Gender Differences in Research Grant Applications and Funding Outcomes for Medical School Faculty

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ABSTRACT

Purpose: To evaluate whether there were differences in acquisition of research grant support between male and female faculty at eight Harvard Medical School-affiliated institutions.

Methods: Data were obtained from the participating institutions on all research grant applications submitted by full-time faculty from 2001 through 2003. Data were analyzed by gender and faculty rank of applicant, source of support (federal or nonfederal), funding outcome, amount of funding requested, and amount of funding awarded.

Results: Data on 6319 grant applications submitted by 2480 faculty applicants were analyzed. Women represented 29% of investigators and submitted 26% of all grant requests. There were significant gender differences in the mean number of submissions per applicant (women 2.3, men 2.7), success rate (women 41%, men 45%), number of years requested (women 3.1, men 3.4), median annual amount requested (women $115,325, men $150,000), mean number of years awarded (women 2.9, men 3.2), and median annual amount awarded (women $98,094, men $125,000). After controlling for academic rank, grant success rates were not significantly different between women and men, although submission rates by women were significantly lower at the lowest faculty rank. Although there was no difference in the proportion of money awarded to money requested, women were awarded significantly less money

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INTRODUCTION

In academic medicine, women are disproportionately entrenched in the lower levels of academic rank\(^1^\)\(^\text{--}^3\) and are less likely to engage in grant-supported research.\(^4^\)\(^,^5\) Previous research suggests that women apply for fewer grants and request less grant money than men.\(^4^\)\(^,^6\) As reported in 2005 from the National Institutes of Health (NIH), funded female applicants received on average 20% fewer dollars than male applicants.\(^4^\)\(^,^6\) The reasons for such disparities in grant funding as well as for the related issue of women’s underrepresentation in the senior ranks of scientific research are hotly debated. Analysis of gender disparities in grant funding is needed in order to expose potential biases and barriers to attaining research grants and academic advancement. Given that increasing numbers of women are entering the medical profession, gender disparities in grant funding foreshadow a critical loss of productivity and innovation.\(^7\)

For the past decades, research grant support has been critical in supporting the research mission of Harvard Medical School (HMS). Biomedical research conducted at HMS and its affiliated institutions was supported by $223,553,712 in 2006 (source: hms.harvard.edu/hms/facts.asp), almost exclusively from grants and contracts. In all medical research institutions, successful acquisition of research support not only is important to the advancement of scientific knowledge but also is fundamental to career development of faculty. To investigate the problem of gender disparity in grant funding for medical research, the Joint Committee on the Status of Women (JCSW) at HMS and Harvard School of Dental Medicine conducted a study of research grant submissions from 2001 through 2003 in eight HMS-affiliated institutions, representing 91% of the total faculty. The goal of this study was to determine if gender differences existed in grant applications and funding outcomes and, if so, to assess the relationship of academic rank and funding source to these disparities. This study replicates and extends previous research by controlling for faculty rank and by examining whether gender influences grant application behavior (number and types of grant applications, resubmissions, amount of funds requested, duration of grants, and funding source) as well as grant success. Such a study is important because it can provide data that may guide the development of interventions aimed at increasing grant success and academic advancement for women.

MATERIALS AND METHODS

The Grant Funding Parity subcommittee of the JCSW obtained data on research grants submitted for consecutive calendar years 2001 through 2003. The study was approved by the offices of sponsored programs and institutional review boards at the participating sites (Beth Israel Deaconess Hospital, Brigham and Women’s Hospital, Cambridge Health Alliance, Children’s Hospital, Dana Farber Cancer Institute, Harvard Medical School, Joslin Diabetes Center, Massachusetts General Hospital). Grants were included if the application was submitted by a principal investigator (PI) at the faculty level of instructor (the entry level for academic faculty at Harvard), assistant professor, associate professor, or full professor and a final funding decision was known. Fellowships and individual training grants were excluded. Datasets from all included institutions were submitted to the Data Coordinating Center at Children’s Hospital Boston and reviewed for completeness. The names of PIs were replaced with code numbers to prevent individual identification.

