Examining the Role of Gender in Career Advancement at the Centers for Disease Control and Prevention

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During the past decade, efforts to promote gender parity in the healing and public health professions have met with only partial success. We provide a critical update regarding the status of women in the public health profession by exploring gender-related differences in promotion rates at the nation's leading public health agency, the Centers for Disease Control and Prevention (CDC). Using personnel data drawn from CDC, we found that the gender gap in promotion has diminished across time and that this reduction can be attributed to changes in individual characteristics (e.g., higher educational levels and more federal work experience). However, a substantial gap in promotion that cannot be explained by such characteristics has persisted, indicating continuing barriers in women's career advancement. (*Am J Public Health.* 2010;100:426–434. doi:10.2105/AJPH.2008.156190)

A recent report published by the National Academy of Sciences stressed the need to eliminate biases and barriers facing women in fulfilling their potential in science.[1] In 2008, the National Institutes of Health (NIH) launched an initiative to study the root cause of continuing low rates of participation of women in scientific research careers.[2] The status of women in the public health profession, the focus of this article, deserves our particular attention because the gender composition of the profession has had a long history of influencing public policies affecting population health and health equity.[3] A milestone in such influence was reached when S. Josephine Baker was appointed as the director of the New York Bureau of Child Hygiene in 1908 and later established the Federal Children's Bureau in 1912, even before women received nationwide suffrage.[3]

As suggested by the evidence vividly accounted by Fee and Greene,[3] the role of women in shaping critical decisions that influence public health policy is governed by their relative status and career advancement in the profession. Previous studies have indicated that although half of federal civil servants are women, their upward mobility is limited, with the majority confined to low-level or midlevel positions.[4] Despite commitments at various levels of government to eliminating gender discrimination in pay and promotion, Katherine C. Naff, a senior research analyst at the US Merit Systems Protection Board concluded, in a 1994 report, that gender disparities in career advancement in the federal civil service persisted through the late 1980s and that these disparities were only partially explained by differences in experience and education.[5]

More broadly, the role of gender in career advancement has stimulated intellectual discourses by economists, political scientists, sociologists, policymakers, and others. Previous literature has examined the role of gender in such settings as the federal civil service,[6–11] state agencies,[12] nonprofit international organizations,[13] and private firms.[14] The public sector has attracted particular attention given the government's formal commitment to equal employment opportunity,[15] which advocates a federal workforce that reflects the nation's diversity and decisions on the part of the government that are responsive to the needs of the people it serves. Scholars of representative bureaucracy have specifically emphasized demographic representation of women and other minorities, not only for symbolic reasons but also to ensure broadly representative policy outcomes that adequately capture the perspectives of such minority groups.

Three factors might explain differences in gender representation among the federal workforce: the glass ceiling, the educational attainment gap, and traditional gender roles.[10] In examining the role of gender in the federal Senior Executive Service (SES), a corps of executives selected into public service as a result of their leadership qualifications, Mani hypothesized that men had a predominant role in upper management, thus defining the role model as well as the qualities necessary for selection to such positions.[4] In addition, social networks have played a critical role in the selection of senior management personnel in the private sector.[4] The public sector has strived to hire and select on the basis of merit; often, however, incomplete information on the job market and the ability and skills of candidates results in use of networking by recruiting supervisors, placing women at a disadvantage because of the predominance of men among senior management. Lewis termed this the "buddy system."[8(p482)]

The majority of the aforementioned studies examined the role and status of women in the entire federal sector. Similar assessments of specific government sectors or agencies are equally critical given the gender-specific variations in role and status across sectors, which often results from differences in the underlying mission, scope, and core functions of the sectors or agencies. At the US Centers for Disease Control and Prevention (CDC), where policy recommendations regarding public health and prevention are made, adequate representation of women at decision-making levels can enhance the perspectives needed to assess policies and practices that affect women and children. For example, integration of a female perspective might be critical with respect to certain programmatic decisions (e.g., recommendations supporting adoption of human papillomavirus vaccine use among young women) as well as internal personnel policies (e.g., maternity leave and flexible work schedules).

Given that the CDC is the nation's premier public health agency, its workforce of more than 9000 federal employees is a critical component of the public health establishment, both nationally and globally. Through its Office of Workforce and Career Development, the CDC provides a number of fellowship programs in which approximately 400 fellows and students are trained each year, with 70% to 80% of these individuals continuing to pursue public health careers in varied institutions such as state and local health departments, nonprofit organizations, academia, federal agencies, and international organizations.[16] The CDC may also have leverage in improving the status of women in public health through its cooperative agreements with academic and nonacademic partners, just as its sister agency, the NIH, has done in biomedical science.[2]

In an editorial published in this journal in 1992, Fee and Korstad commented that efforts to promote gender parity in the healing and public health professions had met with only partial success.[17] Here we provide a critical update on the status of women in the public health profession by exploring gender-related differences in promotion rates at the CDC. Using CDC personnel data, we examine the impact of gender on career progression among General Schedule (GS), GS-equivalent, and SES employees. We used logistic regression and decomposition analyses to partition the observed gender differentials in promotion probabilities into portions explained by observable characteristics (e.g., education and experience) and unexplained residuals.

