Title

Underrepresentation of Hispanic women in science, technology, engineering, mathematics, and medicine

Permalink

Authors

Gencel-Augusto, Jovanka

Minaya, Natasha J

Johnson, Daniel E

et al.

Publication Date

DOI

Peer reviewed

Underrepresentation of Hispanic women in science, technology, engineering, mathematics, and medicine

Jovanka Gencel-Augusto PhD[1,2] | Natasha J. Minaya MD[1,2] |
Daniel E. Johnson PhD[1,2] | Jennifer R. Grandis MD[1,2]

[1]Department of Otolaryngology-Head and Neck Surgery, University of California San Francisco (UCSF), San Francisco, California, USA

[2]UCSF Helen Diller Family Comprehensive Cancer Center, San Francisco, California, USA

Correspondence
Jennifer R. Grandis, Department of Otolaryngology-Head and Neck Surgery, University of California San Francisco, 1450 Third Street, San Francisco, CA 94143, USA.
Email: jennifer.grandis@ucsf.edu

Abstract

Despite ongoing efforts to increase the number of women in science, technology, engineering, and mathematics (STEM) and in medicine, Hispanic women remain severely underrepresented in these fields. This disparity not only hinders scientific innovation and the delivery of culturally competent medical care but also perpetuates a systemic exclusion. Research specifically addressing the challenges faced by Hispanic women, the extent of underrepresentation in these disciplines, and strategies to mitigate these issues is sparce. The authors conducted a systematic analysis of peer-reviewed articles to address this gap. The findings reveal a stark underrepresentation of Hispanic women across all examined fields, particularly compared with White women. In addition, the underrepresentation persists when compared with Hispanic men, although the disparity is less pronounced. The authors identify ongoing disparities in promotion, compensation, and retention rates for Hispanic women; present data for barriers to entry and retention; and highlight existing programs and strategies aimed at addressing this underrepresentation. Finally, a framework is presented for future studies and actionable initiatives, and the broader implications of these findings for the field of oncology are highlighted.

KEYWORDS
career development, diversity, equity, and inclusion (DEI), Hispanic women, medicine, science, technology, engineering, and mathematics (STEM), underrepresentation

INTRODUCTION

Hispanics comprise 19.5% of the US population, making Hispanic Americans the second largest ethnic group after White Americans, who account for 58.4% of the population.[1] Women comprise approximately one half of both Hispanic and White populations. In 2024, the US Census Bureau defines *Whites* as individuals with ancestry in Europe. Before March 2023, this classification also included individuals with ancestry from the Middle East and North Africa. The term *Hispanic* refers to individuals with a Spanish-speaking background tracing their ancestry to Spanish-speaking countries, such as Spain, Mexico, Cuba; countries in Central and South America; as well as US territories like Puerto Rico. The term *Latinx* and its variations (e.g., Latina, Latino) are sometimes used

interchangeably but specifically refer to people with origins in Latin America and the Caribbean.

Despite the growing and significant presence of Hispanics in the United States, they remain notably underrepresented in medicine and across the science, technology, engineering, and mathematics (STEM) professions.[2] This underrepresentation is even more pronounced among Hispanic women, who face intersectional disparities as both women and ethnic minorities in these fields. In 2021, women (all ethnicities) made up only 38% of physicians and surgeons, 16% of astronomers and physicists, 27% of conservation scientists and foresters, 15% of engineers and architects, and 19% of software developers, among other STEM and medicine subdisciplines. Meanwhile, Hispanics (all genders) represented just 7% of physicians and surgeons, 5% of astronomers and physicists, 4% of conservation scientists and foresters, 9% of engineers and architects, and 5% of software developers.[2] Consequently, the representation of Hispanic women in these fields is marginal, underscoring that, despite decades of efforts to increase diversity in STEM and medicine, Hispanic women continue to be significantly underserved.

Increasing the representation of Hispanic women in STEM and medicine is crucial for driving scientific innovation and addressing health care disparities. The unique perspectives brought by minority populations can lead to new approaches to scientific inquiry and breakthrough advances.[3] In addition, their inclusion helps mitigate biases that may emerge when researchers come from similar backgrounds.[4] For example, a recent study indicated that algorithmic prediction errors tend to be alike among software engineers from the same demographic groups, but performance improves when algorithms from different demographic groups are averaged.[5] In the medical field, a diverse medical workforce improves patient outcomes, communication, and engagement with underserved populations, ultimately contributing to more equitable health care.[6] Furthermore, the underrepresentation of Hispanic women influences the opportunities, experiences, and retention of others like them in these fields, perpetuating a cycle of exclusion.

There is a paucity of studies focusing on the careers of Hispanic women in STEM and medicine, particularly concerning their underrepresentation in various subfields, barriers to entry, attrition rates, the specific challenges they face within these workforces, and effective strategies to mitigate this problem. To address this gap, we conducted a systematic analysis of peer-reviewed literature. Our study focuses on several key questions: What is the representation of Hispanic women in various subdisciplines within these fields? How does this representation compare with that of White women and Hispanic men? What are the attrition rates for Hispanic women in these fields? Are Hispanic women being promoted at rates comparable to White women or Hispanic men? Is there a salary gap for Hispanic women in these professions? When do these disparities begin? What are the barriers to entry and retention, and what strategies might effectively address this underrepresentation?

METHODS

Search strategy

Several databases were searched for peer-reviewed articles published in English between January 2010 and May 2024, including PubMed (National Library of Medicine), Academic Search Complete on EBSCOhost (EBSCO Industries, Inc.), and JSTOR (Ithaka Harbors, Inc.). The search strategy focused on the following key terms: *Latina*, *Hispanic women*, *academia*, *STEM*, *scientist*, *physician*, *medicine*, and *career* (see Table 1). For PubMed and Academic Search Complete, these key terms were limited to the article's abstract;

TABLE 1 Terms used in the search strategy.

Database	Key terms
PubMed	• "LATINA" AND "ACADEMIA" • "LATINA" AND "STEM" • "LATINA" AND "MEDICINE" • "HISPANIC WOMEN" AND "ACADEMIA" • "HISPANIC WOMEN" AND "STEM" • "LATINA" AND "SCIENTIST" • "HISPANIC WOMEN" AND "SCIENTIST" • "HISPANIC WOMEN" AND "MEDICINE" AND "CAREER" • "LATINA" AND "PHYSICIAN" AND "CAREER" • "HISPANIC WOMEN" AND "PHYSICIAN" AND "CAREER"
JSTOR	• "LATINA" AND "ACADEMIA" AND "CAREER" • "LATINA" AND "STEM" AND "CAREER" • "LATINA" AND "MEDICINE" AND "CAREER" • "HISPANIC WOMEN" AND "ACADEMIA" AND "CAREER" • "LATINA" AND "PHYSICIAN" AND "CAREER" • "LATINA" AND "PHYSICIAN" • "LATINA" AND "SCIENTIST" AND "CAREER" • "HISPANIC WOMEN" AND "SCIENTIST" AND "CAREER" • "HISPANIC WOMEN" AND "STEM" AND "CAREER" • "HISPANIC WOMEN" AND "MEDICINE" AND "CAREER"
Academic Search Complete	• "LATINA" AND "ACADEMIA" • "LATINA" AND "STEM" • "LATINA" AND "MEDICINE" • "HISPANIC WOMEN" AND "ACADEMIA" • "LATINA" AND "PHYSICIAN" AND "CAREER" • "LATINA" AND "PHYSICIAN" • "LATINA" AND "SCIENTIST" • "HISPANIC WOMEN" AND "SCIENTIST" AND "CAREER" • "HISPANIC WOMEN" AND "STEM" • "HISPANIC WOMEN" AND "MEDICINE"

Abbreviation: STEM, science, technology, engineering, and mathematics.

whereas, for JSTOR, the search encompassed all fields. In addition, search filters were applied to restrict results to original research articles, except for PubMed, in which all search results were included (see Figure 1).

Eligibility criteria

Studies were included if they met the following criteria: (1) published in peer-reviewed journals; (2) original research articles; (3) published between January 2010 and May 2024; (4) written in English; and (4) focused on career-related topics concerning Hispanic women, Hispanic individuals, or women in STEM and medicine.

Study screening and selection

After searching the databases and removing duplicates, we independently screened the titles and abstracts of the retrieved articles for topic relevance, based on the eligibility criteria. We then assessed the full texts for inclusion in the study.

Data extraction, analysis, and synthesis

Relevant findings were extracted independently by two co-authors (J. G.-A. and N.J.M.). The figures were prepared using GraphPad Prism version 10.0 (GraphPad Software).

RESULTS

After de-duplication, the initial database searches identified 803 potentially relevant articles (Figure 1). After the exclusion of irrelevant abstracts (many of which focused on medical studies within Hispanic populations), 107 articles were read and evaluated. Ultimately, 47 articles met the eligibility criteria and were included in this analysis. These articles were categorized into subtopics, including: (1) disparities faced by Hispanic women in STEM and medicine, (2) barriers to entry and retention in STEM and medicine, and (3) strategies for enhancing representation and advancement of Hispanic women in STEM and medicine. For convenience, we have included a table with key terms and definitions (Table 2).

Disparities faced by Hispanic women in STEM and medicine

Hispanic women are underrepresented in STEM and medicine

Gender and ethnic disparities persist in STEM and medicine. In this section, we examine two key questions: what is the relative representation of Hispanic women compared with White women (same gender, different ethnicity), and what is the relative representation of Hispanic women compared with Hispanic men (same ethnicity, different gender) in these fields?
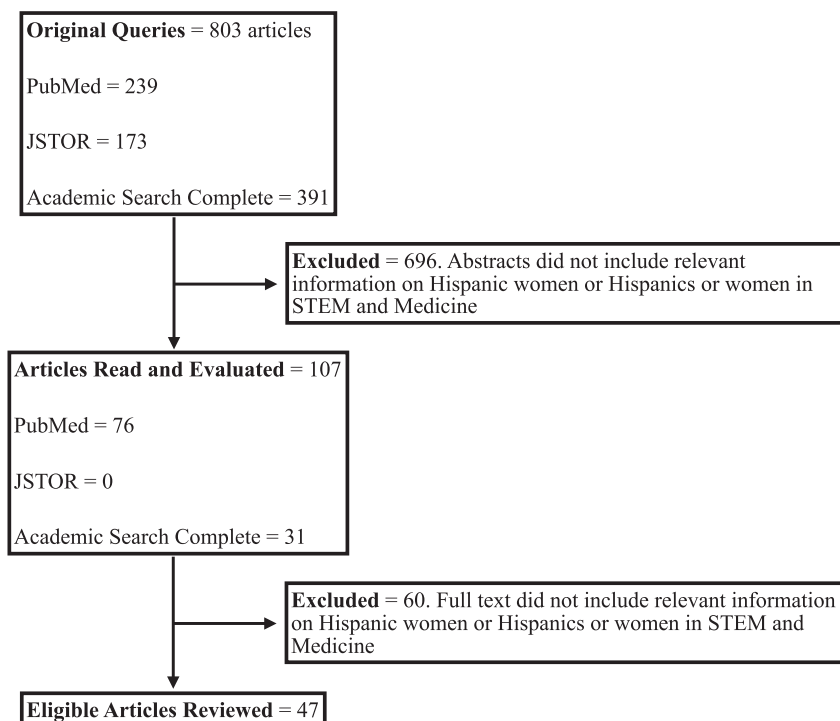
Original Queries = 803 articles

PubMed = 239

JSTOR = 173

Academic Search Complete = 391

Excluded = 696. Abstracts did not include relevant information on Hispanic women or Hispanics or women in STEM and Medicine

Articles Read and Evaluated = 107

PubMed = 76

JSTOR = 0

Academic Search Complete = 31

Excluded = 60. Full text did not include relevant information on Hispanic women or Hispanics or women in STEM and Medicine

Eligible Articles Reviewed = 47

FIGURE 1 Identification and selection of peer-reviewed articles. STEM indicates science, technology, engineering, and mathematics.

TABLE 2 Key terms and definitions.

