

Women's Careers in Biomedical Sciences: Implications for the Economy, Scientific Discovery, and Women's Health

Jennifer L. Plank-Bazinet, PhD,¹ Misty L. Heggeness, PhD, MPP, MSW,²
P. Kay Lund, PhD,³ and Janine Austin Clayton, MD¹

Abstract

While women have been well represented in medical school and biomedical doctoral degree programs, they do not comprise half of academic medicine faculty positions. Furthermore, there is a significant paucity of women in academic medicine leadership positions, as evidenced by the fact that only 16% of dean positions at United States Medical schools are filled by women. In this commentary, the authors review the state of women in academic medicine and argue that increased representation of women in the academic workforce will lead to economic gains, increased scientific discovery, and improvements to women's health.

Keywords: women in science, careers, academic medicine, women's health, scientific discovery, biomedical research workforce, gender and economic development

FOR THE PAST DECADE, approximately half of medical school graduates and doctoral degree recipients in the biological sciences have been women.^{1,2} Despite this gender parity in degree recipients, an underrepresentation of women on medical school faculty persists. In 2014, women made up 38% of full-time medical school faculty in the United States.² Furthermore, women are particularly underrepresented in academic medicine leadership positions, illustrated by the fact that in 2014, only 15% of permanent department chairs and 16% of deans were women.² Recent reports have shown that from a relative labor market perspective, women are not underrepresented in biomedical research during training, but are underrepresented in independent research positions, providing additional evidence that advancement of women in the biomedical workforce is suboptimal.^{3,4}

Multiple factors likely contribute to the low representation of women in academic medicine and biomedical research and deter advancement into leadership positions. Implicit, or subconscious, biases in selecting men over women have been reported as barriers to career advancement of women in academia.^{5,6} Furthermore, when hired, women tend to receive a lower starting salary than their male colleagues.⁷ Given that starting salary often limits future pay increases, salary equity is often unattainable,⁷ and lower earnings throughout a career can negatively impact retirement funds, putting women at a life-long disadvantage.⁸

Considerable evidence suggests that woman mentors and role models pave the way and make the leadership environment

more attractive and hospitable for women academics. Therefore, the paucity of women in senior leadership roles may discourage younger women from advancing. A study by Carrell et al. provides evidence that having female mentors and role models matters.⁹ They conducted a study of women placed randomly into STEM courses taught by women or men and found that the gender gap in course grades was eliminated when female professors taught female students.⁹ Having a mentor leads to increased productivity, career advancement, and satisfaction, further highlighting the importance of mentoring on retention and advancement of women in academic medicine.^{10,11} Recent work has highlighted the importance of mentor networks rather than traditional mentor dyads, as it is unlikely that a single mentor can meet all of the needs of the mentee.¹² In particular, women noted the need to have at least one woman mentor to provide guidance on workplace communication in a male-dominated field, negotiation, and work-life integration.¹² In addition to mentoring, having a sponsor, or advocate, greatly benefits both men and women; individuals with a sponsor are more likely to be promoted.¹³ However, women are less likely to have a sponsor than men.^{13,14} A recent study also indicated that group coaching can augment mentoring to promote persistence among women and individuals from underrepresented groups in academic medicine.¹⁵ Increasing the numbers of female role models, mentors, sponsors, or coaches available to younger women could have a profound effect on the sustained career advancement of women in the biomedical workforce.

¹Office of Research on Women's Health, National Institutes of Health, Bethesda, Maryland.

²Social, Economic, and Housing Statistics Division, US Census Bureau, Suitland, Maryland.

³Division of Biomedical Research Workforce, Office of Extramural Research, National Institutes of Health, Bethesda, Maryland.

It is also possible that leadership positions in academic science simply might not be attractive to women. Perhaps the responsibilities associated with leading a research organization, the time demands of leadership positions, and institutional culture are not appealing, particularly to women with young children, elderly parents, and family obligations.¹⁶ A recent report found that female physician researchers in academia spend 8.5 hours more per week engaged in household chores and family care than their male counterparts.¹⁷ The combination of personal and professional responsibilities could deter women from staying in the biomedical research workforce, and serve as a barrier to advancement into leadership positions. Human resource policies that encourage flexible work schedules, improve child and elderly care resources, and other benefits help make biomedical research careers and leadership roles more hospitable for both men and women.^{18,19} Recent novel policy interventions in paternity leave have shown that when parental leave policies require fathers to take a portion of the leave, mothers are more likely to stay employed.^{20,21} The availability and use of paid paternity leave could empower women and lead to more equity in the workforce.²² Keeping women in the workforce and advancing into leadership positions requires a balanced approach when considering family-friendly policies not only for women, but for men, too.