Data on faculty rank and the total number of full-time faculty at the participating institutions were obtained from the HMS Dean’s report for the year 2002 (the midpoint of our study). Less than 1% of faculty changed rank during the course of the study. Therefore, rank was assigned at the time of the most recent submission.

Variables included in our analyses were PI gender, year of submission, institutional affiliation,
were calculated for comparisons between women and men. For binary and categorical variables, the proportions by gender were compared using the chi-square test or the Fisher’s exact test. For continuous variables, gender differences were tested using parametric or nonparametric tests. The nonparametric two-sample Mann-Whitney Wilcoxon rank sum test was appropriate for the dollar amount of grant requested and awarded because the distributions were skewed in the positive direction. Combined data from participating institutions were analyzed, as the Breslow-Day test for homogeneity indicated that significant differences in female/male ORs were rare.

**RESULTS**

**Comparisons between female and male principal investigators**

Table 1 presents comparisons of grant applications, faculty composition, and outcomes of grants

<table>
<thead>
<tr>
<th>Variable</th>
<th>Both sexes</th>
<th>Women (%)</th>
<th>Men (%)</th>
<th>p valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean number of submissions per personb</td>
<td>2.6 (2.1)</td>
<td>2.3 (2.0)</td>
<td>2.7 (2.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Number and % of PIs submitting &gt;1 grant</td>
<td>1357</td>
<td>361</td>
<td>996</td>
<td>0.002</td>
</tr>
<tr>
<td>Mean number of years requested (±SD)</td>
<td>3.3 (1.6)</td>
<td>3.1 (1.6)</td>
<td>3.4 (1.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Median amount requested (direct costs, year 1)</td>
<td>$134,494</td>
<td>$115,325</td>
<td>$150,000</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Grants that were resubmissions</td>
<td>969/6312 (15%)</td>
<td>227/1636 (14%)</td>
<td>742/4676 (16%)</td>
<td>0.09</td>
</tr>
<tr>
<td>Number of grants funded (% success rate)</td>
<td>2792 (44%)</td>
<td>678 (41%)</td>
<td>2114 (45%)</td>
<td>0.002</td>
</tr>
<tr>
<td>Number of first submissions funded (% success rate)</td>
<td>2320/5343 (43%)</td>
<td>581/1409 (41%)</td>
<td>1739/3934 (44%)</td>
<td>0.06</td>
</tr>
<tr>
<td>Number of resubmissions funded (% success rate)</td>
<td>472/969 (49%)</td>
<td>97/227 (43%)</td>
<td>375/742 (51%)</td>
<td>0.05</td>
</tr>
<tr>
<td>Number of investigators funded for at least one grant (%)</td>
<td>1569 (63%)</td>
<td>428 (59%)</td>
<td>1141 (65%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean number of years awarded (±SD)</td>
<td>1.8 (1.4)</td>
<td>1.6 (1.0)</td>
<td>1.9 (1.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Median amount awarded (direct costs, year 1)</td>
<td>$119,168</td>
<td>$98,094</td>
<td>$125,000</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean % of requested amount awarded (±SD)</td>
<td>93% (17.1)</td>
<td>94% (16.7)</td>
<td>93% (17.2)</td>
<td>0.10</td>
</tr>
</tbody>
</table>

aDifferences were determined by the exact binormal test, Wilcoxon rank sum test or Student’s t test.
bAn additional 16 entries from 14 PIs did not contain information about the sex of the PI; 32 grants from 2 PIs did not list year of submission. A total of 2091 grant submissions were classified as pending or withdrawn. These entries were dropped from all analyses and not included in the tables or figures. Of these, 582 (28%) were submitted by women and 1509 (72%) were submitted by men.
submitted by women and men PIs. Grants were submitted by 2480 PIs, of whom 726 (29%) were women and 1754 (71%) were men. A total of 6319 grants met the inclusion criteria. Of these, 1639 (26%) were submitted by women and 4680 (74%) by men.

