Changes in the Representation of Women and Minorities in Biomedical Careers

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Abstract

Purpose
To examine how efforts and policies to increase diversity affect the relative representation of women and of minority groups within medicine and related science fields.

Method
The authors of this report used data from the Current Population Survey March Supplement (a product of the U.S. Census Bureau and the Bureau of Labor Statistics that tracks race, ethnicity, and employment) to compute the representation ratios of persons employed in biology, chemistry, and medicine from 1968 to 2009 (inclusive). They derived the representation ratios by computing the ratio of the conditional probability that a member of a given group is employed in a specific skilled science field to the overall probability of employment in that field. Their analysis tested for differences in representation ratios among racial, gender, and ethnic groups and across time among those employed as biologists, chemists, and medical doctors.

Results
Representation ratios rose for white females, whose percentage increase in medicine was larger than for any other racial/ethnic group. The representation ratios fell for Hispanics in biology, chemistry, and medicine. The representation ratio rose for African Americans, whose highest percentage increase occurred in biology. Asian Americans, who had the highest representation ratios in all three disciplines, saw a decline in their relative representation in medicine.

Conclusions
The authors have demonstrated that all groups do not benefit equally from diversity initiatives and that competition across related fields can confound efforts to increase diversity in medicine.

Recent contributions in the policy analysis literature point to an economic efficiency criterion associated with diversity.[1,2] In the case of biomedical careers, the economic efficiency criterion means that efforts to produce a more diverse pool of doctors are justified if they result in higher-quality and lower-cost medical care. Such efforts across related fields, such as chemistry and biology, may have unintended effects—either positive or negative—on the diversification of the medical profession. Not every racial, ethnic, or gender group necessarily benefits when different disciplines compete for diversity.

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The Economics of Diversity

One of the key propositions in the emerging literature on the economics of diversity is that heterogeneous groups or teams tend to outperform more homogeneous groups or teams.[3–6] The benefits of diversity include greater stability in the workforce[7]; enhanced thinking skills, intellectual engagement, and motivation[8]; growth in academic skills[8]; expanded consumer markets[9]; and higher values of business enterprises.[10] In short, diversity is associated with economic benefits.

However, economists have also noted some potential costs associated with diversity. Evidence from data on nations around the world and on communities across the United States suggests that racial or ethnic diversity is associated with lower overall economic performance.[11,12] Other evidence points to the difficulty that teams made up of persons from diverse backgrounds have in managing their work. For example, one study shows that heightened conflicts might impede performance.[13] Further evidence against the financial value of diversity comes in part from research showing an inverse correlation between economic growth and ethnic diversity.[14] Another standard contention is that diversity programs or initiatives breed contempt and hostility among those who do not benefit from them.[15]

Finally, a less documented cost is the distributional effect of implementing diversity programs that do not distinguish among beneficiaries. In other words, focusing on the recruitment of members of one particular group may decrease the representation of members of another group. Thus, we wanted to examine the effect that efforts and policies to increase diversity have had on the relative representation of women and of minority group members within medicine and related science fields.

Method

One common method of measuring the benefits resulting from efforts to increase diversity is to compute representation ratios.[16] To determine representation ratios, we calculated the probability of women and of members of ethnic and racial groups working in biology, chemistry, and medicine from 1968 to 2009, inclusive. We calculated the probability, $P(j)$, of being employed in the *jth* related biomedical field (e.g., chemistry). We used $P(j)^k$ to denote the probability that a member of the *kth* group (e.g., Hispanics) would be employed in the *jth* field. Thus, the interpretation of the resulting ratio, $R(j)^k$, is the *kth* group's probability of being in the *jth* profession relative to the overall probability of being in the *jth* profession (e.g., the probability of Hispanics being in chemistry relative to the probability of anyone being in chemistry).

When this ratio is greater than 1, the group's probability of being in the *jth* profession exceeds the overall probability of being in the *jth* profession, or the *kth* group is overrepresented in the *jth* profession. When the ratio is less than 1, the group is underrepresented. When the ratio is equal to 1, the group's representation in the profession is equal to the group's representation in the overall population. The underlying probabilities are conditional on individuals being employed in the skilled (see below) civilian noninstitutionalized labor force. Civilian noninstitutionalized populations exclude persons in the military, those who are incarcerated in prisons or jails, and those in mental hospitals.

