions. Students may use the AMCAS disadvantaged (SDA) prompt to disclose their experiences in a marginalized or underrepresented group, which may not otherwise be included in their application. Reporting SDA+ may reflect exposure to childhood adverse experiences,³³ including childhood maltreatment, bullying, and growing up with mental illness or substance use³⁴ in the family.^{35,36} Students from negatively stereotyped or devalued social groups are more likely to experience bias and discrimination,^{37,38} low self-efficacy and sense of belonging,^{34,39,40} imposter syndrome (i.e., the feeling that they do not deserve to “be there” and that they have simply fooled anyone who thinks otherwise)⁴¹ and microaggressions⁴²—any one of which may adversely affect academic progression in medical school.²¹

Despite our findings, we caution against labeling SDA+ students as academically risky, because doing so might exclude many URiM applicants in the admission process or contribute to underperformance during medical school. Other authors have raised concerns that applicants with significant hardship may be reluctant to use the SDA prompt.²² Our data suggest a ‘protective’ effect of high SED on performance of SDA+ students (compared with low SED/SDA+ students). We speculate high SED students may have developed additional resilience, grit, or success strategies through socioeconomic adversity⁴³ or academic enhancement programs for low-income students such as Mathematics, Engineering Science Achievement programs (MESA),⁴⁴ Federal TRIO Programs (TRIO),⁴⁵ and Summer Health Professions Education Programs.⁴⁶

We believe medical schools should implement strategies to counter the structural barriers to success for all disadvantaged students,⁴⁷ as part of a commitment to diversify the physician workforce.⁴⁸ Faculty development programs that address barriers

to success (e.g., racism, discrimination and bias, stereotype threat, microaggressions, imposter syndrome, belonging) may help faculty to understand the students better and improve their own teaching and evaluation practices.^{42,49,50} Medical schools should teach about racism⁵¹ and the impact of curricula and learning environment in reinforcing stereotypes,^{52,53} which may influence students' career decisions to practice in high-need communities.⁵⁴ Schools should examine the role of examination practices in fostering the social-class achievement gap⁵⁵ and potential bias in supervisors' ratings of learners, which may lead to underrepresentation of Black and Asian students in the Alpha Omega Alpha Honor Medical Society and limit their career opportunities.^{21,56–58} Teaching institutions should develop policies and trainings to address discrimination³⁸ and harassment.⁵⁹ Sharing longitudinal academic performance data across institutions may also contribute important lessons for medical educators. Large-scale, coordinated efforts are needed to support academic success and reduce attrition among disadvantaged students.

Strengths and limitations. A key strength of our study was the use of data across multiple medical schools, addressing the generalizability concerns of previous, single-institution reports. The study also had some limitations. First, the data come from five California public medical schools, so whether the findings apply to other regions or private institutions is unclear. Second, our data predates availability of the AAMC's Socioeconomic Status Indicator, which was added to AMCAS in 2014.⁶⁰ This two-factor indicator, based on parental education (E) and occupation (O), identifies applicants from socioeconomically disadvantaged backgrounds. However, the EO variables are part of the SED score used in our study. Third, we were unable to examine the performance of first-generation college students (i.e., those whose parents do not have at least a bachelor's degree). Starting in 2019, the AMCAS application included a first-generation college student indicator, facilitating such analyses in the future.²⁸ As noted above, it is also possible that some applicants with significant hardships or barriers were reluctant to report SDA, due to concerns about negative reactions among application screeners.²² Lastly, matriculants with missing data (13.5% of study sample) had higher academic metrics, which raises concern about generalizability.

In conclusion, our study findings suggest the need for medical schools to understand more fully the drivers of academic success for disadvantaged students. The mission of equity of opportunity is critical to addressing the needs of diverse populations. As medical schools commit to recruiting and educating students that more closely mirror the U.S. population, they must also address structural barriers within their institutions that limit success of students from disadvantaged and underrepresented groups.