Compared with men, female investigators submitted fewer applications per person during the 3-year period (average number of submissions was 2.3 for women and 2.7 for men) and were less likely to submit more than one grant (50% of women applied for more than one grant whereas 57% of men applied for more than one grant). Women applied for fewer years of funding (average duration of funding request was 3.1 years for women and 3.4 years for men) and requested lower dollar amounts (average budget requested was $115,325 from women and $150,000 from men). Resubmission rates of previously nonfunded applications were not significantly different between men and women.

Overall, 41% of grants submitted by women and 45% of grants submitted by men were funded ($p < 0.001). Success rates were marginally significantly higher for men than for women on first submissions (41% for women and 44% for men, $p = 0.06$) and resubmissions (43% for women and 51% for men, $p = 0.05$). Among individual PIs, 59% of the women and 65% of the men received funding for at least one grant during the period of the study ($p < 0.001$).

On average, grants submitted by women received fewer years of funding than grants submitted by men ($p < 0.001$), and the median amount of money awarded to women was $27,000 lower than the median amount awarded to men ($p < 0.001$). These differences reflect the differences in years and amounts requested between male and female applicants. However, grants submitted by women and men received approximately the same percentage of the requested amount (94% for women and 93% for men, $p = 0.10$).

Results according to funding source

The proportion of women submitting to the NIH (56%, 922 of 1639) was significantly less than the proportion of men submitting to the NIH (62%, 2876 of 4680) ($p < 0.001$). Foundations received approximately the same proportion of non-NIH requests by women (64%) and men (61%). Success rates did not vary according to source of funding, and the median amount of funding received was higher for the NIH grants than for non-NIH grants for both men and women. However, men were awarded higher amounts than women in both NIH and non-NIH grants (median amount of NIH grants was $150,000 for women and $180,000 for men, $p < 0.001$, and median amount of non-NIH grants was $50,000 for women and $65,000 for men, $p < 0.001$).

Findings in relation to faculty rank

As we had data on academic rank from four institutions (representing 59.5% of all applicants and 58.6% of all grant submissions), we replicated the analyses described above and reanalyzed the data controlling for rank. Figure 1 illustrates that at each academic rank, success rates in obtaining grants were similar among men and women faculty. It also shows a trend toward increasing grant success for both women and men at higher academic ranks. Despite comparable success rates at all ranks, there were significant sex differences in dollars awarded at the ranks of instructor and associate professor (Fig. 2). As noted in Table 2, in the year 2002, the midpoint of our study, the percentage of female applicants was comparable to the percentage of male applicants only at the rank of assistant professor. A significantly lower percentage of women than men submitted grants at the rank of instructor ($p < 0.001$). However, at the highest academic ranks of associate and full professor, a significantly higher percentage of women than men submitted grants. Moreover, women at the higher academic ranks attained parity with men in both the amount and years requested.

DISCUSSION

We observed significantly lower rates of grant submission among female faculty compared with male faculty in eight HMS-affiliated institutions. Female faculty submitted fewer applications and requested fewer years of support and lower dollar amounts. As a result, when funded, women received fewer years of support and lower amounts than men. On first submission, male and female faculty were equally successful, and they resubmitted grants with the same frequency when not successful the first time. However, men
were more likely than women to submit multiple grants, to apply to the NIH, and to request more years and more dollars of support. Their success rate in resubmission was also marginally significantly higher than the success rate of women in resubmissions. When successful, both men and women received over 90% of dollars requested. Our data are in agreement with national data reported from the NIH for the same time period. In 2002, female applicants received 23% of the awards granted by the NIH and 20% of the funds. From 2001 to 2003, dollars awarded by the NIH to women were about 80% of the amount awarded to men. For Research Project Grants, the average award was $36,000 less for women. Overall success rates were 3% higher for men than women in the NIH data.