The most commonly used and widely available annual data on national employment come from the Current Population Survey (CPS), a monthly U.S. household survey conducted jointly by the U.S. Census Bureau and the Bureau of Labor Statistics. The March Annual Demographic File and Income Supplement (the March Supplement) provides detailed information on occupations, race, and ethnicity. A harmonized version of the annual files is available through the University of Minnesota's Integrated Public Use Microdata Series, Current Population Survey (IPUMS-CPS): Version 3.0.[17]

We chose for our analysis three related fields that rely on a common core of science background: biology, chemistry, and medicine. Relatively few women or minorities in the noninstitutionalized civilian labor force were employed in these disciplines, especially in the earlier years under investigation (1968 through approximately 1989). To account for the small sample sizes, we merged three years of data for each year and computed three-year moving averages of the representation ratios. In other words, we computed the arithmetic mean of the representation ratios using three years of data. The representation ratio centered on 1990, for example, uses data for 1989, 1990, and 1991, and the representation ratio centered on 1991 uses data for 1990, 1991, and 1992. Then, we averaged the representation ratios for two different time periods: (1) 1968 to 1989 and (2) 1990 to 2009. The last year of the first time period, 1989, was a watershed year marked by reversals to race-conscious affirmative action programs. For example, the landmark U.S. Supreme Court case *Croson v. City of Richmond*[18] made race a suspect (i.e., subject to strict scrutiny) basis for granting contracts. The second period, 1990–2009, corresponds to the period of "diversity" initiatives, through which most major research universities, most public and private colleges and universities, and most medical schools shifted their race-conscious programs and initiatives to race-neutral programs purportedly placing economic disadvantage on the same footing as gender, race, or ethnicity. For our purposes, we have labeled the first period "the affirmative action era" and the second period "the diversity era."

The IPUMS-CPS defines biologists as "biologicial scientists and biological science instructors" and chemists as "chemists, chemical technicians, chemistry teachers, and chemical engineers"; the IPUMS-CPS defines medical doctors and surgeons as "physicians."[17] We used the person weights (i.e., inverse probability of selection into the sample and adjustments to account for the complex stratified sampling scheme)[17] from the CPS files to compute probabilities of being employed as a biologist, chemist, or physician for each of the following groups: white non-Hispanic males, white non-Hispanic females, African Americans (non-Hispanic), Hispanics, Asian Americans (non-Hispanic), and American Indians. (The terms we use are similar, but not identical to the specific racial terms used in the IPUMS-CPS data, which are as follows: white, black/Negro, American Indian/Aleut/Eskimo, and Asian or Pacific Islander. The Hispanic designation—a measure of ethnicity [not race] and available only after 1972—is used to create the mutually exclusive categories examined.)

We computed the probability of being employed as either a biologist or a chemist for those who were, according to the CPS files, 18 to 60 and had completed two or more years of college for the years 1968–2009. We computed the probability of being employed as a physician for persons aged 18 to 60 who had completed more than four years of college for the years 1971–2009, the years for which CPS provides a consistent definition of medical doctor. We used these restrictions to produce appropriate conditional probabilities. We then computed representation ratios for each race/ethnicity for each available year from 1968 to 2009.

We computed two tests of significance. The first was a test of whether the representation ratios within each time period differed between white males and other groups. The second was the test of whether the representation ratios for each group differed between time periods. We used Stata Statistical Software, release 11 (College Station, Texas), to conduct two-sample mean-comparison tests (unpaired).

Results

Table 1 presents the results of computing representation ratios for biologists, chemists, and physicians, by group (i.e., white non-Hispanic males, white non-Hispanic females, African Americans [non-Hispanic], Hispanics, Asian Americans [non-Hispanic], and American Indians). We were able to complete the calculations for Asian Americans only after 1986 because of data availability, and American Indian sample sizes were too small for reporting results prior to 1990.

Table 1 shows that the relative representation of white non-Hispanic males declined in all three fields between the two eras. The average white male representation ratio in biological sciences dropped from 1.28 in 1968–1989 to 1.09 in 1990–2009, representing a 15% decline to near parity. In medicine and chemistry, only modest declines in the representation ratios for white males occurred, and white males remained overrepresented in each of these fields between 1990 and 2009.