Acknowledgments

This work is supported by the Health Resources and Services Administration (HRSA) of the U.S. Department of Health and Human Services (HHS) as part of an award totaling \$ 3,791,026 with 0% financed with non-governmental sources. The contents are those of the author(s) and do not necessarily represent the official views of, nor an endorsement, by HRSA, HHS or the U.S. government. For more information, please visit [HRSA.gov](https://www.hrsa.gov).

References

1. Talamantes E, Henderson MC, Fancher TL, et al. Closing the gap—making medical school admissions more equitable. *N Engl J Med*. 2019 Feb 28;380(9):803–5. <https://doi.org/10.1056/NEJMp1808582>
PMid:30811906
2. Marrast LM, Zellman L, Woodhandler S, et al. Minority Physicians' Role in the Care of Underserved Patients: Diversifying the Physician Workforce May Be Key in Addressing Health Disparities. *JAMA Intern Med*. 2014 Feb 1;174(2):289–91. <https://doi.org/10.1001/jamainternmed.2013.12756>
PMid:24378807
3. Rabinowitz HK, Diamond JJ, Veloski JJ, et al. The impact of multiple predictors on generalist physicians' care of underserved populations. *Am J Public Health*. 2000 Aug;90(8):1225–8. <https://doi.org/10.2105/AJPH.90.8.1225>
PMid:10937001 PMCID:PMC1446348
4. Goodfellow A, Ulloa JG, Dowling PD, et al. Predictors of primary care physician practice location in underserved urban or rural areas in the United States: a systematic literature review. *Acad Med*. 2016 Sep;91(9):1313–21. <https://doi.org/10.1097/ACM.0000000000001203>
PMid:27119328 PMCID:PMC5007145
5. Alsan M, Garrick O, Graziani GC. Does diversity matter for health? Experimental evidence from Oakland. Cambridge MA: National Bureau of Economic Research, 2019. *American Economic Rev*. 2019;109(12):4071–111. <https://doi.org/10.1257/aer.20181446>
6. Dunlap JL, Jaramillo JD, Koppolu R, et al. The effects of language concordant care on patient satisfaction and clinical understanding for Hispanic pediatric surgery patients *J Pediatr Surg*. 2015 Sep;50(9):1586–9. Epub 2014 Dec 31. <https://doi.org/10.1016/j.jpedsurg.2014.12.020>
PMid:25783324
7. Parker MM, Fernandez A, Moffet HH, et al. Association of patient-physician language concordance and glycemic control for limited-English proficiency Latinos with type 2 diabetes. *JAMA Intern Med*. 2017 Mar 1;177(3):380–7. <https://doi.org/10.1001/jamainternmed.2016.8648>
PMid:28114680 PMCID:PMC5339062
8. Saha S, Shipman SA. The rationale of diversity in the health professions: a review of the evidence. Hyattsville, MD: U. S. Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Professions, 2006.
9. Jolly P. Diversity of U.S. medical students by parental income. Washington, DC: Association of American Medical Colleges, 2008.
10. Association of American Medical Colleges (AAMC). Diversity in the physician workforce: facts & figures 2014. Washington, DC: AAMC, 2014.
11. Association of American Medical Colleges (AAMC). Diversity in medical education: facts & figures 2016. Washington, DC: AAMC, 2016.
12. Katz N. State education funding: the poverty equation. Washington, DC: Georgetown University McCourt School of Public Policy, 2020. Available at: <https://www.future-ed.org/state-education-funding-concentration-matters/>.

