Research Letter | Diversity, Equity, and Inclusion

Inequity in National Institutes of Health Predoctoral Fellowships, 2001-2020

Mytien Nguyen, MS; Nghia D. Nguyen, MS; Sarwat I. Chaudhry, MD; Mayur M. Desai, PhD, MPH; Jose E. Cavazos, MD, PhD; Dowin Boatright, MD, MBA, MHS

Introduction

Although a diverse biomedical workforce leads to more research innovation and productivity,1 Black, Hispanic, and American Indian or Alaska Native trainees made up only 7.7%, 7.8%, and 0.5% of all doctoral degree recipients in 2019, respectively.2 Recognizing the importance of predoctoral training in students’ eventual pursuit of an academic career, the National Institutes of Health (NIH) provides considerable support for predoctoral trainees3,4 in the form of T32 traineeship, research assistantships, and individual fellowship (eg, the Ruth L. Kirschstein Predoctoral Individual National Research Service Award [NRSA] F31). Unlike traineeships and research assistantships, fellowships are awarded to individual students, are assigned to study sections, and undergo the rigorous NIH peer review process. NIH fellowship recipients are more likely to receive future research funding and

Figure 1. Trends in Annual Count of Newly Awarded F31 General and F31 Diversity Fellowships

A. Count of newly awarded fellowships over time for general and diversity F31 awards with linear regression trends analysis. B. Count of newly awarded diversity F31 awards compared with total number of underrepresented by race and ethnicity (eg, Black, Hispanic, American Indian, Alaska Native) students. C. Percentage of newly awarded diversity F31 awards compared with proportion of underrepresented students.

Dotted lines indicate the simple linear regression best fit line for each award type, and P values indicate statistical significance of slopes from 0.

Author affiliations and article information are listed at the end of this article.

Open Access. This is an open access article distributed under the terms of the CC-BY License.

JAMA Network Open. 2022;5(10):e2238600. doi:10.1001/jamanetworkopen.2022.38600

October 26, 2022
faculty appointments compared with nonrecipients.\textsuperscript{5,6} The NRSA F31 fellowship is categorized into 2 awards: a general F31 mechanism for all students and a diversity F31 fellowship for students who identify as Black, Hispanic, or American Indian or Alaska Native, have a disability, or are from a socioeconomically disadvantaged background.\textsuperscript{3} However, little is known about temporal trends in funding for F31 general and diversity fellowships. To fill this knowledge gap, we examined trends in number of awards and funding of general and diversity F31 predoctoral fellowships over the past 20 years.

**Methods**

In this cross-sectional study, we examined award and funding rates for NIH predoctoral F31 NRSA fellowships. Grants data were retrieved from the NIH RePORTER Tool for fiscal years 2001 to 2020. Data on graduate student enrollment was retrieved from the NIH Databook. This study was deemed exempt and participant consent was waived by the Yale School of Medicine institutional review board. General and diversity F31 fellowships were determined based on their respective program announcement numbers. Total research dollars were inflation-adjusted to 2020 values. Descriptive statistics and simple linear regression were used to describe trends in total new awards and spending. \( F \) test was used to determine whether linear regression slope was significantly greater than 0, with 2-sided \( P < .05 \) indicating significance. This study followed the STROBE reporting guideline. All analyses were performed in GraphPad Prism v9.2 (Dotmatics).

**Figure 2. Annual NIH Spending on New General and Diversity F31 Fellowships**

A. Total spending (adjusted to 2020 dollars) of newly awarded general and diversity F31 fellowships over time with linear regression trends analysis; dotted lines indicate the simple linear regression best fit line for each award type, and \( P \) values indicate statistical significance of slopes from 0. B. Proportion of total NIH F31 fellowship budget spent on general and diversity F31 fellowships from 2001 to 2020.
Results

Between 2001 and 2020, while the mean (SD) growth rate for general F31 fellowships was 31.37 (95% CI, 27.62-35.12) new awards per year, the growth rate for diversity F31 fellowships was 89% lower at 3.45 (95% CI, 1.15-5.77) new awards per year (P < .001) (Figure 1A). Notably, the number of new diversity F31 awards has remained stagnant since 2010 compared with a diversifying graduate student population (Figure 1B). Between 2001 and 2020, while the proportion of underrepresented graduate students increased by 0.34% (95% CI, 0.26%-0.41%) per year, the proportion of diversity F31 relative to general F31 decreased by 2.09% (95% CI, −2.65% to −1.53%) per year (P < .001) (Figure 1C).