Term	Definition
Ethnicity	Cultural origin of certain group
Hispanic	Spanish-speaking ethnic group
White	European, Middle Eastern, and North African descent group for studies using data collected before March 2023
Parity	Equality in status or opportunity
Attrition	Gradual reduction in numbers
Self-concept	Individual beliefs about one's abilities
Motivational beliefs	Convictions driving personal achievement efforts, such as interest, value, commitment, and belief in one's ability to succeed in a certain field
Diversity climate	Perceived inclusiveness within an environment
Odds ratio	Measures of association between variables
Science identity	Confidence, interest, and sense of belonging in the scientific community
STEM attitudes	Beliefs and perceptions toward STEM fields
Self-efficacy	Belief in one's own competence and ability to succeed
Women of color	Non-White women

Abbreviation: STEM, science, technology, engineering, and mathematics.

We retrieved demographic data from each article analyzed, focusing on the percentages of Hispanic, White, and women populations in specific STEM or medical subfields. Several articles provided numbers for each category intersecting ethnicity and gender; for those that did not, we estimated the percentages of Hispanic women, White women, and Hispanic men based on the provided demographic percentages. For example, if a study reported that 5% of the population was Hispanic (across all genders) and 30% was female (across all ethnicities), we estimated that the percentage of Hispanic women was 1.5% by multiplying these two percentages (see Table S1). The same logic was followed for estimated percentages of White women and Hispanic men.

We divided the data into five categories: (1) *Major groups* includes the US physician workforce, MD graduates, doctorate holders in science and engineering, full-time faculty of all ranks at degree-granting postsecondary institutions, and awardees of National Institutes of Health (NIH) career-development grants. (2) *By medical specialty* includes fellows, residents, and faculty across specific medical fields. (3) *Authorship* encompasses first and last authors of two major journals: *JAMA* (Journal of the American Medical Association) and *The New England Journal of Medicine* (*NEJM*), with 2023 impact factors of 63.1 and 96.2, respectively. (4) The *membership* category includes demographics for members of four medical associations. (5) The *others* category includes data for populations that did not fit into the former categories, such as neuroscience-specific statistics, two

undergraduate STEM majors, staff in academic medical centers, and students enrolled in STEM courses.

First, we compared the representation of Hispanic women versus White women. Because White women constitute three times the number of Hispanic women in the US general population, we also plotted this ratio as a baseline *parity* metric for reference (Hispanic women, 9.6%; White women, 29.4% of general US populations[1]). Ratios >3.0 indicate lower representation of Hispanic women compared with White women in a particular category. Strikingly, all fields for which data were available revealed a stark underrepresentation of Hispanic women relative to White women (Figure 2A–E). In the *major groups* category,[7–11] the lowest ratio of White women to Hispanic women was 8.9 among US physicians (data from 2014 to 2018), meaning that there were 8.9 White women physicians for every Hispanic woman physician. The highest ratio was 18.5 for R01 awardees (between 2004 and 2014) who graduated from medical school (Figure 2A). On average, the ratio of White women to Hispanic women across all major groups was 13.7.

The representation of Hispanic women in medical specialties[12–19] was much more variable but still revealed significant gaps. The lowest ratio was 4.75 for abdominal radiology fellows (data from 2010), and the highest was 39.0 for emergency medicine (EM) associate professors (data from 2019). On average, the ratio was 17.8 (Figure 2B). In terms of authorship,[20] the lowest ratio was 12.5 for first authors in *NEJM*, and the highest was 20.0 for last authors in *NEJM* (Figure 2C). The average ratio was 17.3. For medical association memberships,[21–23] the lowest ratio was 7.11 for members of the American Association of Physicists in Medicine, and the highest was 15.0 for members of the American Association of Directors of Psychiatric Residency Training (Figure 2D). The average ratio was 11.2. Finally, In the *others* category,[24–27] the lowest ratio was 4.69 for students enrolled in STEM courses in a Midwestern state university, and the highest was 15.21 for neuroscience graduates at the master's degree level (Figure 2E). The average ratio was 13.1. Overall, these data underscore a profound underrepresentation of Hispanic women in STEM and medical fields in the United States relative to White women.

Next, we examined the representation of Hispanic women compared with Hispanic men by using a general US population ratio of 1.0 as a parity metric.[1] Ratios >1.0 indicate lower representation of Hispanic women compared with Hispanic men relative to what is seen in the general US population, whereas ratios <1.0 indicate greater representation of Hispanic women. Notably, Hispanic individuals, regardless of gender, were significantly underrepresented compared with White individuals across all categories, with an approximate ratio of 19.1 between White and Hispanic individuals (relative to a general US population ratio of 3.0 White individuals per each Hispanic person; see Table S1). In the *major groups* category,[7–11] the lowest ratio of Hispanic men to Hispanic women was 0.84 among full-time assistant professors (all fields) in degree-granting, postsecondary institutions, indicating a greater representation of Hispanic women, and the highest ratio was 2.27 for R01 awardees between 2004 and 2014 with an MD degree (Figure 3A). On average,
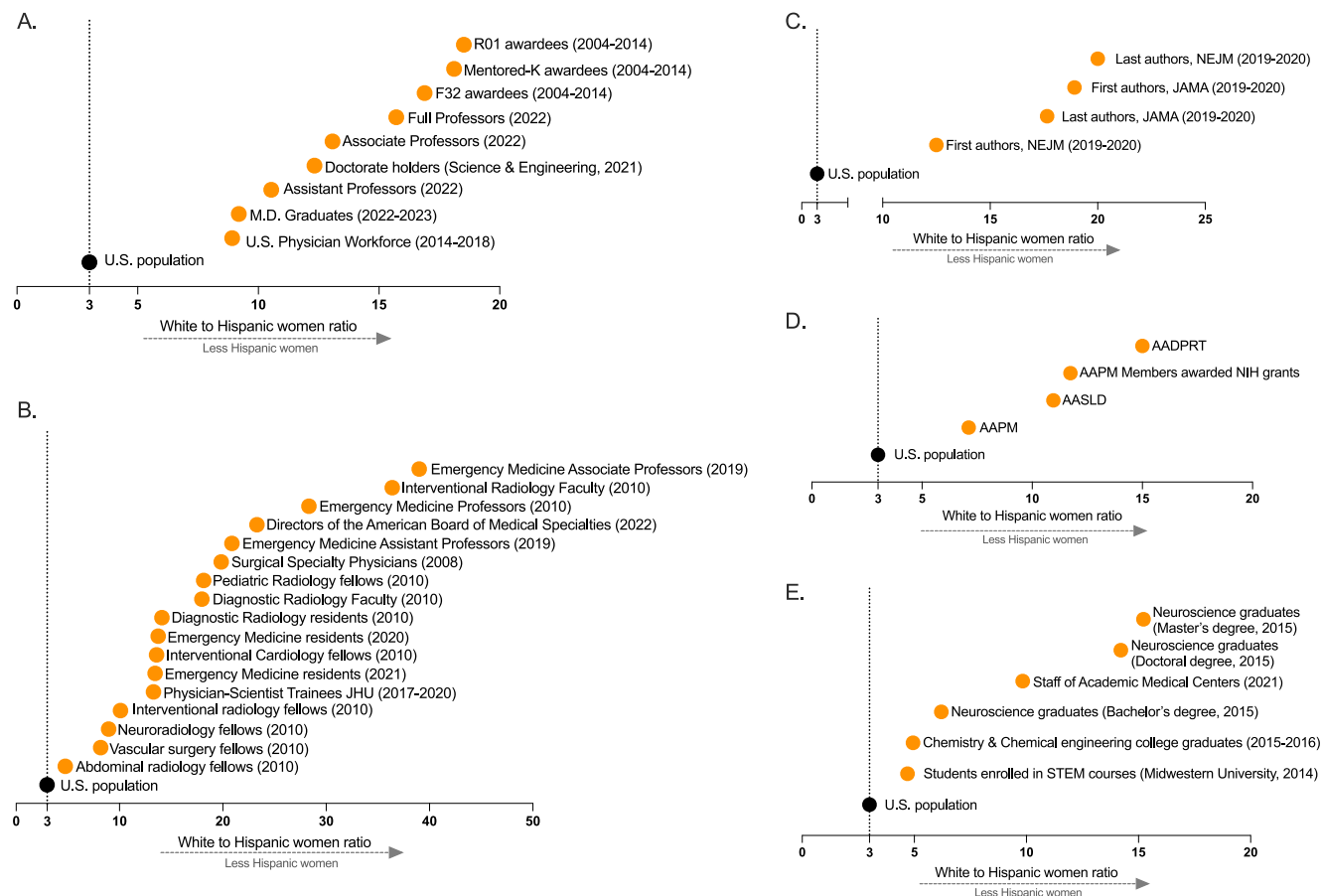
FIGURE 2 Underrepresentation of Hispanic women in STEM and medicine in the United States relative to White women. The x-axis illustrates the ratio of White women to Hispanic women in STEM and medical fields in the United States in five categories, derived from data in Table S1. The baseline ratio of White women to Hispanic women in the general US population is 3:1, based on current demographic statistics. The data highlight significant underrepresentation of Hispanic women in all fields analyzed relative to their population size (ratio >3.0). (A) Major groups. Assistant/associate/full professor ranks are for all disciplines in degree-granting postsecondary institutions. F32, mentored-K, and R01 awardee subgroups represent only awardees who graduated medical school between 1997 and 2004 (B) representation by medical specialty, (C) representation by authorship, (D) representation by professional society memberships, and (E) representation in other groups. AADPRT indicates American Association of Directors of Psychiatric Residency Training; AAPM, American Association of Physicists in Medicine; AASLD, American Association for the Study of Liver Diseases; JAMA, Journal of the American Medical Association; NEJM, *The New England Journal of Medicine*; STEM, science, technology, engineering, and mathematics.

the ratio of Hispanic men to Hispanic women across all major groups was 1.4.

Among medical specialties,[12–19] Hispanic women were underrepresented compared with Hispanic men. The lowest ratios were close to 1.0, meaning that these fields achieved parity, for physician-scientist trainees at John Hopkins University (2017–2020) and pediatric radiology fellows (2010). The highest ratio was 12.69 for interventional radiology faculty (2010). On average, the ratio was 4.0 (Figure 3B). In terms of authorship,[20] the lowest ratio was 1.38 for first authors in *JAMA*, and the highest was 5.66 for last authors in *NEJM* (Figure 3C). The average ratio was 3.0. For medical association memberships,[21–23] the lowest ratio was 0.53 for members of the American Association for the Study of Liver Diseases, and the highest was 9.6 for members of the American Association of Physicists in Medicine awarded NIH grants (Figure 3D). The average ratio was 3.5. Finally, in the *others* category,[24–27] the lowest ratio was 0.75 for

neuroscience graduates at the bachelor's degree level, and the highest was 1.8 for chemistry and chemical engineering graduates at the bachelor's degree level (Figure 3E). The average ratio was 1.4. Overall, these data reveal the underrepresentation of Hispanic women compared with Hispanic men, although the disparity between Hispanic women and men is less pronounced than the gap between Hispanic women and White women.