13. U.S. Department of Education. Low-income and minority students. Washington, DC: U.S. Department of Education. Available at: <https://www2.ed.gov/offices/OPE/AgenProj/report/theme1a.html>.
14. Girotti JA, Chanatry JA, Clinchot DM, et al. Investigating group differences in examinees' preparation for and performance on the new MCAT exam. *Acad Med*. 2020 Mar;95(3):365–74.
<https://doi.org/10.1097/ACM.0000000000002940>
PMid:31425183
15. Handwerk P, Tognatta N, Coley RJ, et al. Access to success: patterns of advanced placement participation in U.S. high schools. Princeton, NJ: Educational Testing Service, 2008.
16. Oyewole S. Sustaining minorities in prehelath advising programs: challenges and strategies for success. In: Smedley B, Stith A, Colburn L, et al, eds. *The right thing to do, the smart thing to do: enhancing diversity in the health professions: summary of the symposium on diversity in health professions in honor of Herbert W Nickens MD*. Washington, DC: National Academies Press, 2001.
17. The Executive Office of the President. Increasing college opportunity for low-income students: promising models and a call to action. Washington, DC: The Executive Office of the President, 2014. Available at: https://obamawhitehouse.archives.gov/sites/default/files/docs/increasing_college_opportunity_for_low-income_students_report.pdf.
18. Carnevale A, Smith N. Balancing work and learning: implications for low-income students. Washington, DC: Georgetown University Center on Education and the Workforce, 2018. Available at: <https://1gyhoq479ufd3yna29x7ubjn-wpengine.netdna-ssl.com/wp-content/uploads/Low-Income-Working-Learners-FR.pdf>.
19. Ko M. Racism in my medical education. *Health Aff (Millwood)*. 2020 Jun;39(6):1087–1091.
<https://doi.org/10.1377/hlthaff.2019.00743>
PMid:32479239
20. Orom H, Semalulu T, Underwood W. The social and learning environments experiences by underrepresented minority medical students: a narrative review. *Acad Med*. 2013;88(11):1765–77.
<https://doi.org/10.1097/ACM.0b013e3182a7a3af>
PMid:24072111
21. Teherani A, Hauer KE, Fernandez A, et al. 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. *Acad Med*. 2018;93(9):1286–92.
<https://doi.org/10.1097/ACM.0000000000002323>
PMid:29923892
22. Lowrance AM, Birnbaum MG. Am i disadvantaged? How applicants decide whether to use the disadvantaged status in the American medical college application service. *Acad Med*. 2019 Nov;94(11):1766–73.
<https://doi.org/10.1097/ACM.0000000000002798>
PMid:31094721
23. Fenton JJ, Fiscella K, Jerant AF, et al. Reducing medical school admissions disparities in an era of legal restrictions: adjusting for applicant socioeconomic disadvantage. *J Health Care Poor Underserved*. 2016;27(1):22–34.

- <https://doi.org/10.1353/hpu.2016.0013>
PMid:27763458
24. Jerant A, Henderson MC, Griffith E, et al. Medical school performance of socioeconomically disadvantaged and underrepresented minority students matriculating after a multiple mini-interview. *J Health Care Poor Underserved*. 2018;29(1):303–20.
<https://doi.org/10.1353/hpu.2018.0021>
PMid:29503302
 25. Jerant A, Sciolla AF, Henderson MC, et al. Medical student socioeconomic disadvantage, self-designated disadvantage, and subsequent academic performance. *J Health Care Poor Underserved*. 2019;30(4):1419–32.
<https://doi.org/10.1353/hpu.2019.0095>
PMid:31680106
 26. Jerant A, Henderson MC, Griffin E, et al. Reliability of multiple mini-interviews and traditional interviews within and between institutions: a study of five California medical schools. *BMC Med Educ*. 2017 Nov 6;17(1):190.
<https://doi.org/10.1186/s12909-017-1030-0>
PMid:29110662 PMCID:PMC5674866
 27. Henderson MC, Kelly CJ, Griffin E, et al. Medical school applicant characteristics associated with performance in multiple mini-interviews versus traditional interviews: a multi-institutional study. *Acad Med*. 2018 Jul;93(7):1029–34.
<https://doi.org/10.1097/ACM.0000000000002041>
PMid:29095170
 28. Association of American Medical Colleges (AAMC). American Medical College Application Services (AMCAS) instruction manual. Washington, DC: AAMC, 2019.
 29. Jerant A, Fancher T, Fenton J, et al. How medical school applicant race, ethnicity, and socioeconomic status relate to multiple mini-interview-based admissions outcomes: findings from one medical school. *Acad Med*. 2015;90(12):1667–74.
<https://doi.org/10.1097/ACM.0000000000000766>
PMid:26017355
 30. McIver JP. Unidimensional scaling. Thousand Oaks, CA: Sage Publications, 1981.
<https://doi.org/10.4135/9781412986441>
 31. United States Medical Licensin Examination (USMLE). USMLE score interpretation guidelines. Philadelphia, PA: National Board of Medical Examiners, 2020.
 32. National Board of Medical Examiners. Subject examinations. Philadelphia, PA: National Board of Medical Examiners, 2020.
 33. Sciolla AF, Wilkes MS, Griffin EJ. Adverse childhood experiences in medical students: implications for wellness. *Acad Psychiatry*. 2019 Aug;43(4):369–74. Epub 2019 Mar 8.
<https://doi.org/10.1007/s40596-019-01047-5>
PMid:30850989 PMCID:PMC6647886
 34. Spitzer B, Aronson J. Minding and mending the gap: social psychological interventions to reduce educational disparities. *Br J Educ Psychol*. 2015 Mar;85(1):1–18.
<https://doi.org/10.1111/bjep.12067>
PMid:25689030
 35. Maurer K. Income support may reduce violence for poor families. Davis, CA: Center for Poverty Research, UC Davis, 2015. Available at: https://poverty.ucdavis.edu/sites/main/files/file-attachments/maurer_family_violence_brief.pdf.
 36. Pew Research Center. Parenting in America: outlook, worries, aspirations are strongly linked to financial situation. Washington, DC: Pew Research Center, 2015.