We believe that empirical insights relating to factors underlying the career advancement of women in public service at the nation's leading public health agency are a useful supplement to the existing literature. Gender parity in career advancement in public health is a critical issue that calls for the attention of policymakers and the public health community to facilitate access to harmonized workforce data sources and initiatives, enabling research that explores and addresses the status of women in the broader public health workforce, including in other organizations.

METHODS

Data for this study were extracted from the administrative personnel records of federal civilian employees employed at the CDC during 2002 through 2006; these records, compiled by the US Office of Personnel Management (OPM), were made available to us by CDC's Management Information Systems Office. The study sample was restricted to employees on GS pay plans and GS-equivalent plans (e.g., employees covered by the Performance Management and Recognition System termination provisions). GS, a pay scale used for the majority of white-collar personnel in the federal civil service, includes most civil service professional, technical, administrative, and clerical positions. The GS system has 15 grades and 10 steps within each grade.

We also included employees compensated by the Senior Biomedical Research Service (RS) and SES pay plans and employees whose compensation is administratively determined. SES consists of top-level federal managers and was created as part of the Civil Service Reform Act (Pub L No. 95-454).[11] The RS schedule, which involves federal civil service positions administered by the hiring agency rather than OPM, covers outstanding scientists who possess a doctoral-level degree in biomedicine or a related field. Administratively determined pay systems are those for which the agency has the authority to determine the compensation for particular groups of positions without regard to GS. Employees compensated under this system are usually scientists or trainees.

We excluded federal blue-collar workers employed under the wage grade schedule, which consisted of less than 1% of the CDC workforce in 2006. We also omitted approximately 10% of the CDC workforce employed as Commissioned Corps officers of the US Public Health Service (PHS), who can be mobilized under military command during emergency situations and have a compensation and merit system that differs from the systems used for civilian employees. All data management and analyses were conducted using Stata version 9 (StataCorp, College Station, TX).

Dependent Variables

The principal dependent variable in our study, the grade of employees on the GS and related (GSR) pay plans, was an ordinal variable conveying position in the organizational hierarchy within the CDC. GSR positions include the majority of administrative, clerical, scientific, and technical occupations in the federal civil service. In addition to GS, GSR, as defined here, included related pay plans that can be converted to a GS grade by the OPM.[18] The GS system allows automatic within-grade step increases that result in pay raises without additional responsibilities; hence, salary alone might not be representative of one's position in the organizational hierarchy. Meanwhile, the GSR grade relates to the responsibilities and administrative duties of the position and strongly correlates with an employee's position on the career ladder.

GSR grades range from 1 to 15. Entry-level positions range from GSR-1 to GSR-7; midlevel positions range from GSR-8 to GSR-12; and top-level positions range from GSR-13 to GSR-15. The majority of employees in scientific occupations typically enter in positions ranging from GS-11 to GS-14. We added a new grade level, GSR-16, to the standard GSR grade range to include employees whose grades extend beyond GSR-15. Specifically, SES employees are categorized as GSR-16 because SES replaced 3 previously senior GS grades (i.e., GS-16, GS-17, and GS-18) in 1978. We also denote the grade of RS employees as GSR-16 because the qualifications for applicants to the RS series include being GS-15 or the equivalent.

Because their salaries could be matched with a GS salary, the majority of employees on the administratively determined pay plan were assigned the corresponding GS grades. Employees on the administratively determined pay plan with salaries greater than the maximum GS-14 salary but less than the maximum GS-15 salary were classified as GSR-15, and those on the administratively determined pay plan with salaries greater than the maximum of GS-15 were classified as GSR-16. Approximately 1% of the full sample of employees on the administratively determined pay plan were omitted because they could not be matched to any GS grade on the basis of their salary information.

We examined 2 additional binary dependent variables to assess promotion. The first, GSR-14+, was a binary variable equal to 1 if the employee was GSR-14 or above and 0 otherwise. A GSR-14+ position is associated with senior scientific or supervisory responsibilities. The second binary dependent variable, GSR-15+, reflected a grade of GSR-15 or above, which is usually associated with a senior management position. To examine progressive promotion rates, we excluded those below

GSR-14 in our analyses of GSR-15+. The regressions for GSR-15+ were all conditional on attainment of GSR-14+.

Independent Variables

Independent variables included age and its squared term, years of government experience and its squared term, and dummy variables for gender, race/ethnicity, educational attainment, and medical professional training.

Age and gender. Age was calculated as the number of full years from the employee's birthday to the date the data were extracted (i.e., October 1, 2006). Existing literature has demonstrated that the relationship between promotion and both age and job tenure is curvilinear rather than linear.[8,19] Hence, we included both age and its squared term in our analyses. For gender, we used a binary indicator for men, with the reference group being women.

Educational attainment and medical professional training. We used 2 measures to capture educational and professional training. The first was a 5-scale categorical variable reflecting educational attainment (high school or less, some college, college, master's degree, and doctoral degree or doctoral degree along with additional education).

Also, because physicians have instrumental roles in public health, we included a binary variable indicating whether or not an employee was a medical officer. Qualifications for the medical officer designation include possession of a doctor of medicine (MD) or doctor of osteopathy (DO) degree from a US or Canadian school approved by a recognized accrediting body in the year of the applicant's graduation (or an equivalent foreign medical degree permanently certified by the Educational Commission for Foreign Medical Graduates), at least 1 year of supervised experience providing direct service in a clinical setting, and licensure when required (as described at http://www.opm.gov/qualifications/SEC-IV/B/GS0600/0602.htm). We hypothesized that both higher levels of education and medical officer status would increase the probability of promotion.