Despite facing gender-related biological pressures, implicit biases, and cultural hurdles, there are opportunities to develop and enhance the use of interventions and mechanisms geared toward sustaining and advancing the careers of women in academic medicine and biomedical research. For example, training modules may be effective in ameliorating implicit biases during hiring.⁶ Institutional culture can be measured and changed, leading to a more positive environment for all faculty.^{23,24} A recent randomized controlled trial at the University of Pennsylvania Perelman School of Medicine proved effective in improving the academic productivity and job satisfaction of women faculty.²⁵ Such programs and others that may be implemented to promote gender diversity in the biomedical workforce have far-reaching implications. In this commentary, we discuss the potential economic impacts, increased scientific discovery, and effects on women's health that may result from increasing the representation of women in academic medicine, biomedical research, and leadership.

Economic Considerations

Biomedical scientists engaged in academic research have invested large amounts of time, energy, and resources into the accumulation of high levels of human capital—the collective skills, knowledge, or other intangible assets of individuals that can be used to create economic value for the individuals, their employers, or their community. Economists assume that individuals aspire to high levels of human capital through education and training because investing early in additional human capital is expected to pay off in terms of the return on lifetime earnings. When scientists stay engaged in academic medicine, biomedical research, and related careers, both the individual and society maximize the benefit and return on their early investments.

Economics includes the study of human behavior under certain constraints, individual preferences, and in response

to incentives. As such, economists study social phenomena that hinder the efficient allocation of resources at an individual and societal level, which in turn has the potential to slow economic growth. Gender inequality in the labor market has the potential to create inefficiencies and slow growth. A recent report by the McKinsey Global Institute reported evidence that advancing gender equality—defined as bringing more women into the labor force, increasing the proportion of women who work full-time, and diversifying the sectors where women work—could accelerate economic growth in the United States and increase the gross domestic product by \$2.1 trillion.^{26,27} In the end, society benefits when highly trained women can stay engaged on the forefront and cutting-edge space of their research and human capital investments.

Enhancing Scientific Discovery

In addition to economic benefits, increased gender diversity in the workforce can enhance scientific discovery. While more empiric data are needed to measure the impact of gender diversity in academic medicine and biomedical research, findings from other fields suggest that increasing representation of women will result in increased scientific discovery.²⁸ Other evidence indicates that diversity, in race/ethnicity, gender, and age, has a significant impact on the overall effectiveness of a group.²⁹ Literature suggests that diverse groups bring together different information, opinions, perspectives, and experiences, which promote increased creativity, innovation, and more effective decision making.³⁰ Indeed, recent studies indicate that publications written by diverse groups have more significant impact than those written by more homogeneous groups,³¹ indicating enhanced scientific discovery and dissemination as a result of diversity. A 2013 publication also reported that groups consisting of men and women produce higher impact work, and their publications received more citations than gender homogeneous groups.³²

There are several potential benefits to gender diversity as it relates to scientific discovery. Gender balance is reported to increase the collective intelligence of a group, and mixed-gender teams have been found to be more effective than teams of all men or all women.^{33,34} Importantly for the scientific enterprise, evidence suggests that diverse groups outperform homogeneous groups of top performers in problem-solving activities, and groups that contain women are more adept at problem solving.^{33,35} Since biomedical research requires multiple strategies, rigorous experimental designs and protocols, and critical data interpretation, multiple points of view facilitate a more comprehensive approach and more thorough analysis of the scientific premise and research findings.

Women have been shown to value and enjoy collaboration and a less hierarchical organizational structure, which is also more conducive to the sharing of ideas and diversity of research focus.^{36,37} Finally, a greater network reach, or a larger collaborative network, is positively correlated with the number of publications and h-index.³⁸ Together, the findings highlighted here suggest that increasing gender diversity and collaborative efforts in academic medicine and biomedical research should enhance scientific discovery and contribute to better health.