Although our results replicate national trends, our study carries the examination of these disparities further by examining the influence of academic rank. A 2000 report from the Wellcome Trust identified seniority as a contributing factor in gender disparity in grant applications from British Higher Education Institutions. Our study is the first in the United States to analyze grant success in biomedical research after controlling for academic rank. Although we found overall higher success rates for male compared with fe-
male applicants (45% vs. 41%, \( p = 0.002 \)), this difference was eliminated after controlling for academic rank. Success rates increased at higher academic ranks for both male and female faculty, but women were underrepresented in the higher ranks in our sample. Interestingly, among associate and full professors, women submitted more grants than men and attained parity with men in dollars and years requested as well as dollars awarded at the full professor level. This higher level of funding activity among women (as compared to men) at the highest academic ranks may be a reflection of the barriers to advancement for women at more junior levels. A greater proportion of women than men leave science at the lower academic ranks, and it is possible that the women who remain represent a highly select and productive group of researchers. Alternatively, as the Massachusetts Institute of Technology (MIT) study\(^{19} \) supports, female researchers may have fewer institutional resources than men and may, therefore, need to obtain more grant support. In addition, these senior women may be less likely than men to have other sources of income, such as endowed chairs or industry support.

This study included eight HMS-affiliated institutions, with unique characteristics in terms of size, resources, patient populations, research focus, and culture, thus representing a cross-section of Harvard investigators. Studies in other academic institutions are needed in order to determine the broader generalizability of our conclusions. Although this research refines our understanding of the gender gap in funding in the medical sciences, it does not explain the reasons for the gender differences we observed in funding requests. In addition, in interpreting our data, it is useful to take effect size into consideration regardless of statistical significance because of the role of sample size on determining significance.

Both individual and institutional factors could explain these types of disparities. From the individual perspective, it is possible that the gender differences in requests and awards simply reflect lower earnings by female physicians\(^{1,5,8–12} \) and, hence, the request for less money for personnel costs. A recent study found that women in academic medicine rated the quality of their work and personal lives as more important than other traditional markers of career success, such as earning potential.\(^{13} \) Gender differences in the distribution of effort devoted to research relative to patient care and teaching could also help to explain these results, particularly at the lower academic ranks. For instance, it may be the case that disproportionately fewer female than male instructors apply for grants because women at this academic level are more involved in teaching and clinical practice or because they become coinvestigators rather than PIs when beginning their careers and juggling family responsibilities. The more modest grant requests by women (as compared to men) might also reflect a preference for clinical research as opposed to basic or technological research. It is possible, too, that gender differences in grant requests reflect differences in male and female perceptions and interaction styles.\(^{14} \) Social psychological research has shown that women tend to ask for and negotiate less money than men when the parameters for asking are unclear.\(^{15} \)

From an institutional perspective, there is evidence that women receive less administrative and technical support than men in the sciences\(^{16–19} \) and less professional support from senior mentors or colleagues.\(^5 \) Other work suggests that the progress of women in academic medicine remains taxed by sex-based biases and stereotypes that favor men.\(^{20} \) The paucity of female mentors or female role models at higher ranks who could guide women through the grant application process may also contribute to disparities in grant requests. More
formation is needed on how women and men decide where to apply, how many grants to submit, how much to request, and when to resubmit.

CONCLUSIONS

It is critical that we bring more stringent analysis to the question of the gender disparity in grant funding. Otherwise, potentially biased impressions prevail, often preventing the initiation of remedial steps to increase grant success and academic advancement for women. The reporting of main-effect gender differences in grant funding misrepresents women’s accomplishments in scientific grant writing by suggesting that women are falling far behind their male peers. As our analyses show, this is not the case. As women are overrepresented in the lower academic ranks, controlling for academic rank shows that the women in our sample were as successful as the men in attaining grant funding. Women, however, were asking for less funding than their male peers except at the highest ranks. At those ranks, women are more likely than men to apply for grants. More research is needed to understand why junior women ask for less funding than their male peers, to examine if this is a problem given their research objectives and professional contributions, and to propose prescriptive suggestions for enhancing support for women’s scientific research as needed.

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