Hispanic women leave the STEM and medical workforce at higher rates and experience lower promotion rates

Lu et al.[28] investigated national attrition rates among EM residents from 2006 to 2016. Attrition rates were determined by calculating the percentage of residents who left their programs based on
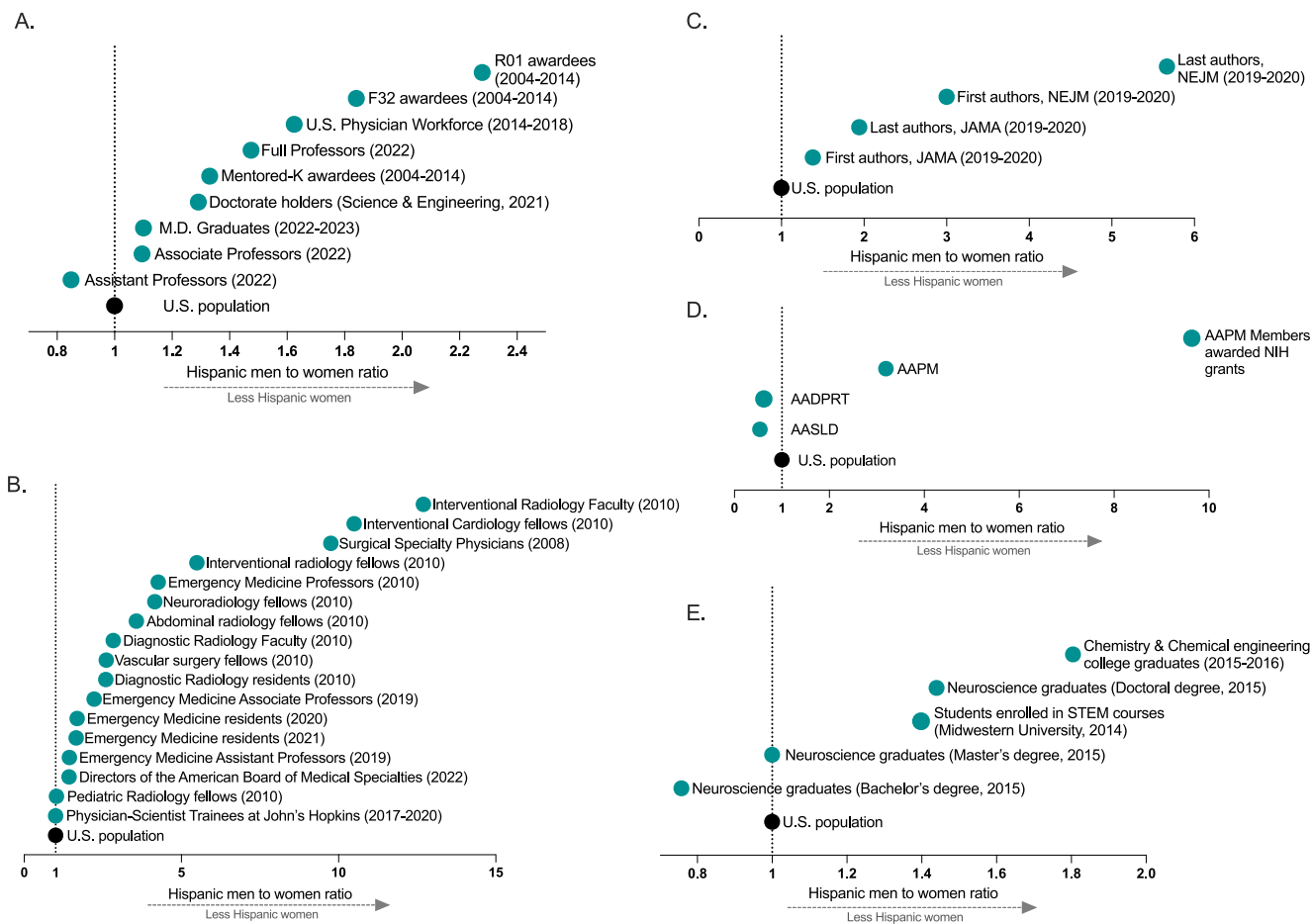
FIGURE 3 Underrepresentation of Hispanic women in STEM and medicine in the United States relative to Hispanic men. The x-axis illustrates the ratio of Hispanic men to Hispanic women in STEM and medical fields in the United States, derived from data in Table S1. The baseline ratio of Hispanic men to Hispanic women in the general US population is approximately 1, based on current demographic statistics. The data highlight underrepresentation of Hispanic women in several fields analyzed relative to their population size (ratio, >1.0). (A) Major groups. Assistant/associate/full professor ranks are for all disciplines in degree-granting postsecondary institutions. F32, mentored-K, and R01 awardee subgroups represent only awardees who graduated medical school between 1997 and 2004 (B) representation by medical specialty, (C) representation by authorship, (D) representation by professional society memberships, and (E) representation in other groups. AADPRT indicates American Association of Directors of Psychiatric Residency Training; AAPM, American Association of Physicists in Medicine; AASLD, American Association for the Study of Liver Diseases; *JAMA*, Journal of the American Medical Association; NEJM, *The New England Journal of Medicine*; STEM, science, technology, engineering, and mathematics.

aggregated national data. When comparing attrition rates across genders, female residents were more likely to leave (44.3% of women were part of the attrition population vs. 38.8% of women in the overall EM resident population) and more likely to report health or family causes as a reason for their attrition (21.5% for females vs. 9.6% for males). Furthermore, the study indicated that White residents had significantly lower attrition rates than Hispanic residents (0.9% vs. 1.8%, respectively) despite an overall attrition rate for EM residents that remained low (<2%).

In another study, Johnson et al.[29] analyzed the promotion and attrition rates in academic surgery, analyzing data from 31,045 faculty across 138 institutions between 2005 and 2020. Their findings revealed that Hispanic female faculty members were significantly less likely to be promoted within a 10-year period compared with their White male counterparts, with a hazard ratio of 0.68. This means that Hispanic women faced a 32% lower likelihood of promotion compared with White men. Notably, the promotion rates for Hispanic women were lower than those for White women (hazard ratio, 0.75) and Hispanic men (hazard ratio, 0.85), highlighting a pronounced disparity in career advancement for Hispanic female faculty.

Regarding attrition, the study indicated that Hispanic female faculty had a significantly higher likelihood of leaving their positions within 10 years, with a hazard ratio of 2.43 compared with White males. This indicates that Hispanic women were greater than twice as likely to leave their academic roles as their White male counterparts. Furthermore, this attrition rate was also higher than that observed for White women (hazard ratio, 1.53 compared with White men) and Hispanic men (hazard ratio, 1.98 compared with White men). These findings underscore the dual challenges faced by Hispanic women in academic surgery because they experience not only lower promotion rates but also higher attrition rates compared with White men, White women, and Hispanic men.

Hispanic women experience persistent disparities in faculty rank progression

Efforts to improve the promotion trajectory for women and minority faculty have been hindered by a lack of clear metrics and methods to track underrepresentation by rank. To address this, Fassiotto et al.[30] developed the Rank Equity Index (REI), which compares a group representation at higher academic ranks with their representation at lower ranks (percentage of faculty cohort at higher rank/percentage of faculty cohort at lower rank). An REI of 1.00 indicates parity, whereas values >1.00 or <1.00 reveal disparities in rank progression that may be hidden in aggregate faculty data.

Those authors applied the REI to self-reported demographic data from US medical school faculty collected by the Association of American Medical Colleges in 2017. The results indicated that women (all ethnicities) did not achieve parity in any pairwise rank comparison (professor/assistant, 0.53; professor/associate, 0.66; associate/assistant, 0.8), whereas men exceeded parity at all ranks (professor/assistant, 1.41; professor/associate, 1.2; associate/assistant, 1.17). In addition, REI analysis by ethnicity revealed that Hispanics (all genders) did not achieve parity at any comparison (professor/assistant, 0.72; professor/associate, 0.73; associate/assistant, 0.98), whereas Whites exceeded parity at all ranks (professor/assistant, 1.32; professor/associate, 1.16; associate/assistant, 1.13). Interestingly, among four large departments that were included for analysis (internal medicine, pediatrics, surgery, and basic sciences), basic sciences had the lowest REIs for Hispanic faculty (professor/assistant, 0.64; professor/associate, 0.67; associate/assistant, 0.96), whereas Whites exceeded parity again at all ranks in this department (professor/assistant, 1.43; professor/associate, 1.25; associate/assistant, 1.15). These findings highlight a greater disparity for Hispanic women because they face the combined challenges of both gender and ethnicity inequities across all academic ranks.

In another study, Hobgood and Fassiotto[17] used the REI to analyze the rank progression of EM faculty from 2015 to 2017 and into 2019, focusing on gender and ethnicity. The REI analysis by gender revealed that women faculty consistently did not achieve parity in any rank comparison across the study period. Specifically, the REIs for women for the years 2015, 2017, and 2019 were: professor/assistant, 0.46, 0.46, and 0.47; professor/associate, 0.71, 0.65, and 0.63; and associate/assistant, 0.66, 0.71, and 0.75, respectively.

When analyzed by ethnicity, the data indicated that Hispanic faculty reached and exceeded parity only in the professor/associate comparison, with REIs of 1.16 in 2017 and 1.21 in 2019. However, they continued to have REIs <1.00 in the other rank comparisons (professor/assistant, 0.83 and 0.88; associate/assistant, 0.72 and 0.73 in 2017 and 2019, respectively). In contrast, White faculty achieved and exceeded parity across all pairwise rank comparisons.

The study also provided data specifically for Hispanic women, revealing a significant disparity between Hispanic women and men. For Hispanic females, the REIs in 2017 and 2019 were as follows: professor/assistant, 0.57 and 0.44; professor/associate, 1.03 and 0.76; and associate/assistant, 0.58 and 0.58, respectively. In contrast, Hispanic males had much higher REIs in 2017 and 2019: professor/assistant,

1.08 and 1.19; professor/associate, 1.23 and 1.43; and associate/assistant, 0.87 and 0.84, respectively. In addition, the data indicated that White women also had higher REIs than Hispanic women in 2017 and 2019, with the following REIs: professor/assistant, 0.57 and 0.58; professor/associate, 0.73 and 0.7; and associate/assistant, 0.79 and 0.83, respectively. Importantly, Hispanic women experienced a downward REI trend between 2017 and 2019, whereas Hispanic men and White women experienced an upward trend in most comparisons.

These findings highlight the persistent disparities experienced by Hispanic women faculty in rank progression among several STEM and medicine subdisciplines.

Hispanic women experience persistent earning gaps

Tao[31] examined the gender earnings gaps among academic scientists and engineers by ethnicity from 2003 to 2013. Their findings revealed that Hispanic women earned less than White women, with earnings gaps ranging from 8% to 12%. In addition, Hispanic women earned less than Hispanic men, with gender earnings gaps ranging from 13% to 17%. To understand the current status, we extracted 2021 earnings data from the same source used by Tao (the National Center for Science and Engineering Statistics[32]). This revealed a sustained gap between both Hispanic women and White women and between Hispanic women and Hispanic men (Figure 4).[31,32]

Factors influencing entry and retention of Hispanic women in STEM and medicine

Factors influencing entry of Hispanic women in STEM and Medicine

In this section, we describe findings from studies analyzing factors that affect the entry and retention of Hispanic women in STEM and medicine across various training and career stages. When data for Hispanic
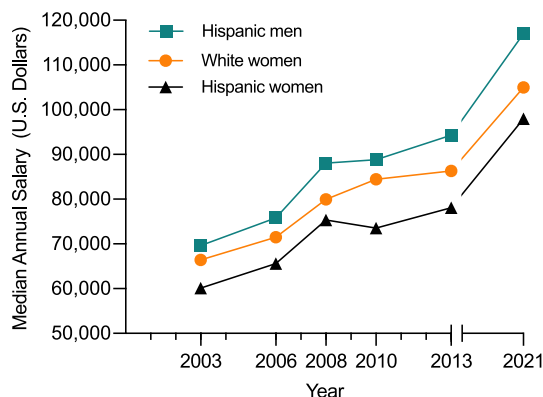

FIGURE 4 Persistent earnings gap for Hispanic women in academic science and engineering. The x-axis represents the years when data were collected, and the y-axis represents the median annual salary in US dollars. Data from 2003–2013 were adapted from Tao,[31] with 2021 data independently extracted from the National Center for Science and Engineering Statistics, 2021.[32]

women were not available, we used data for women in general and for Hispanic or minority individuals. The main findings are summarized in Table 3.

Self-perception of competencies

Correll has reported that children are more likely to pursue a subject they think they are good at.[44] Morales et al.[33] assessed third graders'

TABLE 3 Barriers to entry and retention of Hispanic women in science, technology, engineering, and mathematics and in medicine.