By way of contrast, the representation ratios for white females surged from 0.72, 0.34, and 0.28 in, respectively,

Table 1

Representation Ratios* for Biologists, Chemists, and Medical Doctors

Professional group	White males	White females	African Americans	Hispanics	Asian Americans†	American Indians‡
1968–1989						
Biologists	1.28	0.72	0.37	0.65	1.93	0.60
Chemists	1.49	0.34	0.64	0.94	1.74	0.39
Medical doctors§	1.40	0.28	0.48	1.33	*2.57*	—¶
1990–2009						
Biologists	1.09	0.88	0.52	0.56	2.09	0.95
Chemists	1.44	0.51	0.76	0.47	2.10	0.56
Medical doctors	1.36	0.49	0.62	1.06	2.04	0.93
Percentage change, from 1968–1989 to 1990–2009						
Biologists	–0.15	0.22	0.42	*–0.15*	*0.08*	*0.58*
Chemists	*–0.03*	0.53	*0.18*	–0.50	0.21	*0.45*
Medical doctors	–0.03	0.77	0.29	–0.20	–0.21	—¶

*All ratios are significant at the 5% level, two-tailed test, except those in italics.
† Data available from 1986 to 2009.
‡ Data available from 1988 to 2009.
§ Data available from 1972 to 2009.
¶ Too few observations to compute three-year moving averages (or, therefore, percentage change).

biology, chemistry and medicine in the affirmative action era to 0.88, 0.51, and 0.49, respectively, in the diversity era. In medicine, the percentage increase for white (non-Hispanic) women was larger than for any other racial/ethnic group, yet their representation remains low (0.49) because other groups (e.g., white males and Asian Americans) have higher probabilities of being physicians.

The representation ratios for African Americans also increased between the two periods in all three fields: from 0.37, 0.64, and 0.48 in, respectively, biology, chemistry, and medicine during the affirmative action era to, respectively, 0.52, 0.76, and 0.62 during the diversity era. The largest gain in representation for African Americans was in biology, and percentage improvements in medicine were not far behind.

Hispanic representation ratios declined between the two periods in all three fields. Hispanics, who can be of any race, had representation ratios of 0.65, 0.94, and 1.33 in, respectively, biology, chemistry, and medicine from 1968 to 1989 compared with, respectively, 0.56, 0.47, and 1.06 from 1990 to 2009. Interestingly, during the affirmative action era, most Hispanics self-identified as white, and from 1990 to 2009, increasing numbers of Hispanics self-identified as "other" or American Indian.

Data on Asian Americans were not available from IPUMS-CPS for all years prior to 1989; however, both before and after the shift from affirmative action to diversity, the Asian American representation in the biology, chemistry, and medical professions exceeded their representation in the skilled workforce. Indeed, in every instance, the representation ratios exceed those for all groups, including even white males. In biology and chemistry, the Asian American representation ratios rose between the affirmative action and the diversity eras. In medicine, their representation ratios fell 21% from 2.57 to 2.04.

American Indian representation ratios for biologists and chemists rose from 0.60 and 0.39 during the affirmative action era to 0.95 and 0.56 after 1990. Too few observations in the period prior to 1990 are available for computing the representation ratios for American Indians employed as physicians, although the post-1990 value is lower than that for white males, Hispanics, or Asian Americans.

All of the differences of the representation ratios between white males and other groups were statistically significant except for the difference between Asian Americans and white males prior to 1990 among physicians.

By way of contrast, not all within-group changes in representation ratios were statistically significant between 1968–1989 and 1990–2009. Specifically, the changes in the representation ratios among biologists for Hispanics, Asian Americans, and American Indians were not statistically significant, nor were the changes in the representation ratios among chemists for African Americans and white males (see Table 1).

Discussion

Our analysis demonstrates that not all groups benefited to the same degree when affirmative action shifted to diversity programming. In particular, the representation of white males—who were once overrepresented in these professions—decreased. (However, one decline—within the chemistry profession—from a representation ratio of 1.49 to a ratio of 1.44 was not statistically significant.) The representation of Hispanics, who represent a diverse group of nationalities and ethnicities, also decreased. This decline, however, may also be the result of a rise in the number of Hispanics who self-identify as nonwhite, and this rise in self-identifying as nonwhite, in turn, may be the result of the current wave of Hispanics emigrating from numerous Latin American countries who have less attachment to the conceptualization of "white."[19,20] The representation of Asian Americans, who clearly have been historically overrepresented in medicine, decreased in the diversity era. Thus, the modest improvements by some groups (e.g., women, African Americans) were offset by declines in the representativeness of other groups (e.g., Hispanics). This decline is one of the costs of diversity.

Using the IPUMS-CPS data to compute representation ratios in biomedical fields across racial, ethnic, and gender groups, we illustrate the problem inherent in diversity policies. African American representation among physicians and surgeons in the marketplace is affected by shares of white women, Hispanics, and Asian Americans in the marketplace who all compete for limited slots for admissions to medical schools post-1989. Movements of women and minorities in one field can affect the representation of women and minorities in other fields.

Net losses?