Total NIH spending on F31 fellowships has increased more than 5-fold over time, from $5.9 million in 2001 to $34.8 million in 2020. During this time, funding to general F31 fellowship increased significantly ($1.23 million [95%CI, $1.08-$1.38 million]) compared with the diversity F31 fellowship ($0.11 million [95% CI, $0.01-$0.20 million]) (P < .001) (Figure 2A). The proportion of NIH funding toward diversity F31 relative to general F31 has decreased from 55.0% to 21.8% (Figure 2B).

Discussion

In the last 2 decades, there has been a disproportionate growth of general NIH predoctoral F31 fellowships compared with diversity F31 fellowships despite an initial equal investment in general and diversity F31 fellowships, with a 90% greater increase for general F31 fellowship compared with diversity F31 fellowships. This widening gap may be reflective of a slower growth of applicants to diversity F31 fellowships, a decrease in award rate, or that underrepresented applicants are applying to the general rather than diversity F31 or are supported by other award mechanisms within or outside of the NIH. This study is limited by lack of data on numbers of applicants to F31 fellowships and personal information of applicants, which warrants future study.

Underrepresented biomedical science trainees face many challenges and barriers in their academic pursuits, including discrimination, racism, and lack of mentorship. Prestigious NIH fellowships, like the NRSA F31 fellowship, facilitate a path toward early career success for underrepresented trainees, increasing trainee's likelihood of PhD completion, postdoctoral funding, and application to major research grants. Our data suggests that early gaps in predoctoral fellowships to underrepresented biomedical scientists may contribute to future inequity in research funding and career advancement.
Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: M. Nguyen, N. Nguyen, Chaudhry, Cavazos, Boatright.

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: M. Nguyen, N. Nguyen, Chaudhry, Desai, Boatright.

Obtained funding: Boatright.

Administrative, technical, or material support: M. Nguyen, N. Nguyen, Cavazos, Boatright.

Supervision: Chaudhry, Desai, Boatright.

Conflict of Interest Disclosures: Dr Cavazos reported grants from UT Health San Antonio NIH T32GM113896 during the conduct of the study. No other disclosures were reported.

Funding/Support: Ms M. Nguyen is supported by NIH grants T32GM136651, RO1AG068863, and F30AI157227. Mr N. Nguyen is supported by the National Defense Science and Engineering Fellowship and Howard Hughes Medical Institute Gilliam Fellowship. Dr Boatright is supported by NIH grant R01GM137411.

Role of the Funder/Sponsor: The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Disclaimer: The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

REFERENCES

1. Hofstra B, Kulkarni VV, Munoz-Najar Galvez S, He B, Jurafsky D, McFarland DA. The diversity-innovation paradox in science. Proc Natl Acad Sci USA. 2020;117(17):9284-9291. doi:10.1073/pnas.1915378117

2. National Science Foundation. Women, Minorities, and Persons with Disabilities in Science and Engineering. Directorate for Social, Behavioral and Economic Sciences; 2021.

3. Valantine HA, Lund PK, Gammie AE. From the NIH: a systems approach to increasing the diversity of the biomedical research workforce. CBE Life Sci Educ. 2016;15(3):fe4. doi:10.1187/cbe.16-03-0138

4. Rubin R. Diversifying the NIH-funded workforce. JAMA. 2018;320(12):1230-1230. doi:10.1001/jama.2018.13868

5. Pickett CL. The increasing importance of fellowships and career development awards in the careers of early-stage biomedical academic researchers. PLoS One. 2019;14(10):e0223876. doi:10.1371/journal.pone.0223876

6. Pion G. The early career progress of NRSA predoctoral trainees and fellows. Published March 2001. Accessed September 22, 2022. https://grants.nih.gov/training/career_progress/Table_of_Contents.pdf