Barrier to	Barriers/influencing factors	Description	Reference(s)
Entry	Low self-perception of math and science competencies	Girls and Hispanic students show lower self-perceptions of their math and science competencies as early as third grade.	Morales 2023[33]
		Hispanic female adolescents exhibit a more negative math self-concept in 10th grade compared with male adolescents.	Seo 2019[34]
	Absence of parents with STEM degrees or occupations	The experience and knowledge parents gain through STEM degrees or occupations shape the support they provide to their children, influencing their STEM motivational beliefs. Hispanic parents without STEM degrees/occupations are twice as prevalent as those with STEM degree/occupations.	Hsieh & Simpkins 2022[35]
	Lack of supportive personal networks	Family members are the most frequently nominated influential relationship group for underrepresented females in their decision to pursue careers in STEM. Regardless of educational levels, relatives who encourage learning and reassure students' capabilities increase the likelihood that these students will pursue a STEM career.	Yap 2024[36]
		College faculty/staff and K–12 educators also have substantial influence in encouraging individuals to pursue careers in STEM.	Yap 2024[36]
		Parental support for STEM, even when parents do not have a STEM degree/occupation, is positively correlated with adolescents' STEM motivational beliefs	Hsieh & Simpkins 2022[35]
		Students with better support from parents, friends, and their neighborhood exhibit higher self-perceived math and science competencies regardless of ethnicity or sex.	Morales 2023[33]
	Lack of professional networks	Hispanic students show lower utilization of campus resources and reduced tendency to seek support from instructors and academic advisors.	Wang 2017[24]
		Faculty are less likely to respond to meeting requests from women and minority students compared with White males.	Milkman 2012[37]
	Mentoring gender discordance	Hispanic female undergraduate students show 70% lower productivity (measured by the presentation of research projects at professional conferences) when they have a male mentor compared with a female mentor.	Morales 2021[38]
Retention	Lower publication rates in medical school	Underrepresented females (including Hispanic and Black females) were the group with lowest publication rates despite a similar number of research experiences.	Nguyen 2022[39]
	Experiences of gender-based and ethnicity-based discrimination	54.4% and 71.8% of Hispanic women report discrimination from patients (and their families) and from others in the medical field, respectively.	Geiger 2024[40]
		Workplace gender discrimination was linked to racial discrimination, including belittlement by colleagues and mistreatment by patients.	Hennein 2023[27]

TABLE 3 (Continued)

Barrier to	Barriers/influencing factors	Description	Reference(s)
		Women and minority groups rated diversity climate more negatively than men or White counterparts. Women reported experiencing gender harassment.	Jagsi 2023[41]
		62.5% of Hispanic women physicians reported discrimination, including sex and maternity bias.	Feld 2023[22]
		27.9% of minority individuals reported unfair treatment and disrespect because of race/ethnicity compared with 2.6% of White physicians.	Pandharipande 2019[42]
	Higher rates of depression, anxiety, imposter syndrome, and burnout	Hispanic women experienced the following during medical training: depression, 76.2%; anxiety, 92.6%; imposter syndrome, 90.7%; and burnout, 87.4%.	Geiger 2024[40]
	Unequal pay or benefits	Minority individuals and women have lower self-perception of equal pay compared with White or male colleagues.	Hennein 2023,[27] Jagsi 2023[41]
		50% of Hispanic women reported unequal pay or benefits compared with 41% of White women.	Feld 2023[22]
	Lower consideration for promotion and access to career advancement	25% of Hispanic women reported unfair lack of consideration for promotion compared with 17.8% of White women.	Feld 2023[22]
		38.9% of women agreed with the statement that "leadership and career advancement opportunities are less accessible to female physicians" compared with only 8.3% of men. 31.8% of minority individuals also agreed with a statement that there is "less availability of leadership and career opportunities to minority physicians in your department of practice" compared with only 13.3% White individuals.	Pandharipande 2019[42]
	Impact of COVID-19	There is higher career regret among women and non-White ethnicities.	Akhavan 2024[14]
		Women and minority groups show higher consideration of leaving the workforce and reducing hours and greater worry about the impact on career development.	Delaney 2021[43]
	Discomfort in sharing personal identity, culture, and background	A lower percentage (63.6%) of minority individuals reported feeling comfortable sharing about their personal identity, culture, and background in their department/practice compared with 79.9% of White individuals.	Pandharipande 2019[42]
	Mentor gender and ethnicity discordance	71.9% of women and 40.9% of minority individuals value having a mentor of the same sex or ethnicity, respectively, compared with 34.3% of men and 18.5% of White individuals, respectively.	Pandharipande 2019[42]
	Verbal or emotional abuse	Women and minority individuals reported verbal or emotional abuse more frequently compared with men or White individuals.	Lall 2021[15]
	Higher prevalence of suicidal thoughts	Being part of a minority group increased the odds of experiencing suicidal thoughts (odds ratio [OR], 1.15) as did pregnancy or childcare responsibilities (OR, 1.1).	Lall 2021[15]
	Lower attainment of F32, K-mentored, and R01 awards	Estimated ORs for Hispanic women to obtain research awards are 0.56 for F32 awards, 0.67 for K awards, and 0.44 for R01 awards, unadjusted for Step 1 scores. Adjusted ORs for Hispanic women are 0.73 for F32 awards, 0.92 for K awards, and 0.53 for R01 awards.	Estimated using data from Jeffe & Andriole 2018[8]

Abbreviations: COVID-19, coronavirus disease 2019; K–12, kindergarten through 12th grade; STEM, science, technology, engineering, and mathematics.

self-perceptions of their math and science competencies while adjusting findings for their actual abilities through standardized math and science assessments (in 2014). The results indicated that girls (all ethnicities) and Hispanic students (all genders) had lower *self-perceptions* of their abilities in math and science, respectively, which could potentially limit the entry of these populations into STEM disciplines. Moreover, Seo et al.[34] used a nationally representative sample of 10th graders (in 2002) to investigate ethnic and gender differences in math-related ability beliefs and their long-term impact on STEM career attainment (longitudinally followed through 2012–2013). The findings indicated that Hispanic female adolescents had a more negative math *self-concept* (beliefs about their math abilities) compared with Hispanic male adolescents and that their high school math achievement did not predict STEM career expectancy (i.e., good grades did not translate into a likelihood of entering a STEM field).

Those studies highlight that early low self-perception of competencies may affect the entry of Hispanic women into STEM disciplines. Providing targeted support to these women, either by boosting their confidence early on or by implementing measures to counter doubts about their belonging and qualifications in STEM, could be crucial for increasing their representation in STEM and medicine.

Personal networks

Personal networks refer to the social interactions a person maintains over time. For children, these networks primarily include parents and close relatives, friends (such as neighbors or classmates), and teachers. These individuals play a crucial role in shaping students' self-perceptions and motivating their pursuit of careers in STEM fields.

Morales et al.[33] reported that students in the third grade who were satisfied with parental attention, friendships, and their neighborhood had higher self-perceived competencies in math and science regardless of ethnicity or sex. Moreover, Hsieh and Simpkins[35] examined whether the experience and knowledge parents gain through STEM degrees and occupations shape the STEM support they provide and, consequently, their adolescents' STEM *motivational beliefs* (interest, value, commitment, and belief in their own ability to succeed in STEM). Hispanic parents comprised 18% of the entire sample. Among parents who had STEM degrees or occupations, Hispanic parents represented only 10%, whereas they constituted 21% of parents without STEM degrees or occupations. The study indicated that parental STEM support and adolescent STEM motivational beliefs were lower among families in which parents did not have a STEM degree or occupation (as was the case for Hispanics) compared with families in which at least one parent had a STEM degree or occupation. Among Hispanic families without a parent who held a STEM degree or occupation, the parents' support for STEM was positively correlated with adolescents' STEM motivational beliefs. This suggests that, although Hispanic students are less likely to have a parent with a STEM background, the parents' attitudes toward STEM can significantly affect their children's motivational beliefs in STEM.

Yap et al.[36] analyzed how personal networks influenced students in 2-year colleges to pursue careers in STEM. The study involved 36 women of color, including 19 Hispanic women who were majoring in STEM at a 2-year, Hispanic-serving institution. Participants identified family members (44.4%), college faculty and staff (33.3%), and kindergarten through 12th grade (K–12) educators (25%) as the most influential relationship groups for their STEM trajectory. Notably, 16.7% of participants did not nominate any influential figures. Regardless of the educational levels of family members, having relatives who encouraged curiosity about learning and reassured students of their capabilities was crucial. In addition, exposure to relatives' medical issues and experiences with injustice acted as catalysts for pursuing a STEM career for some participants. These findings highlight the significant role personal networks play in influencing entry into STEM fields.

In conclusion, the support and influence of family, friends, and educators play a critical role in shaping the self-perceptions and motivational beliefs of Hispanic girls and women, significantly affecting their pursuit of careers in STEM and medicine.

Professional networks

Establishing professional networks is a critical component of success for STEM and medical trainees. These activities require proactive efforts from trainees and a willingness of potential mentors and sponsors to engage.

Wang et al.[24] investigated the intent of female students to transfer from 2-year colleges to STEM programs. Their study indicated that Hispanic women were more likely than their White peers to express an intent to transfer into STEM fields. However, Hispanic students reported lower engagement in transfer-oriented interactions, such as using campus resources or seeking information from instructors and academic advisors about transferring to a 4-year institution. However, the study did not analyze whether Hispanic women had a higher incidence of being single parents, first-generation college students, full-time or part-time workers, or were from low-income backgrounds—factors that could contribute to lower engagement because of additional family and personal responsibilities.

In another study, Milkman et al.[37] investigated race-based and gender-based bias in the decisions of university faculty members to offer students access to valuable opportunities. Those authors discovered reduced access for women and minorities (Hispanic individuals, Black individuals, and other groups) relative to White males. When students requested meetings a week in advance, White males were granted access to faculty 26% more often than women and minorities and received faster and more frequent responses. In a similar study, Milkman et al.[45] investigated potential discrimination against women and minority groups by examining the response rates of professors who were contacted by fictional prospective students interested in discussing research opportunities before applying to doctorate programs. The study involved 6500 professors (with oversampling of non-White professors totaling 2173, including 630 Hispanics) from 89 disciplines (including STEM and health disciplines) at 259 institutions. The prospective students' names were randomly assigned to signal gender and race, whereas the content of the message remained identical. The findings revealed that women and all minority groups had a lower response rate than White males in STEM and health disciplines. Importantly, in health sciences, Hispanic females received fewer responses than Hispanic males (with a logistic

regression B coefficient of responses of −0.346 for Hispanic women compared with White men and of 0.075 for Hispanic men compared with White men). Interestingly, the trend was reversed in the life sciences (B, −0.287 for Hispanic women and −0.686 for Hispanic men, all compared with White men) and in natural sciences, physical sciences, and math (B, 0.262 for Hispanic women and −0.262 for Hispanic men, all compared with White men), with Hispanic women receiving more responses than Hispanic men. However, the authors did not discuss whether this trend reversal could be attributed to the potential oversampling of minority faculty in these disciplines.

Collectively, these data suggest that Hispanic females lag in establishing professional networks, potentially because of extra personal responsibilities and a lack of interest from potential mentors in many disciplines.

Gender discordance in mentoring

Faculty mentorship is a key component of research experiences, and many students in STEM research training encounter demographically discordant mentoring relationships, in which mentors and students differ in gender or ethnicity. Morales et al.[38] examined the effect of mentoring discordance on undergraduate Hispanic students' intentions to pursue graduate school and their research productivity. The study indicated that Hispanic female students who had male mentors reported 17% higher levels of intention to pursue a STEM PhD program after their summer research experience compared with those who had female mentors. However, they were 70% less likely to present their research projects at professional conferences when they had a male mentor than when they had a female mentor. For Hispanic male students, the mentor gender and ethnic discordance had no effect on their research productivity (presentation of research at a conference). The authors suggest that higher PhD intentions with male mentors may be caused by the *privilege-crossover effect*, in which White or male mentors have more social capital and enable more networking opportunities. In contrast, underrepresented mentors may face greater challenges because of fewer resources[46] and higher service demands.[47] Lower rates of research presentations by Hispanic female students may also be influenced by public speaking anxiety and concerns about traveling with male mentors, making female mentors potentially better suited to support these female students. Further research is needed to understand these factors.

Factors influencing retention of Hispanic women in STEM and medicine

Work recognition: Publications and awards

Nguyen et al.[39] examined the association between sex and ethnicity and the publication rates of medical students. Their findings revealed that, despite having more research experience, women had significantly fewer publications than men. Furthermore, underrepresented women (including Hispanic and other minority groups) had the lowest publication rates among all groups, with an adjusted ratio of 0.8 compared with White men. In contrast, underrepresented men had a publication ratio of 0.95, and White women had a ratio of 0.9. These findings suggest that inequities begin early in training, and these factors can significantly influence future funding attainment, job offers, and promotion opportunities.

Jeffe and Andriole[8] investigated the prevalence and predictors of obtaining federal F32 postdoctoral research training awards, early career mentored-K (K01/K08/K23) awards, and independent-investigator R01 awards among US medical school graduates (who graduated between 1997 and 2004). Hispanic graduates were less likely to receive F32 awards (odds ratio [OR], 0.7), mentored-K awards (OR, 0.68), and R01 awards (OR, 0.76) compared with White graduates when the data were not adjusted for Step 1 test scores. Similarly, women were less likely to receive F32 (OR, 0.81) and R01 (0.59) awards compared with men. If an assumption is made that the effects of being a Hispanic and being a woman on receiving an award are independent, we estimated that the ORs for Hispanic women would be 0.56 for F32 awards, 0.67 for K awards, and 0.44 for R01 awards by combining Hispanic ORs and female ORs.