Approximately 80 employees each year were classified as being in professional occupations, even though their education variable indicated that they had completed high school only. Because the majority of professional positions require a college education or the equivalent (e.g., the OPM defines professional occupations as white-collar occupations that "require knowledge in a field of science or learning characteristically acquired through education or training equivalent to a bachelor's or higher degree with major study in or pertinent to the specialized field, as distinguished from general education"[20]), we attributed this situation to data entry or recording errors. Because of the discrepancy, we excluded these records from our analysis. The gender distribution in this group was proportional to the overall gender distribution in the study, and there is no reason to believe that such errors would be correlated with gender or other explanatory variables. Thus, excluding them from our analyses should not have led to changes in the results.

Years of government service. Work experience in the federal government helps employees develop marketable skills and knowledge, as well as social networks that are more productive within rather than outside the government. These valued skills and knowledge might, in turn, increase their chances of being promoted within the agency. Number of years of government service in the personnel data system is computed for administrative purposes (i.e., to calculate qualified annual and sick leaves and to determine retirement eligibility). It is the period (rounded down to the closest integer in years) during which one is officially employed by the federal government, including approved annual, sick, and unpaid leave.

Race/ethnicity. The race/ethnicity code in the CDC personnel data classifies employees as White, Black, Hispanic, American Indian/Alaska Native, Asian/Pacific Islander, or of unknown race/ethnicity. We included 4 of these categories in this study: White, Black, Asian/Pacific Islander, and Hispanic; White was the reference category. American Indian/Alaska Natives and those of unknown race/ethnicity, together representing less than 1% of the study sample (with sample sizes that declined below 30 when stratified by gender), were excluded from the analyses because of data confidentiality concerns. Supplementary analyses indicated that the addition of another race/ethnicity category combining American Indian/Alaska Natives and those of unknown race/ethnicity did not affect our results qualitatively, most likely because of the limited sample size.

Analytic Approach

We used 2-sample *t* tests with unequal variances (for continuous variables) and 2-sample proportion tests (for discrete variables) to compare individual characteristics among men and women. In addition, Pearson χ^2 tests were calculated to compare the 2 categorical variables, race and education, between men and women.

In our analyses, we used ordinal logistic regressions for GSR grade to accommodate its ordinal nature[9]; we used regular logistic regressions for the binary indicators (i.e., GSR-14+ and GSR-15+). The explanatory variables included age, age squared, indicators of educational attainment, a binary medical officer indicator, years of government experience and its squared term, and indicators of racial/ethnic groups. We separated regressions by gender to generate the necessary parameter estimates for the decomposition conducted later in the analysis, and we used pooled estimation to examine the gap between men and women with respect to promotion.

Oaxaca–Blinder decomposition[21,22] has been used extensively in the labor economics literature to partition gaps between groups into differences that can be explained by control variables and residuals that cannot be explained by these variables. The residual is usually associated with differences in unobserved factors (e.g., social networks or discrimination). Using Oaxaca–Blinder decomposition, we decomposed the gender difference in promotion into 2 parts: that explained by individual characteristics (i.e., age, education, professional training, experience, and race/ethnicity) and the unexplained residual illustrated in the following equations[14]:

$$(1)\quad \hat{y}_m - \hat{y}_w = [f(x_m, \theta_m^*) - f(x_w, \theta_m^*)] + [f(x_w, \theta_m^*) - f(x_w, \theta_w^*)]$$

and

$$(2)\quad \hat{y}_m - \hat{y}_w = [f(x_m, \theta_w^*) - f(x_w, \theta_w^*)] + [f(x_m, \theta_m^*) - f(x_m, \theta_w^*)]$$

where $\hat{y}_m$ and $\hat{y}_w$ are predicted promotion grade (GSR grade, GSR-14+, or GSR-15+) for men and women, θ_k^* ($k = m$ [men], w [women]) indicates the maximum-likelihood estimates for the k gender group, and $f(x_i, \theta_j^*)(i, j = m, w)$ is the prediction for the i gender group using parameter estimates from estimations of the j group.

In both equations 1 and 2, the first term on the right-hand side identifies the part that can be explained by the differences in control variables x, conditional on a parameter structure, and the second term indicates the unexplained residual, which is a result of structural differences in parameter estimates. Although equations 1 and 2 involve different structural reference categories, they produce consistent results; thus, we present only the results from equation 1. We calculated values for both explained and unexplained gaps, as well as their share in the overall gap.

Sensitivity Analysis

We examined the sensitivity of the analysis to certain specification problems, including the distribution of GSR grades. As GSR grades have gradually inflated with time, the grade distribution has shifted toward the higher end, leading to a potential estimation problem. With a skewed distribution and different group sizes, low and high grades might have different functional relationships with individual characteristics. One way to remedy this problem is to group the grades into different categories according to levels of proficiency. We used and evaluated 2 grouping methods in this study. The first classified the grades into the following 4 levels of proficiency: trainee and entry (GSR-1 to GSR-8), intermediate (GSR-9 to GSR-11), full performance (GSR-12 to GSR-13), and senior expert (GSR-14 and above). We note this classification as P4.