37. Cook TE, Dimant IE, Novick R, et al. Gendered expectations: strategies for navigating structural challenges in support of transgender and nonbinary trainees in academic medicine. *Acad Med.* 2020;95(5):704–9.
<https://doi.org/10.1097/ACM.00000000000003202>
PMid:32079959
38. Whitgob EE, Blakenburg RL, Bogetz AL. The discriminatory patient and family: strategies to address discrimination towards trainees. *Acad Med.* 2016;91(11):65–9.
<https://doi.org/10.1097/ACM.00000000000001357>
PMid:27779512
39. Jury M, Smeding A, Stephens N, et al. The experience of low-ses students in higher education: psychological barriers to success and interventions to reduce social-class inequality. *J Soc Issues.* 2017;73(1):23–41.
<https://doi.org/10.1111/josi.12202>
40. Walton G, Cohen G, Cwir D, et al. Mere belonging: The power of social connections. *J Pers Soc Psychol.* 2012 Mar;102(3):513–32. Epub 2011 Oct 24.
<https://doi.org/10.1037/a0025731>
PMid:22023711
41. LaDonna K, Ginsburg S, Watling C. “Rising to the level of your incompetence”: what physicians’ self-assessment of their performance reveals about the imposter syndrome in medicine. *Acad Med.* 2018 May;93(5):763–8.
<https://doi.org/10.1097/ACM.00000000000002046>
PMid:29116983
42. Ackerman-Barger K, Boatright D, Gonzalez-Colaso R, et al. Seeking Inclusion Excellence: Understanding Racial Microaggressions as Experienced by Underrepresented Medical and Nursing Students. *Acad Med.* 2020 May;95(5):758–63.
<https://doi.org/10.1097/ACM.00000000000003077>
PMid:31725462 PMCID:PMC7185051
43. Duckworth A, Peterson C, Matthews MD, et al. Grit: perseverance and passion for long-term goals. *J Pers Soc Psychol.* 2007 Jun;92(6):1087–101.
<https://doi.org/10.1037/0022-3514.92.6.1087>
PMid:17547490
44. Mathematics, Engineering, Science Achievement (MESA). Welcome to MESA USA. MESA (website), 2020. Available at: <https://mesausa.org>.
45. U.S. Department of Education. Federal TRIO Programs. Washington, DC: U.S. Department of Education, 2019. Available at: <https://www2.ed.gov/about/offices/list/oep/trio/index.html>.
46. Summer Health Professions Education Programs (SHPEP). About SHPEP. SHPEP (web site), 2020. Available at: <http://www.shpep.org>.
47. Bailey Z, Krieger N, Agenor M, et al. Structural racism and health inequities in the USA: evidence and interventions. *Lancet.* 2017;389(10077):1453–63.
[https://doi.org/10.1016/S0140-6736\(17\)30569-X](https://doi.org/10.1016/S0140-6736(17)30569-X)
48. Hardeman R, Medina E, Kozhimannil K. Structural racism and supporting Black lives—the role of health professionals. *N Engl J Med.* 2016;375(22):2113–5.
<https://doi.org/10.1056/NEJMp1609535>
PMid:27732126 PMCID:PMC5588700
49. Stephens N, Hamedani M, Destin M. Closing the social-class achievement gap: a difference-education intervention improves first-generation students’ academic performance and all students’ college transition. *Psychol Sci.* 2014;25(4):943–53.