The economic model of diversity posits that both costs and benefits are associated with expanding the pool of women and of people from different races and ethnicities in a marketplace. One common justification for diversity is that it produces net benefits to society, such as in medicine, improved health care and reductions in health disparities.[21–28] Nevertheless, not all groups benefit equally from changing policies. The earlier race-conscious programs and policies (from the 1960s to the 1980s) contrast with more recent policies designed to be race-neutral and to remedy various types of disadvantage. Our data show that different groups experienced different outcomes across these two eras, confirming our initial hypothesis that efforts to increase diversity produce costs as well as benefits.

For example, the group whose representation ratios increased the most in chemistry during the diversity era was white females (their ratio rose from 0.34 to 0.51). The representation of African Americans in chemistry from 1990 to 2009 also increased over the earlier era (from 0.64 to 0.76), but the increase was not statistically significant. Further, the representation ratios of Hispanics in chemistry declined from 0.94 during the affirmative action era to 0.47. In short, the diversity period witnessed uneven improvements and some declines in the relative representation of different groups, including those who were already underrepresented, in different health-related sciences.

Implementing diversity

There is widespread evidence of continuing underrepresentation of African Americans, Hispanics, American Indians, and, to a lesser extent, white women, in biomedical and behavioral research careers.[29–33] Ginther and colleagues[34] demonstrate that even after controlling for the initial underrepresentation of these groups among researchers, their success rates in obtaining National Institutes of Health awards are substantially lower than those of whites.

We believe that current mechanisms for achieving diversity in medical schools and other advanced settings tend to emphasize pipeline models (i.e., a college preparatory high school program and summer enrichment programs followed by a four-year university or college). Such a pathway, the most common route toward medical practice, has been historically followed by white males. These pipeline models inherently privilege persons who attend four-year colleges and universities. However, increasingly African Americans, Hispanics, and American Indians are found in two-year colleges, some of which are for-profit and have little or no connection to traditional pipelines to the profession. To illustrate, in 2000, among undergraduate students under the age of 24 enrolled in degree-granting institutions, an estimated 44.6%, 48.3%, and 52.2%, respectively, of African Americans, Hispanics, and American Indians were in two-year colleges.[35] By 2008, the estimated enrollment rates had grown for these three groups to, respectively, 49.7%, 55.7%, and 55.2%.[36] In short, the majority of Hispanics and American Indians and a near majority of African Americans are not in the conventional four-year college or university pipeline.

Another threat to the success of diversity programs is competition across related fields. Efforts to increase the supply of underrepresented groups in biology and chemistry can confound efforts to increase diversity in medicine. By drawing on exactly the same pool of students favored by pipeline approaches, biology, chemistry, and medical school diversity initiatives compete against one another.

An alternative approach to achieving diversity might focus on partnering with the very institutions where underrepresented groups are concentrated. Collaborative efforts among medical science and related fields to increase diversity in nontraditional institutions and pathways might generate larger pools of students eligible for admission to medical school and, thereby, increase the overall representation of targeted groups. Without targeting *each* underrepresented group, however, this alternative approach may involve costs for *other* groups—which further illustrates the difficulty of developing diversity policies that are truly race-neutral.

Interventions and policies designed to remedy the underrepresentation of women and of ethnic or racial groups could benefit from better evidence on the most cost-effective approaches to producing physicians and surgeons from these groups. The interventions that work for majority groups do not necessarily also work for ethnic minorities or women.

Limitations

The patterns reported herein do not control for other factors that might explain changes in representation ratios. We have not statistically accounted for differences in earnings or differences in non-STEMM (science–technology–engineering–mathematics–medicine) occupational choices, such as law or business. We have not explicitly accounted for the changes in measurement of race. In the years prior to 2000, CPS reported only single-race categories; thereafter, survey respondents could check more than one race box. Our analysis considers only single-race persons. Moreover, we have made no distinction between native-born and foreign-born minorities in this analysis. Some of the increase in the representation ratios among African Americans in medicine, for example, could be attributable to increases in the number of African or Caribbean physicians in the United States.

Conclusions

We have demonstrated that changes in the representation of women and minority group members in medicine and related science fields have not been uniform between the affirmative action era (1968–1989) and the diversity era (1990–2009). Whereas some groups gained representation during the diversity era, other groups lost ground. The problem, we contend, is that diversity initiatives do not necessarily benefit all groups via increased representation. Moreover, successful diversity initiatives in one science field can have the unintended effect of reducing representation in other science fields, creating competition for the same students. One approach to remedying this problem is to explore alternatives to pipeline models for increasing the supply of qualified medical school applicants.

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