We denote the other grouping method as P3 because it involved the following 3 levels of proficiency: trainee and entry (GSR-1 to GSR-9), full performance (GSR-10 to GSR-13), and senior expert (GSR-14 and above). The different functional relationship between dependent and independent variables across categories is also known as the proportional odds assumption in the biostatistics literature, and it can be addressed through use of the stereotype logit model.[23] We examined sensitivity to sample partition by occupation as well, using the PATCO occupational category code (which classifies positions as professional, administrative, technical, clerical, or other) to divide the sample into professional and nonprofessional categories.

RESULTS

The percentage of women among CDC GSR employees during the study period (2002–2006) was stable at slightly more than 60%. Table 1, which summarizes individual characteristics by gender, reveals noteworthy trends. In 2002, the average grade for women was 10.8, whereas the average grade for men was 12.5. The difference of 1.7 indicates that men tended to hold positions that were more than a full grade level higher than women. The average grades of both men and women increased steadily with time; however, the gender gap in average GSR grade, although narrowing with time, persisted (Figure 1a). In contrast, the gender gap with respect to GSR-14+ and GSR-15+ positions was steady over the study period, at approximately 18 and 8 percentage points, respectively. The percentage of women attaining GSR-15+ positions (5.6%) in 2006 was less than that of men (13.9%).

Our findings showed that the overall workforce is aging, with the average age increasing by 1.5 years among men and 1.2 years among women over the 5-year study period. Racial/ethnic composition among male employees changed slightly, with a 3.7-point decline in the percentage of Whites and a 2.3-point increase in the percentage of Blacks.

The educational profile of the workforce showed the greatest changes. Although both gender groups exhibited improvements in educational attainment, women's progress surpassed that of men. The percentage of women with master's degrees increased from 23.6% to 29.5% during the study period, as compared with a smaller increase among men (28.1% to 29.2%). The percentage of men with a high school education or less increased slightly with time. Although the percentages of both men and women who had doctoral degrees were higher in 2006 than in 2002, the percentage among men was approximately twice that among women (25.4% versus 14.7%). Finally, both gender groups demonstrated moderate increases in the percentage of medical officers (1.5% to 1.9% among women and 3.4% to 4.5% among men) as well as in average years of government service (13.3 to 13.6 years among women and 14.3 to 14.6 years among men).

Regression and Decomposition Analyses

Results from the ordinal logit regression with GSR grade as the dependent variable (Table 2) were consistent with the summary statistics relating to the role of gender. After control for observable characteristics (i.e., age, education, professional training, race/ethnicity, and years of government service), increases in GSR grade were less likely among women than among men (Table 2). A persistent but narrowing gender gap existed with respect to promotion, with a notable decline in the gap during from 2003 to 2004.

Age and years of government service exhibited nonlinear relationships with GSR grade. Both higher levels of education and medical professional training increased the probability of moving to a higher GSR grade. Although not shown in Table 2, racial/ethnic background was associated with promotion (the coefficients were negative, with Whites as the reference group). This finding deserves examination in future studies given that the racial/ethnic compositions of both the general population and the CDC workforce have changed with time, complicating the relevant statistical inferences.

Table 2 illustrates estimated odds ratios (ORs) for the GSR-14+ and GSR-15+ logistic regressions, respectively. The ORs for male gender associated with the GSR-14+ and GSR-15+ grades are illustrated in Figure 1. The gender gap in the probability of being promoted to GSR-14 or above declined with time, as indicated by the decrease in the OR for male employees from 1.595 in 2002 to 1.513 in 2006 (Table 2). However, the rate of decrease also diminished with time (Figure 1). Those who had more years of federal service, had a college education or above, and were medical officers had better odds of being promoted to GSR-14+.

A gender gap remained in terms of the probability of promotion to GSR-15+ (conditional on attainment of GSR-14+). In 2006, the odds of promotion were 22.5% higher for men than for women, a reduction from the 39.2% difference in odds in 2003 (Table 2). However, unlike promotion to GSR-14+, promotion to the more elite GSR-15+ depended

TABLE 1—Summary Statistics of Centers for Disease Control and Prevention Employees, by Gender: United States, 2002–2006