Implications for Women's Health

The previous section emphasized the importance of increasing gender diversity to gain multiple perspectives, and this is particularly important when considering women's health. Women are more likely to recommend research protocols relevant to women's health, and throughout history, women have, indeed, led efforts to develop programs to improve the health of women.³⁹ The Commission on Graduate Medical Education indicated that the status of women in academic medicine and the health of women are inextricably linked.⁴⁰

Research to benefit the health of women extends far beyond reproductive health, as emphasized by sex-specific differences in responses to multiple drugs. For example, there are sex differences in the pharmacodynamics of zolpidem, leading to lower clearance of the drug in women compared with men.^{41,42} Strikingly, 8 of 10 drugs removed from market by the FDA between 1997 and 2000 posed greater health risks to women than men.⁴³ Women are more likely than men to experience health benefits after smoking cessation, but women are less successful in quitting.^{44–46} A recent meta-analysis of clinical trial data indicated that varenicline, a smoking cessation drug, has better short and immediate-term outcomes in women than men, and equal efficacy after 1 year.⁴⁷ The examples are a few of many that illustrate the importance of considering sex and gender influences in biomedical research.

Increasing the representation of women in academic medicine, specifically in leadership positions, could enhance development of research programs that benefit the health of women. Scientific advancement is guided by the research question under consideration, and we hypothesize that women are more likely to pose questions related to the health of women. Consideration of sex and gender influences in biomedical research, recruiting women to clinical trials, including pregnant women in clinical trials, and analyzing and reporting data stratified by sex/gender, all promise to improve the health of women.⁴⁸ Greater representation of women in biomedicine and leadership will help ensure that women play a role in discussions and decisions about future initiatives and research programs to benefit the health of women.

Conclusion

As we have discussed, increasing the representation of women in academic medicine and biomedical research affects the careers of women themselves and also benefits society and the biomedical research enterprise overall. Additional and more effective programs and strategies to recruit, retain, and advance women in science and medicine is of paramount importance, and should be the goal of multiple stakeholders, including academic departments, leadership at institutions of higher education, scientific societies, and the federal government. Key players will need to come together to develop innovative and effective strategies for recruitment, retention, and sustained advancement of women in academic medicine and biomedical research.⁴⁹

Despite a common goal of increasing representation of women, each university or organization is a unique entity with a unique culture and set of goals and needs.⁵⁰ Therefore, individual organizations may have to undergo a culture change designed to meet the circumstances and demands of that organization. A one size fits all approach is unlikely to be effective, but organizations can learn from one another.⁵⁰

The National Science Foundation ADVANCE program provides institutions with grant funding to develop approaches to increase representation and advancement of women, to develop sustainable means of promoting gender equity, and to contribute to diversity in science and engineering.⁵¹ The ADVANCE Portal, a website highlighting the activities of ADVANCE grantees, facilitates sharing of information and makes findings available to the public.⁵² Additionally, a 2015 publication highlights successful interventions developed by ADVANCE grantees and demonstrates how faculty experiences can be improved through implementation of such approaches.⁵³ In an attempt to retain early career physician scientists in research, the Doris Duke Charitable Foundation established a Fund to Retain Clinical Scientists to provide supplemental, flexible funds to early career physician scientists facing extraprofessional demands of caregiving.⁵⁴

Online publication of tool kits, best practices, or lessons learned by entities that have been successful will be beneficial for other organizations to adopt effective strategies. Furthermore, convening leaders in academic medicine, biomedical research, economics, and behavioral and social sciences may promote diverse and innovative strategies to benefit women in science and science as a whole. A group that has been successful in evaluating the status of women in academic medicine is the Research Partnership on Women in Biomedical Careers, a grassroots group that seeks to identify evidence-based interventions to increase recruitment, retention, and sustained advancement of women in biomedical research careers.⁵⁵ This group, former grantees of an NIH request for applications on Causal Factors and Interventions that Promote and Support the Careers of Women in Biomedical and Behavioral Science and Engineering,^{56,57} aims to increase the impact of the findings of those awards through publications, presentations, conferences, and journal collections such as this. Increasing awareness of the issues faced by women in academic medicine and potential approaches for alleviating the barriers is a positive step forward to increasing the representation of women in the senior levels of academic medicine and biomedical research.

Author Disclosure Statement

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Address correspondence to:
Jennifer L. Plank-Bazinet, PhD
Office of Research on Women's Health
National Institutes of Health
6707 Democracy Boulevard
Suite 400
Bethesda, MD 20817

E-mail: jennifer.bazinet@nih.gov