When the data were adjusted for Step 1 scores, disparities for Hispanics persisted but were lower (F32 [OR, 0.84], K awards [OR, 0.86], R01 [OR, 0.87]). However, attainment of awards by women was similar to unadjusted values (F32 [OR, 0.87], R01 [OR, 0.62]). Under these new metrics and continuing to use the assumption of independent effects of gender and ethnicity, the estimated ORs for Hispanic women are 0.73 for F32 awards, 0.92 for K awards, and 0.53 for R01 awards. Importantly, receiving an F32 award increased the likelihood of being awarded a K award by 9.5-fold, and receiving a K award increased the likelihood of obtaining an R01 award by 28-fold (all ethnicities grouped). These findings highlight the significant disparities faced by minority groups, including Hispanic women, in obtaining career-development funding that is crucial for their success and longevity in STEM fields and medicine.

Despite these general estimations, minority trainees at institutions that have implemented measures to enhance and support institutional diversity may achieve greater success in obtaining independent funding. Kalyani et al.[48] investigated differences in obtaining independent research funding (R01 and other R awards) among career-development (K) awardees in the Department of Medicine at Johns Hopkins University School of Medicine between 1998 and 2008. Their study found no significant sex differences in the attainment of R awards. Interestingly, being part of a minority group (combined Black and Hispanic individuals) increased the likelihood of receiving any R award by 2.3-fold. Notably, Johns Hopkins' Department of Medicine has launched several initiatives to address minority underrepresentation and promote diversity. The Task Force on Women's Academic Careers (established in 1990) tackles gender-specific barriers, whereas the Diversity Council (formed in 2002) runs programs like a minority student clerkship to enhance diversity. Both groups participate in annual reviews to improve diversity in leadership, highlighting the effectiveness of institutional investment in diversity efforts.

Together, the findings described above highlight inequalities in the two most important currencies in STEM and medicine: publications and grants. Lower success in either area can significantly

influence the placement and retention of Hispanic women in these fields.

Discrimination, harassment, and mental health challenges

Feeling valued in the workplace is a critical aspect of retention. To capture the experiences of Hispanic women in medicine during their medical training in the continental United States (48 contiguous states, excluding Alaska, Hawaii, and US territories), Geiger et al.[40] conducted an online survey in 2022 that was distributed through a social media platform. They collected responses from 230 self-identifying Hispanic women, predominantly medical students (46.9%). It is important to note that there was no control group in this study because all participants were Hispanic women. A significant portion (54.5%) reported negative ethnicity-based interactions from patients and/or their families, whereas 71.8% experienced such interactions from others within the medical field. High rates of depression (76.2%) and anxiety (92.6%) were reported, especially by medical students. Feelings of imposter syndrome and burnout were also prevalent, at 90.7% and 87.4%, respectively. Notably, 44.8% of the respondents were born outside the United States, and 29.3% received their medical school training abroad. Although not discussed by the authors, training outside the United States introduces additional potential challenges related to immigration, including paperwork and financial burdens, language barriers, and cultural adjustment.

Jagsi et al.[41] interrogated the experiences of faculty in academic medicine, providing comparisons across genders and ethnicities. Women rated the general climate more negatively than men, reported experiencing gender harassment more frequently, and rated the diversity climate (shared perceptions of diversity and inclusion within an organization) more negatively. Faculty members underrepresented in medicine rated the diversity climate significantly lower compared with White respondents. Both underrepresented faculty and women faculty reported lower perceptions of equitable salary, appropriate credit for comments in meetings, involvement in important decision making, and inclusion in informal social gatherings.

Feld et al.[22] reported a similar experience for minority women hepatology physicians. Those authors reported that Hispanic women more frequently reported workplace discrimination (62.5%) compared with White women (percentage not specified), including sex and maternity bias. Specific types of discrimination more frequently reported by Hispanic women included unequal pay or benefits (50.0% of Hispanic women vs. 41.1% of White women) and fewer opportunities for career advancement, including promotion and leadership roles (25.0% of Hispanic women vs. 17.8% of White women).

Pandharipande et al.[42] conducted a national survey of physicians in radiology and radiation oncology to identify potential barriers to building a diverse workforce. Gender-specific analysis revealed that women were less likely than men to feel respected by their patients and their families (52.3% of women vs. 65.2% of men). A higher proportion of women valued having a mentor of the same gender

(71.9% of women vs. 34.3% of men), and a higher proportion of minority individuals valued having a mentor of the same ethnicity (40.9% of minority individuals vs. 18.5% of White individuals). Furthermore, a higher proportion of women indicated that leadership and career advancement opportunities were less available to female physicians compared with responses from men (38.9% vs. 8.3%, respectively). Minority physicians also reported that leadership and career advancement opportunities were less accessible to them compared with the responses from White colleagues (31.8% vs. 13.3%). In addition, minority physicians felt less comfortable sharing information about their personal identity, culture, or background with colleagues, and they also reported higher levels of unfair treatment and disrespect because of race/ethnicity compared with White physicians (27.9% of minority physicians vs. 2.6% of White physicians).

Lall et al.[15] investigated perceived mistreatment among US EM residents as well as the relationship between mistreatment and suicidal ideation. Those authors reported that women and minority individuals were more likely to experience discrimination based on gender and race/ethnicity. Women were more likely to experience discrimination based on pregnancy or childcare status. Importantly, women and individuals from minority groups were less likely to have children than men or White individuals, respectively, suggesting a potential trade-off between career advancement and personal fulfillment that should be investigated further. Women and minority individuals also reported higher instances of verbal or emotional abuse than men and White counterparts, respectively. Being part of a minority group increased the odds of experiencing suicidal thoughts (OR, 1.15), as did pregnancy or childcare responsibilities (OR, 1.1).

In summary, Hispanic women experience significantly higher levels of discrimination from both patients and colleagues, a lack of belonging, fewer career advancement opportunities, and a higher incidence of mental health challenges. These factors can significantly influence their decision to leave STEM and medicine.

The coronavirus disease 2019 impact

Because coronavirus disease 2019 (COVID-19) influenced all fields of health care, its impact on trainees was particularly pronounced. Akhavan et al.[14] evaluated how the COVID-19 pandemic influenced EM residents' perceptions of regret regarding their career choice. They observed that career regret was more prevalent among women and non-White individuals compared with men and White individuals, respectively. Similarly, Hennein et al.[27] examined the experiences of medical workers in academic medical centers during the intense pressure on health systems brought on by the COVID-19 pandemic in 2021. Their findings indicated that a higher level of racial discrimination was linked to increased gender discrimination. In other words, experiencing racial discrimination heightened the likelihood of also encountering gender discrimination, a pattern that may disproportionately affect Hispanic women physicians. Their qualitative analysis demonstrated that workplace discrimination based on gender, which was connected to racial discrimination,

included being belittled by colleagues (such as assumptions about their profession and incorrect professional titles), having fewer opportunities for professional advancement, and being mistreated by patients.

Because of the COVID-19 pandemic, many workers at academic medical centers transitioned to remote work, balancing their job duties with childcare and assisting their children with schoolwork during workdays. Delaney et al.[43] examined effects of the COVID-19 pandemic on career development at the University of Utah Health, an academic health care system with multiple hospitals, community clinics, and specialty centers, during the pandemic. They reported that members of underrepresented groups, as well as women, reported more consideration of leaving the workforce and reducing work hours and higher worry about the impact of COVID-19 on their career development.

These reports highlight how unprecedented situations like the COVID-19 pandemic exacerbate existing inequities. We suggest that these effects are likely to persist, and the long-term consequences should be investigated and addressed to prevent a further decline in the representation of Hispanic women and other minority groups in STEM and medicine.

Strategies for enhancing representation and success of Hispanic women in STEM and medicine

In this section, we present findings from various studies that highlight strategies to support the entry and retention of Hispanic women in STEM and medicine across different training and career stages. We discuss the impact of extracurricular programs for middle schoolers, the qualities of mentors that best support the development of Hispanic women, and the effectiveness of peer-based coaching strategies. In addition, we examine the role of funding agencies in promoting diversity efforts for enrollment into graduate programs and career-development initiatives. We also discuss the importance of educating Hispanic women about stereotype threat and strategies to combat it. Although many of the studies we present are specifically focused on Hispanic women, we also include research that, although not exclusively centered on this population, provides valuable insights and tools that could significantly enhance the entry and retention of Hispanic women in STEM and medicine.

Extracurricular programs for middle schoolers

Hernandez-Matias et al.[49] conducted an evaluation of the Seeds of Success Girls in STEM Ambassadors Program during 2020–2021 (*Seeds of Success*). Facilitated by Ciencia Puerto Rico, a nonprofit organization, Seeds of Success is an out-of-school initiative based in Puerto Rico, where approximately 98% of the population identifies as Hispanic. This program aims to inspire middle-school girls (grades 7–

9) to consider STEM careers by building STEM-relevant skills (problem solving and critical thinking), providing exposure to role models, and developing leadership abilities. The program outcomes were measured through preprogram, midprogram, and postprogram surveys. In total, 241 girls participated in the program during 2020–2021. Postprogram results indicated a significant increase in participants' perceptions of their science identity, STEM attitudes, numerical skills, and perception of these skills. In addition, there was an increase in self-perception as leaders, higher confidence in their ability to succeed in science, greater knowledge about STEM careers and opportunities, and improved access to STEM role models. Also, surveys indicated an increase in participants' ability to recognize Puerto Rican and female STEM professionals. Overall, the survey scores were higher postprogram than preprogram, and 95% of participants expressed their intention to engage in future STEM activities.

Similarly, Broder et al.[50] assessed the outcomes of a 6-month after-school program (Science Club) for an underrepresented community of middle-school students at a K–8 public school in Colorado, where 89% are minority students (mostly Hispanic and Somali refugees). This program allowed students to conduct original scientific research, including formulating a research question, collecting data, and analyzing and interpreting results, which they then presented at an annual conference. The study indicated an increase in participants' interest in STEM careers and in self-efficacy (the belief in one's ability to succeed). Both self-efficacy and STEM career interest grew after students presented their research, emphasizing the significant yet underexplored role of dissemination in shaping K–8 students' self-efficacy.

Such extracurricular programs describe a promising intervention with the potential to enhance access to and participation in STEM for Hispanic girls.

Effective mentorship and coaching

Strong social relationships with faculty and fellow students are crucial for success in higher education and STEM fields. Undergraduate research programs provide opportunities to develop these valuable social connections with mentors and peers. Daniels et al.[51] conducted interviews with 17 undergraduate students (including 10 Hispanic females) from a Hispanic majority institution to explore their experiences in STEM-focused summer research programs. Their study examined how male and female students build social relationships with mentors and peers during these programs and how these interactions influence their experiences in STEM. Women valued mentoring that included elements of friendship and counseling (psychosocial mentoring) more than men. They also placed higher importance on same-gender mentoring and mentors who were available to answer questions. In terms of peer relationships, women preferred building supportive connections with a few similar peers. In contrast, men felt more comfortable with mentors who

provided limited guidance, favored informal interactions, and preferred having a broader peer network, potentially reflecting their alignment with the male-dominated culture of STEM.

Bechtel et al.[52] performed a qualitative study in 2022 exploring the mentorship experiences of female pediatric EM physicians to identify effective and ineffective mentorship aspects. The study included 22 participants (77% White, 23% Hispanics), primarily at the rank of assistant professor (45%). The researchers identified key personal and professional characteristics of effective mentors, summarized as the *four As*: altruistic, approachable, available, and advocating. Successful mentors prioritized the mentee's success above their own, were easily approachable for personal and professional discussions, and actively advocated for the mentee's career advancement through promotion or research opportunities. They provided personalized, actionable guidance and were honest, experienced, relatable, and understanding. In addition to identifying successful mentor characteristics, this study provides a valuable framework for effective mentorship, emphasizing the importance of: (1) recognizing the need for and benefits of mentorship, (2) establishing an effective processes for finding suitable mentors, and (3) training mentors to develop the key traits of good mentors.