	2002 (n = 7611)		2003 (n = 7632)		2004 (n = 7640)		2005 (n = 7467)		2006 (n = 7479)	
	Women (n = 4710)	Men (n = 2901)	Women (n = 4741)	Men (n = 2891)	Women (n = 4737)	Men (n = 2903)	Women (n = 4514)	Men (n = 2953)	Women (n = 4540)	Men (n = 2939)
					Dependent variable					
GSR grade, mean	10.8	12.5***	11.0	12.6***	11.3	12.7***	11.6	12.7***	11.7	12.8***
GSR-14+, %	13.5	32.1***	14.5	34.2***	17.0	35.5***	18.9	36.9***	20.4	38.3***
GSR-15+, %	3.7	12.0***	3.5	12.4***	4.4	13.0***	4.9	13.3***	5.6	13.9***
					Independent variable					
Age, y, mean	44.2	46.9***	44.4	47.0***	44.7	47.4***	44.7	47.7***	45.4	48.4***
Years of government service, mean	13.3	14.3***	13.2	14.0***	13.3	14.1***	13.1	14.0***	13.7	14.6***
Race/ethnicity, %										
White (Ref)	61.2	76.0***	60.6	75.3***	60.8	74.6***	59.5	73.2***	58.8	72.3***
Black	31.2	14.0***	31.3	14.4***	30.9	15.0***	31.3	15.5***	31.8	16.3***
Asian/Pacific Islander	4.7	6.7***	5.0	6.8***	5.3	6.8**	6.0	7.4*	6.3	7.5*
Hispanic	2.9	3.3	3.1	3.5	3.0	3.6	3.2	4.0*	3.1	3.9*
Education, %										
High school or less (Ref)	11.5	2.0***	10.6	1.8***	10.1	2.5***	8.4	2.6***	8.4	2.9***
Some college	26.4	11.0***	25.4	10.2***	23.4	9.5***	20.8	9.2***	20.7	10.0***
College	27.4	36.1***	27.2	36.3***	26.7	34.9***	27.4	33.7***	26.7	32.5***
Master's degree	23.6	28.1***	25.3	27.8*	27.2	28.8	29.3	29.2	29.5	29.2
Doctoral degree or more	11.3	22.9***	11.5	24.0***	12.7	24.3***	14.1	25.2***	14.7	25.4***
Medical officer, %	1.5	3.4***	1.5	3.6***	1.6	3.8***	1.8	4.2***	1.9	4.5***

Note. GSR = General Schedule and related series; GSR-14+ = GSR grades equal to or greater than GS-14; GSR-15+ = GSR grades equal to or greater than GS-15. *P* values were calculated from 2-sample *t* tests with unequal variance (for continuous variables) and 2-sample proportion tests (for discrete variables). Pearson χ^2 tests were calculated for the 4 race/ethnicity categories and the 5 categories of education. The distributions of race/ethnicity and education were statistically different between men and women during the study period.
*$P<.1$; **$P<.01$; ***$P<.001$.

primarily on educational attainment. Status as a medical officer had a statistically significant and substantially larger impact on being promoted to GSR-15+ than non-medical officers, conditional on being promoted to GSR-14+. More important, although the OR for medical officer status increased steadily over time for GSR-15+, it gradually declined for GSR-14+.

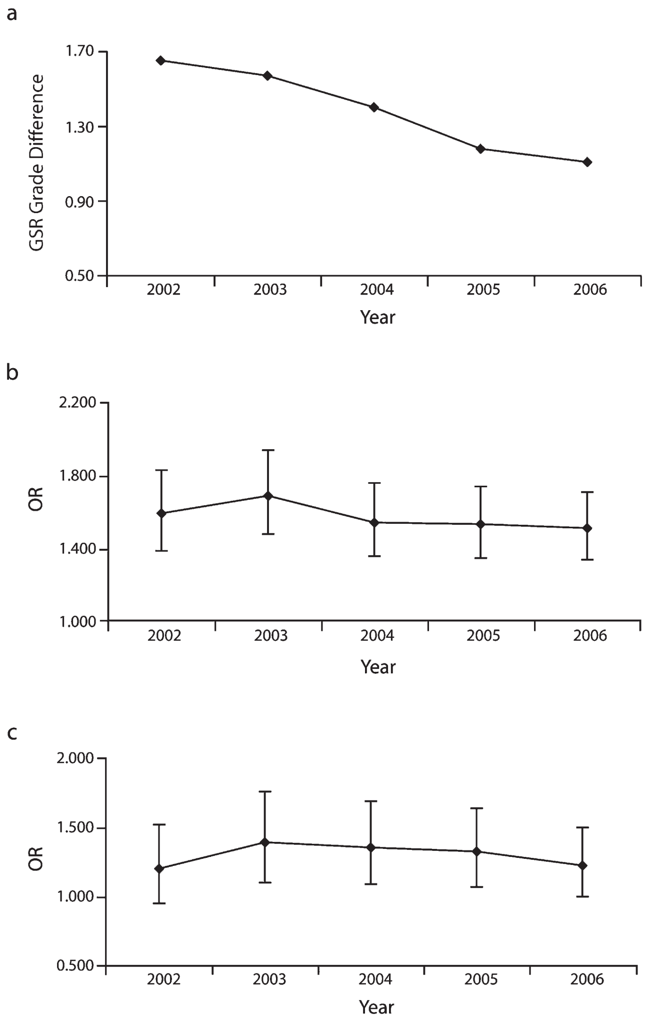
Predicted mean GSR grades revealed that the gender gap decreased with time. The probability of being promoted to GSR-14+ increased for both gender groups (Table 3). There were no major changes in the gender gap in terms of being promoted to GSR-15+ conditional on GSR-14+ status. Two key findings should be noted. First, individual characteristics (i.e., age, years of experience, education, professional training, and racial/ethnic background) accounted for a substantial percentage (approximately 70% for both GSR grade and GSR-14+ and approximately 50% for GSR-15+) of the change in the gender gap in promotion. Second, changes in individual characteristics accounted for approximately 60% of the change in this GSR grade gap. That is, women earned their improved career status through better education and more experience.

Sensitivity Analyses

Sensitivity analyses indicated that the gender gap in GSR grade diminished with time and that a sharp decline in 2004 occurred, regardless of the dependent variable (i.e., P3 or P4) or model specifications (i.e., stereotype logit). We examined sensitivity to sample partition and found that dividing the sample into professional and nonprofessional categories via the PATCO code did not change the main conclusions of our analysis (results of the sensitivity analyses are available on request from the authors).