- <https://doi.org/10.1177/0956797613518349>
PMid:24553359
50. Nientara A, Boatright D, Resiman A. Blackface in White space: using admissions to address racism in medical education. *J Gen Intern Med*. 2020 Jul 29.
 51. Acosta D, Ackerman-Barger K. Breaking the silence: time to talk about race and racism. *Acad Med*. 2017;92(3):285–88.
<https://doi.org/10.1097/ACM.0000000000001416>
PMid:27655050
 52. Hurtado S, Eagan M, Tran M, et al. “We do science here”: underrepresented students’ interactions with faculty in different college contexts. *J Soc Issues*. 2011 Sep;67(3): 553–79.
<https://doi.org/10.1111/j.1540-4560.2011.01714.x>
PMid:23503924 PMCID:PMC3596161
 53. Karani R, Varpio L, May W. Commentary: racism and bias in health professions education: how educators, faculty developers, and researchers can make a difference. *Acad Med*. 2017;92(ociation of American Medical Colleges Learn Serve Lead:Proceedings of the 56th Annual Research in Medical Education Sessions):S1–6.
<https://doi.org/10.1097/ACM.0000000000001928>
PMid:29065016
 54. Phelan SM, Burke SE, Cunningham BA, et al. The effects of racism in medical education on students’ decisions to practice in underserved or minority communities. *Acad Med*. 2019 Aug;94(8):1178–89.
<https://doi.org/10.1097/ACM.0000000000002719>
PMid:30920443
 55. Autin F, Batruch A, Butera F. Social justice in education: how the function of selection in educational institutions predicts support for (non)egalitarian assessment practices. *Front Psychol*. 2015 Jun 4;6:707.
<https://doi.org/10.3389/fpsyg.2015.00707>
PMCID:PMC4454842
 56. Riese A, Rappaport L, Alverson B, et al. Clinical performance evaluations of third-year medical students and association with student and evaluator gender. *Acad Med*. 2017;92(6):835–40.
<https://doi.org/10.1097/ACM.0000000000001565>
PMid:28099178
 57. Dayal A, O’Connor DM, Qadri U, et al. Comparison of male vs female resident milestone evaluations by faculty during emergency medicine residency training. *JAMA Intern Med*. 2017 May 1;177(5):651–7.
<https://doi.org/10.1001/jamainternmed.2016.9616>
PMid:28264090 PMCID:PMC5818781
 58. Boatright D, Ross D, O’Connor P, et al. Racial disparities in medical student membership in the Alpha Omega Alpha honor society. *JAMA Intern Med*. 2017 May 1;177(5):659–65.
<https://doi.org/10.1001/jamainternmed.2016.9623>
PMid:28264091 PMCID:PMC5818775
 59. Fnais N, Sobiah C, Chen MH, et al. Harassment and discrimination in medical training: a systematic review and meta-analysis. *Acad Med*. 2014 May;89(5):817–27.
<https://doi.org/10.1097/ACM.0000000000000200>
PMid:24667512

60. Grbic D, Jones D, Case S. The role of socioeconomic status in medical school admissions: validation of a socioeconomic indicator for use in medical school admissions. *Acad Med.* 2015;90(7):953–60.
<https://doi.org/10.1097/ACM.0000000000000653>
PMid:25629949