In 2021, Kiser et al.[53] analyzed the impact of a peer-based coaching system for physicians at the instructor and assistant professor levels at the Massachusetts General Physicians Organization. Participants (approximately 80% female) were randomized into a control group (which received wellness resources) or an intervention group (which received six peer-coaching sessions) over 3 months. The results demonstrated that those in the peer-coaching group experienced reductions in burnout and interpersonal disengagement, along with improvements in professional fulfillment and work engagement. Although this study did not focus on Hispanics, it suggests that similar trials targeting Hispanic women, potentially with Hispanic women as coaches, could be beneficial. It is also important to note that the 3-month duration was relatively short, indicating the need for a longer term study. Notably, Cruz et al.[54] reported a year-long, peer-based initiative for first-year Hispanic college students in STEM careers, in which Hispanic peer coaches were employed. This longer term study demonstrated increased student persistence, fostered a robust social-support system, and enhanced students' sense of belonging, based on qualitative data.

Collectively, these studies highlight the importance of tailored mentorship and supportive social relationships in enhancing the experiences and success of Hispanic women in STEM and medicine.

Funding agencies and targeted programs

Funding agencies play a pivotal role in supporting diversity efforts in STEM and medicine. Ayedun et al.[55] assessed how administrators and faculty perceive the impact of NIH funding requirements on the diversity of matriculants for medical-scientist training programs (MSTPs). Their study indicated that changes to MSTP grant-review criteria, which linked funding to diversity, compelled MSTPs to implement initiatives aimed at increasing matriculant diversity. These initiatives included redefining programmatic priorities to improve diversity, allocating financial and human resources to bolster matriculant diversity (such as recruitment strategies, human capital, and program activities), using holistic review to enrich the applicant pool (allowing for balanced consideration of applicants' experiences and academic performance, characteristics that may contribute positively to their success as students and physician-scientists), and encouraging rigorous evaluation of the effectiveness of recruitment efforts. This study also highlights the need to educate medical and graduate school leadership on the importance of having a diverse student body. Some schools with low performance in diversity recruitment acknowledged the need to meet certain policies but did not fully understand the underlying importance. Overall, the NIH requirements established a mechanism of accountability for institutions to prioritize diversity efforts.

Tagge et al.[56] reported on the outcomes of the TRANSCENDS program (Training in Research for Academic Neurologists to Sustain Careers and Enhance the Numbers of Diverse Scholars). The objective of this career-development initiative, which was funded by the National Institute of Neurologic Disorders and Stroke and the American Academy of Neurology, was to support individuals who are underrepresented in neurologic research, including neurology fellows and junior faculty. Between 2016 and 2019, the program enrolled 23 scholars, with 21 persisting throughout and included in the study. Among them, eight were Hispanic females, representing 38% of the participants. Program activities included an online clinical research degree program, monthly webinars, American Academy of Neurology meeting activities, mentoring, and participation in publications and conferences. Participants had an average of nearly two publications per year with significant authorship contribution (such as first, second, or corresponding authorship). Qualitative assessments from mentee feedback highlighted the most valuable aspects of the program: professional skills development (such as article and grant writing), networking opportunities, and mentoring. Suggested improvements included adding a workshop for mentoring the mentors, offering more transitional support for mentees as they progress in their careers, and implementing a requirement for quarterly reports from mentees.

Hill et al.[57] developed the Women and Inclusion in Academic Medicine study to identify the individual, institutional, and sociocultural factors that influence the entry, progression, persistence, and advancement of women faculty, with a particular focus on women of color (women who belong to racial and ethnic groups that are non-White) in academic medical positions. The study sampled 13 academic medical institutions, collecting qualitative interview data from 21 junior faculty women of color and quantitative data from 3127 respondents through an online survey. Although the results of the study have not yet been reported, it is expected to serve as a framework for future research and provide a roadmap for

understanding and tackling the challenges faced by women of color in advancing their careers in academic medicine.

These studies collectively highlight the significant impact of funding agencies and targeted programs in advancing diversity in STEM and medicine. By linking funding to diversity goals, providing structured career-development initiatives, and understanding and addressing the unique challenges faced by underrepresented groups, these efforts contribute to creating a more supportive and equitable academic and professional environment.

Educating about and combating stereotype threat

Stereotype threat occurs when individuals fear that their actions will reinforce negative stereotypes about their ethnicity, leading to underperformance. Ben-Zeev et al.[58] examined the effects of a brief psychosocial intervention, called STEP, designed to protect the intellectual performance and safety of underrepresented minorities in STEM fields. The intervention included a tutorial on stereotype threat to depersonalize the experience. Such information helps promote an understanding that stereotype threat affects many individuals and places the anxiety within social systems rather than attributing it to personal deficiencies. An actionable component was also included in which participants discussed past experiences and strategies for future situations. Participants were then given an abstract reasoning test that was framed as a measure of intellectual abilities and was designed to mimic stereotype threat and induce anxiety about evaluation and underperformance. The intervention effectively protected participants' performance, improved class grades, and reduced concerns about confirming ethnic stereotypes, increasing resilience and narrowing the performance gap between underrepresented minorities and others in STEM. These findings indicate that addressing stereotype threat and providing targeted support can greatly enhance the experiences and outcomes of Hispanic women in STEM and medicine, empowering them to enter and persist in these fields.

Informed by the findings of this study, we have outlined a comprehensive training pipeline for Hispanic women, highlighting targeted interventions that are critical at specific career stages (Figure 5).

DISCUSSION

In this study, we aimed to elucidate the critical issue of underrepresentation of Hispanic women in STEM and medicine. In exploring the extent and nature of disparities, we highlight the systemic barriers that Hispanic women encounter in these fields and emphasize the importance of targeted strategies to improve diversity and inclusion.

Our analysis reveals a profound underrepresentation of Hispanic women in STEM and medicine, especially when compared with White women. This disparity exists at all levels of the career pipeline but is particularly pronounced in groups associated with higher career attainment. For instance, Hispanic women are significantly underrepresented among full professors compared with their representation in junior faculty positions. Similarly, this gap is evident when comparing graduate trainees with undergraduate trainees as well as comparing medical faculty with medical trainees.

In STEM and medicine, authorship on peer-reviewed articles is one of the prime currencies, reflecting achievement and influence within these fields and determining success in future career-advancement opportunities. We describe a significant disparity in Hispanic women's authorship in two leading journals: *NEJM* and *JAMA*. Alarmingly, Abdalla et al. estimated that it could take up to 1213 years for the proportion of Hispanic first authors (all genders) to match the proportion of Hispanic individuals in the general US population (using a current growth rate of Hispanic authorship of 0.01% per year)[20] if effective interventions are not implemented to address this disparity.

The underrepresentation in STEM and medicine extends even to *low-barrier* opportunities, such as professional society memberships. Unlike other categories, society membership typically requires only the payment of a fee, making financial resources, including access to institutional funds, a key factor. This financial barrier may contribute to the disproportionally higher representation of White individuals, who generally have greater financial power. Taken together, these data suggest an urgent need for effective and immediate strategies to reverse current trends.

Although Hispanic women are also underrepresented relative to Hispanic men, the disparity is less pronounced than that observed compared with White women. Our findings highlight that Hispanic individuals, irrespective of gender, are markedly underrepresented across STEM and medicine. These findings suggest that ethnicity plays a critical role in representation, with gender also contributing significantly, albeit to a lesser degree. However, when examining metrics such as promotion, attrition, and compensation, gender does have a major impact. We present evidence of higher attrition rates, lower promotion rates, and a persistent salary gap for Hispanic women compared with both White women and Hispanic men. In these areas, the gap between Hispanic women and Hispanic men is often larger than that between Hispanic women and White women, indicating that gender plays a critical role in these specific metrics, with ethnicity contributing, although to a lesser degree. One potential explanation for this disparity is the overlap of pregnancy and childcare responsibilities with key career-advancement periods,[59] a factor that warrants further investigation in the context of Hispanic women. The data presented in our study reveal the complex interplay between ethnicity and gender in the broader issue of underrepresentation, illustrating how Hispanic women are disproportionately disadvantaged.

A significant limitation we encountered in articles selected for inclusion in our analysis was their focus on reporting disparities without delving into the underlying causes. For instance, regarding the salary gap: are Hispanic women initially offered lower compensation than others? Are they less likely to negotiate or ask for higher salaries? What is the composition of the search committees that hire
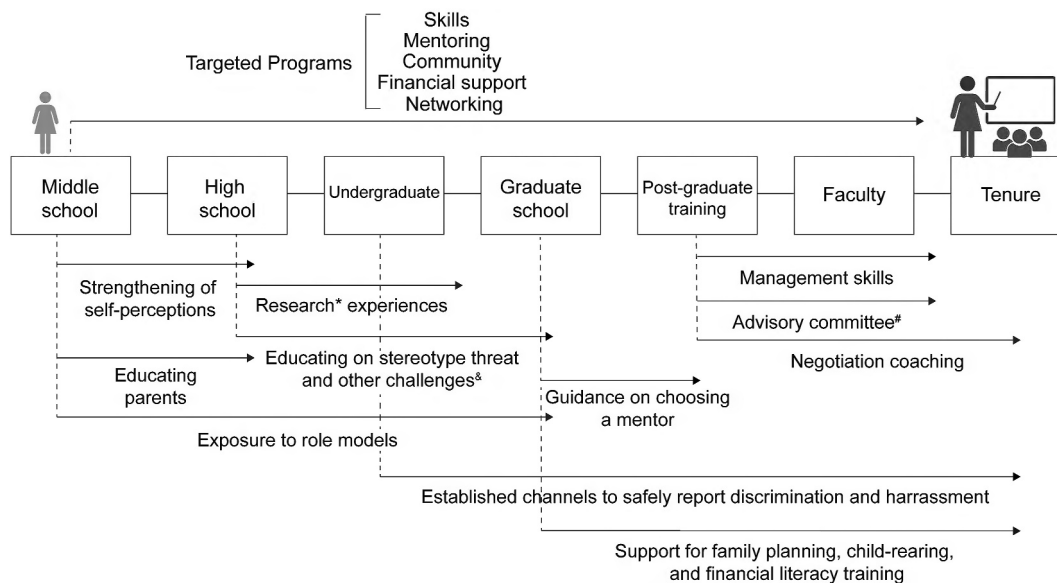
FIGURE 5 Training pipeline for Hispanic women in (academic) STEM and medical careers. This pipeline illustrates how targeted programs should support Hispanic women throughout their careers. Core objectives across all career stages include skill development, mentoring, community building, financial support, and networking opportunities. The lower section of the diagram highlights additional stage-specific interventions. For instance, in middle school, strengthening self-perceptions and educating parents on how to support their children's STEM and medical career aspirations is essential. At the postgraduate level, the focus shifts to negotiation strategies for tenure-track faculty positions and management skills. Some interventions, such as safe channels for reporting discrimination and harassment, are vital at every stage but become particularly critical during the highlighted phases. *Research experiences for science-based disciplines and other relevant experience, such as medical shadowing, for aspiring medical trainees. &Other challenges may involve educating Hispanic girls on how to recognize and report discrimination and harassment. #Advisory committees are especially important here because they provide guidance during these less structured career stages, unlike PhD programs in which such committees are a standard component. STEM indicates science, technology, engineering, and mathematics.

them? These questions remain largely unexplored, pointing to a need for more in-depth research to understand and address the root causes of these disparities.

One critical question in understanding and addressing the disparities Hispanic women face is identifying when they begin. We present important data suggesting that gender and ethnic minorities, such as Hispanic females, already experience biases regarding their abilities and sense of belonging as early as third grade (aged 8–9 years). Our analysis highlights that self-perceptions, personal networks, and professional networks play critical roles in promoting entry into these fields. All three pillars are essential for the successful integration of Hispanic women into these workforces and thus should be the primary focus of targeted programs. Programs like Seeds of Success[49] are particularly helpful in strengthening self-perceptions, developing skills, and building both personal (peer) and professional networks (mentors and other professionals) from childhood. These programs also play a crucial role in engaging one of the most important components of personal networks—parents. By educating and involving parents, these programs help them support their children's aspirations and pathways into STEM and medical careers.