DISCUSSION

One of the key conclusions that can be drawn from our findings is that the gender gap in promotion within CDC's workforce is diminishing. This diminishing gap is a result of improvements in education and experience among female employees. This trend coincides with societal changes during the past several decades that have led to improvements in educational attainment and higher rates of labor participation among women. Progress among female employees in educational attainment is in tandem with the situation in the US workforce as a whole, wherein the gender difference in education has diminished, or even reversed in certain cases, with time.[24] This



Note. CI = confidence interval; GSR = General Schedule and related series; GSR-14+ = GSR grades equal to or greater than GS-14; GSR-15+ = GSR grades equal to or greater than GS-15; OR = odds ratio. ORs for the male binary indicator were derived from logit regressions on GSR-14+ and GSR-15+. Regressions shown in panel C limited the sample to those at GSR-14+. ORs estimated predicted odds of promotion among men relative to women, all other factors being equal. The upper and lower bars represent 95% CIs.

FIGURE 1—Centers for Disease Control and Prevention employee trends in (a) gender differences in GSR grade, (b) odds ratios of promotion among men relative to women (dependent variable GSR-14+), and (c) odds ratios of promotion among men relative to women (dependent variable GSR-15+, conditional on GSR-14+), by year: United States, 2002–2006.

finding is also in agreement with the conclusion of Bowling et al. that women's increased access to senior positions in leading executive state agencies "springs from more solid educational, career, and organizational foundations."[12(p823)] However, on the basis of our results for GSR-15+ positions, we are unsure whether women now encounter fewer barriers in securing top posts in the agency, as Bowling et al. described for their sample during 1970 through 2000.

Explaining the Gender Gap

Our analysis indicates that individual characteristics explain only part of the gender gap in promotion at the CDC. A significant portion of that gap cannot be explained by observed individual characteristics, and some of the unexplained variance might be due to unobservable factors such as leadership skills. Although men's and women's educational levels converged over time, the unexplained portion of the gender differences in GSR-14+ positions increased slightly.

Examining personnel data from the OPM, Mani emphasized the role of education in explaining women's career advancement but noted that education could account for only part of the gender gap in salary she observed.[9] Note that we used indicators for education that are standard in empirical studies of this nature but could not control for differences in quality of education as a result of lack of relevant data. For example, rarely do personnel databases or surveys collect information on an employee's academic institution; however, even if such information were available, the existing literature does not provide a consistent and comprehensive assessment of educational institutions in terms of ranking (or quality) by field and specialty. Studies incorporating information on educational quality would be of interest if such data become available.

Lewis provided evidence that differing perceptions among men and women may be a factor in promotion and that horizontal mobility has restricted women's career advancement.[8] Employees may consider the effects of career changes on their partners and families, and this may have more of an adverse impact on women than on men. Studies in which labor market surveys have been used to examine the gender gap show that childbearing and child rearing may influence or disrupt women's career choices and career development more than men's, but our data did not include information on such factors.

In addition, as a result of confidentially concerns, personnel data systems generally do not incorporate information on family size, household composition (including information on number of children), marital status, and whether a household is headed by a woman. Moreover, even if these factors were controlled, there might still be unexplained variance as a result of unobserved factors such as the glass ceiling and gender roles (as argued by Hsieh and Winslow[10]). More detailed and focused surveys involving a sufficient number of employees are necessary to explore such concerns. The need for systematic data collection methods

TABLE 2—Regression Results From Ordinal and Binary Logit Models of Centers for Disease Control and Prevention Employee Characteristics: United States, 2002–2006