Once entry into STEM and medicine is achieved, it is crucial to continue supporting Hispanic women as they progress in their careers. We discuss barriers to retention, which are closely tied to systemic issues within these professions and reflect deeply rooted societal beliefs. Despite their commitment and hard work, Hispanic women

continue to face significant challenges, including being less recognized in publications (fewer publications despite exposure to research experiences), receiving less funding, and experiencing more discrimination and harassment. Consequently, Hispanic women suffer from a disproportionately high incidence of mental health problems throughout their careers in STEM and medicine.[40,60] The articles we analyzed did not fully address the additional challenges that Hispanic women face because of their cultural background; these challenges are recognized and explained in great detail in a recent commentary by Werner Washburne et al.[61] Challenges associated with cultural background include financial difficulties, extra caregiving responsibilities, and struggles in building community (not being included, feeling isolated), among others. When these challenges are compounded by a hostile institutional system that fails to recognize the contributions of Hispanic women and discriminates against them, it can create an environment in which many ultimately are driven to exit the workforce.

Key components in addressing the underrepresentation of Hispanic women include (1) suitable mentoring, (2) developing targeted programs, and 3) educating about stereotype threat and other challenges faced by minority groups. Research on mentoring for Hispanic women suggests that they may benefit from co-mentoring arrangements. A gender-concordant and ethnic-concordant mentor can provide a supportive and safe environment for Hispanic women trainees, whereas a co-mentor who is not a gender or ethnic minority can help them leverage the *privilege-crossover effect* to access broader

networks and resources.[46] In addition, *mentoring-the-mentor* initiatives can focus on equipping mentors with essential mentorship qualities and teaching them how to adapt to the unique needs of each mentee. Peer-based coaching programs can also significantly enhance the experiences of Hispanic women in STEM and medicine, not only offering professional guidance but also fostering a sense of community with others from similar cultural backgrounds.

Funding agencies have a responsibility to continue enforcing diversity initiatives at institutions while also educating leaders on the critical importance of maintaining a diverse faculty and trainee body. Targeted programs provide essential training, mentoring, financial support, and opportunities to build community within peer cohorts. Although specific programs tailored for Hispanic women are still limited, several federally funded and privately supported initiatives are available from which Hispanic women can benefit. Notable examples include the NIH Maximizing Opportunities for Scientific and Academic Independent Careers K99/R00 program, the Howard Hughes Medical Institute Hanna H. Gray Fellows program, and the President's Postdoctoral Fellowship Program at the University of California and partner universities, among others, which support postdoctoral trainees from underrepresented groups in their transition to independent careers in biomedicine and other STEM fields. In addition, the Society for Advancement of Chicanos/Hispanics & Native Americans in Science is a valuable resource dedicated to fostering the success of trainees from these groups at all career stages through mentorship, networking, and professional development. Other important programs come from subfield-specific societies, such as the American Cancer Society, the American Association for Cancer Research, and others.

Educating Hispanic women and others at institutions about stereotype threat is fundamental and should begin early, ideally in high school or college, to equip Hispanic women with the tools to depersonalize and effectively combat this phenomenon. Simultaneously, mentors and supervisors should be trained to recognize and mitigate stereotype threat, for example, by providing constructive feedback that emphasizes the trainee's potential and growth rather than solely evaluating their current abilities.[62] The article by Werner Washburne et al.[61] thoroughly examines the obstacles faced by Hispanic women in STEM, particularly at the faculty level, and proposes solutions at the individual, departmental, and institutional levels. Publications like this underscore the urgent need and growing interest within the scientific and medical communities to address the severe underrepresentation of Hispanic women.

Finally, there is a pressing need for systems of accountability as well as safe and confidential mechanisms for reporting of injustices. In this review, we have highlighted the discrimination and harassment that Hispanic women experience from peers, superiors, and patients (for those in medical positions). To address injustices from superiors, it is crucial to implement more robust systems for maintaining comprehensive training records for each mentor or supervisor. For instance, in many research-based disciplines, trainees are often part of groups led by a single individual. This makes it essential to monitor, evaluate, and report mentorship quality, ensuring that mentors are held accountable for their conduct. In addition, implementing a system

in which trainees can access information about mentorship quality within different groups will provide future trainees with insights into the training environment, helping them make informed decisions when selecting a mentor. Similarly, peers who engage in discrimination or hostile behavior should be safely reported through confidential channels, and those found responsible should be required to undergo educational training before returning to work. This process ensures that they understand the impact of their actions and are less likely to repeat such behavior. Although addressing patient behavior is more complex, those who discriminate against or mistreat their physicians should be held accountable through formal warnings and, if necessary, restrictions on their interactions with health care staff. Because patient relationships can span several years, any instance of such behavior should prompt superiors to assign a suitable physician partner to attend all future visits, ensuring a supportive and monitored environment for the affected physician.

Taking into consideration our findings and suggested interventions, we provide a detailed training pipeline that introduces targeted programs at specific career stages (Figure 5), such as early self-confidence development and parental education, as well as later stage support, including tenure negotiation and leadership training. The pipeline also emphasizes the importance of consistent, stage-agnostic resources, such as skill development, financial support and safe reporting channels, which are crucial for entry, career progression, and long-term retention.

Study limitations

A relatively small number of publications, only eight of the 47 that met our inclusion criteria, explicitly focused on the careers of Hispanic women in STEM and medicine. Although these studies provide valuable insights, many suffer from technical limitations, such as small sample sizes or the absence of appropriate control groups.

Most of the remaining articles included in our analysis provided an overview of ethnic diversity within specific subfields. However, these studies often lacked detailed reporting on gender representation within each ethnicity. Consequently, for many groups, we were only able to estimate the percentage of Hispanic women by extrapolating from the provided data on female and Hispanic representation. In addition, the narrow focus of many articles on specific subfields limited the use of statistical measures, such as confidence intervals and significance testing.

Although a few studies reported intersectional data on gender and ethnicity, their small sample sizes often made it difficult to address specific research questions at the intersection of gender and ethnicity. Consequently, many studies focused on either gender or ethnicity separately, rather than exploring their combined effects.

As with any systematic review, there is a risk of bias, including potential article attrition and subjective interpretation of the findings reported in each study. Furthermore, the heterogeneity of study designs and the variability in metrics used to assess representation pose additional challenges, limiting the ability to directly compare

results across studies. This variation in methodologies can affect the consistency and reliability of conclusions, underscoring the need for standardized approaches in future research.

Longitudinal studies are needed to thoroughly assess the factors that influence the entry and retention of Hispanic women in STEM and medicine and tie factors to outcomes. The majority of the articles we reviewed considered only a single career stage, which, although informative, failed to provide a comprehensive understanding of the broader context of the career trajectories of Hispanic women to capture nuanced and evolving experiences.

These limitations underscore the critical need for larger, more comprehensive studies with sufficient sample sizes to provide the statistical power required to examine the intersection of gender and ethnicity across various aspects and career stages of STEM and medicine. Future research should be designed to address these gaps.

Importance of findings for oncologists and cancer researchers

Hispanic oncologists make up only 4.7% of all US oncologists (2018),[63] and <4% of participants in cancer clinical trials are Hispanic,[64] although Hispanics represent 19.5% of the US population. This underrepresentation of Hispanic professionals in both clinical oncology and clinical cancer research perpetuates disparities in cancer care for Hispanic patients. Similarly, Hispanic researches represented only 5% of R01 applicants and awardees from the National Cancer Institute in 2020.[65] This lack of representation is especially concerning for cancers like cervical or liver cancers, which disproportionately affect Hispanic people. Hispanic women are 40% more likely to be diagnosed with cervical cancer than White women, and both Hispanic males and females are approximately twice more likely to be diagnosed with and to die from liver cancer compared with White individuals.[66] This underrepresentation of Hispanic cancer researchers limits the study of cancers that disproportionately burden Hispanic communities.

Individuals with personal or cultural ties to ethnic communities are more likely to prioritize research that addresses population-specific challenges, such as improving clinical trial recruitment and tailoring health care delivery. The inclusion of more Hispanic women in these fields is essential not only to deliver culturally appropriate care but also to steer research and clinical decisions that better meet the unique needs of Hispanic patients. Ultimately, increasing Hispanic female representation in oncology and cancer research is a critical step toward reducing disparities in cancer outcomes for this underserved population.

CONCLUSION

There is growing recognition of the need for a diverse workforce, yet the underrepresentation of Hispanic women in STEM and medicine remains a significant challenge. This disparity calls for urgent and sustained institutional efforts, as we have outlined. The success of Hispanic women in STEM and medicine is necessary for the advancement of these fields and society at large.

ORCID
Jovanka Gencel-Augusto https://orcid.org/0000-0003-1333-415X
Jennifer R. Grandis https://orcid.org/0000-0002-1013-8965

REFERENCES

1. United States Census Bureau. *Annual Estimates of the Resident Population by Sex, Race, and Hispanic Origin for the United States: April 1, 2020 to July 1, 2023 [table]*. United States Census Bureau; 2023. Accessed June, 2024. https://www.census.gov/data/tables/time-series/demo/popest/2020s-national-detail.html

2. Pew Research Center. Appendix A: Detailed charts and tables. 2021. Accessed June, 2024. https://www.pewresearch.org/science/2020/09/29/appendix-a-detailed-charts-and-tables/

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

4. Gomez LE, Bernet P. Diversity improves performance and outcomes. *J Natl Med Assoc*. 2019;111(4):383-392. doi:10.1016/j.jnma.2019.01.006

5. Cowgill B, Dell'Acqua F, Deng S, et al. Biased programmers? Or biased data? A field experiment in operationalizing AI ethics. In: Association for Computing Machinery, ed. *Proceedings of the 21st Association for Computing Machinery Conference on Economics and Computation*. 2020:679-681. doi:10.2139/ssrn.3615404

6. Marrast LM, Zallman L, Woolhandler S, Bor DH, McCormick D. Minority physicians' role in the care of underserved patients: diversifying the physician workforce may be key in addressing health disparities. 2014;174(2):289-291. doi:10.1001/jamainternmed.2013.12756

7. Balderas-Medina Anaya Y, Hsu P, Martinez LE, Hernandez S, Hayes-Bautista DE. Latina women in the U.S. physician workforce: opportunities in the pursuit of health equity; *Acad Med*. 2022;97(3):398-404. doi:10.1097/ACM.0000000000004412

8. Jeffe DB, Andriole DA. Prevalence and predictors of US medical graduates' federal F32, mentored-K, and R01 awards: a national cohort study. *J Investig Med*. 2018;66(2):340-350. doi:10.1136/jim-2017-000515

9. National Center for Education Statistics. *Table 315.20. Full-time faculty in degree-granting postsecondary institutions, by race/ethnicity, sex, and academic rank: Fall 2020, fall 2021, and fall 2022*. US Department for Education, National Center for Education Statistics; 2023. Accessed June, 2024. https://nces.ed.gov/programs/digest/d23/tables/dt23_315.20.asp

10. National Center for Science and Engineering Statistics (NCSES). *Survey of Doctorate Recipients (SDR)*. National Science Foundation,

NCSES; 2021. Accessed June, 2024. https://ncses.nsf.gov/surveys/doctorate-recipients/2021

11. Association of American Medical Colleges (AAMC). *2023 FACTS: Enrollment, Graduates, and MD-PhD Data*. AAMC; 2023. Accessed June, 2024. https://www.aamc.org/data-reports/students-residents/data/2023-facts-enrollment-graduates-and-md-phd-data

12. Higgins MCSS, Hwang WT, Richard C, et al. Underrepresentation of women and minorities in the United States IR academic physician workforce. *J Vasc Interv Radiol*. 2016;27(12):1837-1844.e2. doi:10.1016/j.jvir.2016.06.011

13. Rincon-Torroella J, Feghali J, Antar A, et al. The Johns Hopkins Physician-Scientist Training Program to enhance institutional retention and entry into academic positions: an evaluation of program effectiveness and outcomes. *Acad Med*. Published online April 29, 2024. doi:10.1097/ACM.0000000000005748

14. Akhavan AR, Zhan T, Lall MD, et al. Suicidal ideation, perception of personal safety, and career regret among emergency medicine residents during the COVID-19 pandemic. *AEM Educ Train*. 2024;8(2):e10955. doi:10.1002/aet2.10955

15. Lall MD, Bilimoria KY, Lu DW, et al. Prevalence of discrimination, abuse, and harassment in emergency medicine residency training in the US. *JAMA Netw Open*. 2021;4(8):e2121706. doi:10.1001/jamanetworkopen.2021.21706

16. Deshpande SP, Deshpande SS. Career satisfaction of surgical specialties. *Ann Surg*. 2011;253(5):1011-1016. doi:10.1097/SLA.0b013e3182153a35

17. Hobgood C, Fassiotto M. Using the Rank Equity Index to measure emergency medicine faculty rank progression. *Acad Emerg Med*. 2021;28(9):966-973. doi:10.1111/acem.14268

18. Venkatesh S, Bravo M, Schaaf T, Koller M, Sundeen K, Samadani U. Consequences of inequity in the neurosurgical workforce: lessons from traumatic brain injury. *Front Surg*. 2022;9:962867. doi:10.3389/fsurg.2022.962867

19. Jacobs JW, Fleming TK, Jagsi R, et al. Analysis of race and ethnicity among United States medical board leadership. *J Womens Health (Larchmt)*. 2023;32(9):921-926. doi:10.1089/jwh.2023.0088

20. Abdalla M, Abdalla M, Abdalla S, Saad M, Jones DS, Podolsky SH. The under-representation and stagnation of female, Black, and Hispanic authorship in the Journal of the American Medical Association and the New England Journal of Medicine. *J Racial Ethn Health Disparities*. 2023;10(2):920-929. doi:10.1007/s40615-022-01280-z

21. Rankin J, Whelan B, Pollard-Larkin J, et al. Diversity and professional advancement in medical physics. *Adv Radiat Oncol*. 2023;8(1):101057. doi:10.1016/j.adro.2022.101057

22. Feld LD, Sarkar M, Au JS, et al. Parental leave, childcare policies, and workplace bias for hepatology professionals: a national survey. *Hepatol Commun*. 2023;7(9):e0214. doi:10.1097/HC9.0000000000000214

23. Lee PC, Flores JM, Adams A, et al. Who we are today: a national survey of diversity among psychiatry program directors. *Acad Psychiatry*. 2021;45(91):43-48. doi:10.1007/s40596-021-01398-y

24. Wang X, Chan HY, Soffa SJ, Nachman BR. A nuanced look at women in STEM fields at two-year colleges *factors that shape female students' transfer intent*. 2017;8:146. doi:10.3389/fpsyg.2017.00146

25. Glass J, Takasaki K, Sassler S, Parker E. Finding a job: an intersectional analysis of search strategies and outcomes among U.S. *STEM graduates*. 2023;83:100758. doi:10.1016/j.rssm.2023.100758

26. Ramos RL, Alvina K, Martinez LR. Diversity of graduates from bachelor's, master's and doctoral degree neuroscience programs in the United States. *J Undergrad Neurosci Educ*. 2017;16(1):A6-A13.

27. Hennein R, Gorman H, Chung V, Lowe SR. Gender discrimination among women healthcare workers during the COVID-19 pandemic.

Findings from a mixed methods study. 2023;18(2):e0281367. doi:10.1371/journal.pone.0281367

28. Lu DW, Hartman ND, Druck J, Mitzman J, Strout TD. Why residents quit: national rates of and reasons for attrition among emergency medicine physicians in training. *West J Emerg Med*. 2019;20(2):351-356. doi:10.5811/westjem.2018.11.40449

29. Johnson J, Mesiti A, Brouwer J, Shui AM, Sosa JA, Yeo HL. Surgeon intersectionality and academic promotion and retention in the US. *JAMA Surg*. 2024;159(4):383-388. doi:10.1001/jamasurg.2023.7866

30. Fassiotto M, Flores B, Victor R, et al. Rank Equity Index: measuring parity in the advancement of underrepresented populations in academic medicine. *Acad Med*. 2020;95(12):1844-1852. doi:10.1097/ACM.0000000000003720

31. Tao Y. Earnings of academic scientists and engineers: intersectionality of gender and race/ethnicity effects. *Am Behav Scientist*. 2018;62(5):625-644. doi:10.1177/0002764218768870

32. National Center for Science and Engineering Statistics (NCSES). *TABLE 50. Median annual salaries of U.S. residing full-time employed doctoral scientists and engineers, by field of doctorate, ethnicity, race, and sex: 2021*. National Science Foundation, NCSES; 2021. Accessed June, 2024. https://ncses.nsf.gov/surveys/doctorate-recipients/2021#tableCtr8235

33. Morales DX, Grineski SE, Collins TW. Racial/ethnic and gender inequalities in third grade children's self-perceived STEM competencies. *Educ Stud*. 2023;49(2):402-417. doi:10.1080/03055698.2020.1871324

34. Seo E, Shen Y, Alfaro EC. Adolescents' beliefs about math ability and their relations to STEM career attainment: joint consideration of race/ethnicity and gender. *J Youth Adolesc*. 2019;48(2):306-325. doi:10.1007/s10964-018-0911-9

35. Hsieh TY, Simpkins SD. Longitudinal associations between parent degree/occupation, parent support, and adolescent motivational beliefs in STEM. *J Adolesc*. 2022;94(5):728-747. doi:10.1002/jad.12059

36. Yap MJ, Foriest J, Walker K, Sanford S, Rice A. Family helps transform the STEM pathways of community college women of color STEM majors. *CBE Life Sci Educ*. 2024;23(1):ar10. doi:10.1187/cbe.21-09-0273

37. Milkman KL, Akinola M, Chugh D. Temporal distance and discrimination: an audit study in academia. *Psychol Sci*. 2012;23(7):710-717. doi:10.1177/0956797611434539

38. Morales DX, Grineski SE, Collins TW. Effects of mentor-mentee discordance on Latinx undergraduates' intent to pursue graduate school and research productivity. *Ann N Y Acad Sci*. 2021;1499(1):54-69. doi:10.1111/nyas.14602

39. Nguyen M, Chaudhry SI, Asabor E, et al. Variation in research experiences and publications during medical school by sex and race and ethnicity. *JAMA Netw Open*. 2022;5(10):e2238520. doi:10.1001/jamanetworkopen.2022.38520

40. Geiger G, Kiel L, Horiguchi M, et al. Latinas in medicine: evaluating and understanding the experience of Latinas in medical education: a cross sectional survey. *BMC Med Educ*. 2024;24(1):4. doi:10.1186/s12909-023-04982-y

41. Jagsi R, Griffith K, Krenz C, et al. Workplace harassment, cyber incivility, and climate in academic medicine. *JAMA*. 2023;329(21):1848. doi:10.1001/jama.2023.7232

42. Pandharipande PV, Mercaldo ND, Lietz AP, et al. Identifying barriers to building a diverse physician workforce: a national survey of the ACR membership. *J Am Coll Radiol*. 2019;16(8):1091-1101. doi:10.1016/j.jacr.2019.05.008

43. Delaney RK, Locke A, Pershing ML, et al. Experiences of a health system's faculty, staff, and trainees' career development, work culture, and childcare needs during the COVID-19 pandemic. *JAMA Netw Open*. 2021;4(4):e213997. doi:10.1001/jamanetworkopen.2021.3997

44. Correll SJ. Gender and the career choice process: the role of biased self-assessments. *Am J Sociol.* 2001;106(6):1691-1730. doi:10.1086/321299

45. Milkman KL, Akinola M, Chugh D. What happens before? A field experiment exploring how pay and representation differentially shape bias on the pathway into organizations. *J Appl Psychol.* 2015;100(6):1678-1712. doi:10.1037/apl0000022

46. Ginther DK, Schaffer WT, Schnell J, et al. Race, ethnicity, and NIH research awards, *Science.* 2011;333(6045):1015-1019. doi:10.1126/science.1196783

47. Wood JL, Hilton AA, Nevarez C. Faculty of color and white faculty: an analysis of service in colleges of education in the Arizona public university system. *J Professoriate.* 2016;8(1):85.

48. Kalyani RR, Yeh HC, Clark JM, Weisfeldt ML, Choi T, MacDonald SM. Sex differences among career development awardees in the attainment of independent research funding in a Department of Medicine. *J Womens Health (Larchmnt).* 2015;24(11):933-939. doi:10.1089/jwh.2015.5331

49. Hernandez-Matias L, Diaz-Munoz G, Guerrero-Medina G. Seeds of success: empowering Latina STEM girl ambassadors through role models, leadership, and STEM-related experiences. *J Stem Outreach.* Published online September 26, 2023. Accessed June, 2024. https://pmc.ncbi.nlm.nih.gov/articles/PMC10601408/

50. Broder ED, Guilbert KE, Tinghitella RM, Murphy SM, Ghalambor CK, Angeloni LM. Authentic science with dissemination increases self-efficacy of middle school students. *Integr Comp Biol.* 2019;59(6):1497-1508. doi:10.1093/icb/icz140

51. Daniels HA, Grineski SE, Collins TW, Frederick AH. Navigating social relationships with mentors and peers: comfort and belonging among men and women in STEM summer research programs. *CBE Life Sci Educ.* 2019;18(2):ar17. doi:10.1187/cbe.18-08-0150

52. Bechtel K, Langhan ML, Levine D, Hanson J. Pediatric emergency medicine and mentoring: what women want. *Pediatr Emerg Care.* 2024;40(6):449-453. doi:10.1097/PEC.0000000000003192

53. Kiser SB, Sterns JD, Lai PY, Horick NK, Palamara K. Physician coaching by professionally trained peers for burnout and well-being: a randomized clinical trial. *JAMA Netw Open.* 2024;7(4):e245645. doi:10.1001/jamanetworkopen.2024.5645

54. Cruz CRG, Rajpal G, Lecocke M, Martines I, Lurie A, Peer coaching program development: a framework of first-year Latina/o student persistence pursuing STEM pathways at a Hispanic serving institution. *J Hispanic Higher Educ.* 2021;20(4):365-384. doi:10.1177/1538192719867096

55. Ayedun A, Agbelese V, Curry L, et al. Perspectives on National Institutes of Health funding requirements for racial and ethnic diversity among medical scientist training program leadership. *JAMA Netw Open.* 2023;6(5):e2310795. doi:10.1001/jamanetworkopen.2023.10795

56. Tagge R, Lackland DT, Gorelick PB, et al. Career development program for underrepresented in medicine scholars in academic neurology: TRANSCENDS. *Neurology.* 2021;97(3):125-133. doi:10.1212/WNL.0000000000012058

57. Hill EV, Wake M, Carapinha R, et al. Rationale and design of the Women and Inclusion in Academic Medicine Study. *Ethn Dis.* 2016;26(2):245. doi:10.18865/ed.26.2.245

58. Ben-Zeev A, Paluy Y, Milless KL, et al. 'Speaking truth' protects underrepresented minorities' intellectual performance and safety in STEM. *Educ Sci (Basel).* 2017;7(2):65. doi:10.3390/educsci7020065

59. Bakkensen JB, Smith KS, Cheung EO, et al. Career trajectories among women in medicine. 2023;6(7):e2326192. doi:10.1001/jamanetworkopen.2023.26192

60. Muñoz JA, Villanueva I. Latino STEM scholars. Barriers, and mental health: a review of the literature. *J Hispanic Higher Educ.* 2022;21(1):3-16. doi:10.1177/1538192719892148

61. Werner Washburne M, Trejo J, Zambrana RE, et al. Early career Latinas in STEM: challenges and solutions. *Cell.* 2023;186(23):4985-4991. doi:10.1016/j.cell.2023.10.016

62. Aronson J, Fried CB, Good C. Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. *J Exp Soc Psychol.* 2002;38(2):113-125. doi:10.1006/jesp.2001.1491

63. Duma N, Velazquez AI, Franco I, et al. Donde estan? Latinx/Hispanic representation in the oncology workforce: present and future. *JCO Oncol Pract.* 2022;18(5):388-395. doi:10.1200/OP.22.00153

64. Espinoza-Gutarra MR, Duma N, Aristizabal P, et al. The problem of Hispanic/Latinx under-representation in cancer clinical trials. *JCO Oncol Pract.* 2022;18(5):380-384. doi:10.1200/OP.22.00214

65. Bin Han Ong M. Single digits: Black, Hispanic scientists strikingly underrepresented at NCI among senior workforce and grantees. *The Cancer Letter.* July 2, 2021. Accessed August, 2024. https://cancerletter.com/issues/20210702/

66. Surveillance Research Program; Surveillance, Epidemiology, and End Results (SEER) Program; National Cancer Institute. *SEER*Explorer: An interactive website for SEER cancer statistics.* National Cancer Institute; 2024. https://seer.cancer.gov/statistics-network/explorer/overview.html

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.