	2002, Estimate, b (95% CI)	2003, Estimate, b (95% CI)	2004, Estimate, b (95% CI)	2005, Estimate, b (95% CI)	2006, Estimate, b (95% CI)
	Coefficient estimates from ordinal logit model (dependent variable: GSR grade)				
No.	7611	7632	7640	7467	7479
Male	0.43*** (0.34, 0.52)	0.45*** (0.36, 0.54)	0.40*** (0.31, 0.49)	0.37*** (0.28, 0.46)	0.36*** (0.27, 0.45)
Some college	0.42*** (0.25, 0.59)	0.32*** (0.14, 0.50)	0.29*** (0.11, 0.48)	0.39*** (0.19, 0.59)	0.35*** (0.16, 0.54)
College	2.80*** (2.62, 2.98)	2.61*** (2.43, 2.80)	2.52*** (2.33, 2.71)	2.58*** (2.38, 2.78)	2.55*** (2.36, 2.75)
Master's degree	3.88*** (3.69, 4.08)	3.71*** (3.52, 3.91)	3.57*** (3.37, 3.77)	3.62*** (3.41, 3.83)	3.60*** (3.39, 3.80)
Doctoral degree or more	5.08*** (4.86, 5.30)	4.85*** (4.63, 5.07)	4.64*** (4.42, 4.86)	4.65*** (4.42, 4.88)	4.62*** (4.39, 4.84)
Medical officer	3.12*** (2.83, 3.41)	3.01*** (2.72, 3.29)	2.95*** (2.67, 3.22)	2.84*** (2.58, 3.11)	2.86*** (2.60, 3.12)
Years of service	0.10*** (0.09, 0.12)	0.09*** (0.07, 0.10)	0.09*** (0.07, 0.10)	0.09*** (0.07, 0.10)	0.10*** (0.09, 0.12)
Years of service squared	0.00*** (0.00, 0.00)	0.00*** (0.00, 0.00)	0.00*** (0.00, 0.00)	0.00*** (0.00, 0.00)	0.00*** (0.00, 0.00)
	OR estimates from logistic regressions (dependent variable: GSR-14+)[a]				
No.	7611	7632	7640	7467	7479
Male	1.60*** (1.39, 1.83)	1.69*** (1.48, 1.94)	1.55*** (1.36, 1.76)	1.54*** (1.35, 1.74)	1.51*** (1.34, 1.71)
Some college	0.71 (0.42, 1.22)	0.76 (0.45, 1.29)	0.52*** (0.33, 0.82)	0.64 (0.39, 1.05)	0.80 (0.49, 1.30)
College	5.26*** (3.37, 8.21)	5.04*** (3.24, 7.86)	3.22*** (2.26, 4.60)	3.91*** (2.62, 5.83)	4.55*** (3.01, 6.86)
Master's degree	11.96*** (7.64, 18.73)	10.75*** (6.88, 16.81)	6.98*** (4.88, 9.99)	8.03*** (5.36, 12.01)	9.68*** (6.41, 14.63)
Doctoral degree or more	47.64*** (29.93, 75.83)	38.79*** (24.48, 61.46)	23.22*** (15.98, 33.74)	26.67*** (17.60, 40.40)	30.82*** (20.16, 47.12)
Medical officer	100.68*** (53.39, 189.83)	65.03*** (36.14, 117.00)	107.99*** (53.16, 219.39)	57.33*** (32.71, 100.47)	57.29*** (32.20, 101.91)
Years of service	1.12*** (1.09, 1.14)	1.10*** (1.07, 1.13)	1.11*** (1.08, 1.13)	1.11*** (1.09, 1.14)	1.12*** (1.09, 1.15)
Years of service squared	1.00*** (1.00, 1.00)	1.00*** (1.00, 1.00)	1.00*** (1.00, 1.00)	1.00*** (1.00, 1.00)	1.00*** (1.00, 1.00)
	OR estimates from logistic regressions (dependent variable: GSR-15+)[b]				
No.	1564	1676	1835	1941	2053
Male	1.20 (0.95, 1.52)	1.39*** (1.10, 1.76)	1.36*** (1.09, 1.69)	1.33*** (1.07, 1.64)	1.23** (1.00, 1.50)
Some college	0.78 (0.14, 4.31)	0.34 (0.06, 2.05)	0.15*** (0.05, 0.46)	0.64 (0.20, 2.08)	0.97 (0.29, 3.16)
College	3.12 (0.89, 10.92)	2.22 (0.72, 6.86)	0.39*** (0.19, 0.78)	1.05 (0.44, 2.51)	1.56 (0.60, 4.05)
Master's degree	4.30** (1.23, 15.08)	2.62* (0.84, 8.14)	0.48** (0.24, 0.98)	1.29 (0.54, 3.08)	1.90 (0.73, 4.95)
Doctoral degree or more	6.46*** (1.84, 22.72)	4.23** (1.36, 13.20)	0.82 (0.41, 1.67)	2.18* (0.91, 5.25)	3.13** (1.20, 8.16)
Medical officer	3.24*** (2.18, 4.81)	3.17*** (2.15, 4.68)	3.21*** (2.21, 4.65)	3.42*** (2.40, 4.88)	3.67*** (2.62, 5.15)
Years of service	1.06*** (1.02, 1.11)	1.05** (1.01, 1.09)	1.05** (1.01, 1.09)	1.07*** (1.02, 1.11)	1.07*** (1.03, 1.11)
Years of service squared	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)

Note. CI = confidence interval; GSR = General Schedule and related series; GSR-14+ = GSR grades equal to or greater than GS-14; GSR-15+ = GSR grades equal to or greater than GS-15; OR = odds ratio. Age, age squared, and the race/ethnicity variables Black, Hispanic, and Asian/Pacific Islander were included in the regression but are not shown here for the sake of space. Estimates for ancillary parameters in the ordinal logit regressions in the top section are omitted.

[a]The reported estimates are the odds ratios for promotion with all other factors held equal.

[b]Conditional on GSR-14+.

*$P < .1$; **$P < .05$; ***$P < .01$.

could be addressed in future research through the development of appropriate survey instruments.

Carr et al. documented evidence that women in academic medicine perceive a lack of mentoring from senior female faculty on a broad range of skills, including conflict resolution, training in negotiation, and grant writing.[25] As illustrated by the summary statistics presented in Table 1, men do in fact dominate senior management positions; thus, the absence of female role mentors can be problematic for women employed at the CDC. Meanwhile, with more women stepping into middle management, the buddy system, as described by Lewis,[8] may play a reduced role in the career progression of women and may ultimately be phased out. Mentoring programs, along with long-term training opportunities, leadership training, and flexible work schedules to accommodate family needs, are potential intervention strategies that might help female employees rise to higher levels within the agency.[1,26,27]

It should be noted that the CDC has historically relied on multiple fellowship programs to generate a cadre of public health professionals, with promising graduates following career paths to leadership positions.[16] The declining gender gap might also reflect the increasing

TABLE 3—Oaxaca Decompositions of Gender Gaps in Promotion of Centers for Disease Control and Prevention Employees: United States, 2002–2006

	Predicted Value		Gender Gap			% of Gender Gap	
Year	Men	Women	Absolute Difference	Explained Difference[a]	Unexplained Difference[b]	Explained Difference[c]	Unexplained Difference[d]
Decomposition of predicted GSR grade: ordinal logit regressions							
2002	12.45	10.81	1.64	1.09	0.55	66.5	33.5
2003	12.52	10.97	1.56	1.04	0.52	66.6	33.4
2004	12.60	11.21	1.39	0.93	0.46	67.1	32.9
2005	12.68	11.50	1.17	0.79	0.38	67.3	32.7
2006	12.71	11.61	1.10	0.75	0.34	68.6	31.4
2002–2006			0.54	0.34	0.21	63.0	38.9
Decomposition of predicted promotion probability: GSR-14+ logit regressions							
2002	0.32	0.13	0.19	0.14	0.05	73.3	26.7
2003	0.34	0.15	0.20	0.14	0.06	69.5	30.5
2004	0.35	0.17	0.18	0.13	0.06	67.9	32.1
2005	0.37	0.19	0.18	0.12	0.06	65.6	34.4
2006	0.38	0.20	0.18	0.12	0.06	67.6	32.4
Decomposition of predicted promotion probability: GSR-15+ logit regressions[e]							
2002	0.37	0.28	0.10	0.06	0.04	63.3	36.7
2003	0.36	0.24	0.12	0.06	0.06	49.1	50.9
2004	0.37	0.26	0.11	0.06	0.05	52.7	47.3
2005	0.36	0.26	0.10	0.05	0.05	49.4	50.6
2006	0.36	0.27	0.09	0.05	0.04	56.4	43.6

Note. GSR = General Schedule and related series; GSR-14+ = GSR grades equal to or greater than GS-14; GSR-15+ = GSR grades equal to or greater than GS-15.
[a]Portion that can be explained by education, medical officer status, age, race/ethnicity, and years of government service.
[b]Total gender difference in outcome (predicted GSR grade and promotion probabilities) minus explained difference.
[c]Explained gender difference in outcome (predicted GSR grade and promotion probabilities) divided by difference in outcome between men and women × 100%.
[d]Unexplained gender difference in outcome (predicted GSR grade and promotion probabilities) divided by difference in outcome between men and women × 100%.
[e]Conditional on GSR-14+.

proportion of women in these fellowship programs who have eventually assumed leadership positions at the agency.

Limitations and Conclusions

One limitation of this study is that some of the employees (on average, 61 per year) on the administratively determined pay plan were excluded because we were unable to match them to a GS grade. Their salary range was comparable to the range from the high steps of GS-7 (or low GS-8) to the high steps of GS-14 (or low GS-15). Hence, this exclusion should not have led to systematic bias in our results.

We also excluded employees who were members of the PHS Commissioned Corps (which includes a substantial number of CDC's medical and scientific leaders) from our analysis. However, an examination of the data relating to the Commissioned Corps led to the same conclusion drawn for the GSR grades (i.e., although the gender gap has decreased with time, a substantial gap persists). On October 1, 2002, men accounted for 73.5% of Corps members with a rank of O-6 (a PHS rank that corresponds to GS-14 or GS-15), 54.3% of those with a rank of O-5, and approximately 44% of those in the O-1 through O-4 categories. As of October 1, 2006, 62.6% of the O-6 officers were men, and the percentages for the remaining grades were roughly the same as in 2002.

It is important to clarify that although we controlled for race and ethnicity in our regression analyses, we did not estimate or decompose disparities related to race/ethnicity because existing econometric methodologies cannot decompose on both dimensions (i.e., gender and race) at one time. Weeks and Wallace used survey data from the American Medical Association to assess gender and racial disparities in physician incomes.[28,29] However, we took a different approach for 2 reasons. First, although we acknowledge the importance of addressing both gender- and race-related disparities in workforce assessment, we focused our attention on gender disparities in this paper. Second, 1 of our objectives was to decompose gender disparity into contributions that can be explained and those that cannot be explained. Nonetheless, racial disparities are a critical issue, and exploring the determinants of racial gaps in career advancement by conducting race- and ethnicity-specific decomposition analyses could provide critical insights and remains a part of our future research agenda. Another limitation is our lack of information on supervising structures (e.g., knowledge of the gender of employees and their supervisors might provide more information).

Finally, the gender composition of newly hired or exiting employees may have had an impact on the gender differences in career advancement we observed. We believe that it is important to conduct additional studies to examine such factors as hiring and retention practices. We hope to explore these factors in future studies and are attempting to acquire longitudinal data sets with additional variables containing information on hiring and retention.

Our analyses of the CDC workforce revealed a narrowing gender gap with respect to promotion at the nation's leading public health agency. This diminishing gap can be explained in part by individual characteristics (e.g., education, experience, and age), but unexplained variance in the gap persists. Interventions or policies such as family-friendly workplace and mentoring programs can be used to further advance gender parity in promotion through provision of career assistance to female employees. ■

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Contributors

Z. Chen conducted the statistical analysis. All of the authors contributed to the origination of the study and the study design and to the writing of the article.

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