Hypothesis: The number of women authors in the surgical literature has increased during the past 20 years.

Design: Randomly selected issues of odd-year journals in Archives of Surgery and Annals of Surgery from January 1, 1985, to December 31, 2003, were reviewed. We determined the gender of each author and reported trends in the occurrence of women authors over time.

Results: The percentage of women authors has increased over time and parallels the percentage of women faculty in academic surgery positions. A much higher percentage of women authors than men authors are non-physicians. The trend for increased authorship by women over time was significant in Archives of Surgery.

Conclusion: Although the number of women first authors is low, their contributions to the field of surgery should be acknowledged, and efforts to provide women with the resources and opportunities to conduct research and publish their findings should be a focus for surgical departments looking to increase their research productivity.

Arch Surg. 2005;140:1074-1077

Women have been earning more bachelor’s degrees than men since the mid-1980s, with many women adopting traditional occupations such as teaching and nursing. Recently, the number of women attending medical schools has been greater than the number of men. However, the number of women entering and advancing in academic medicine continues to lag, especially outside the fields of pediatrics and obstetrics.

Women remain underrepresented in leadership roles in academic medicine, including full professorships, department chairs, and research leaders, and this lack is pronounced in the field of surgery. Approximately 14% of all surgeons are women. Many issues facing the advancement of women into leadership positions in surgery have been discussed, including a sense that they are overlooked as collaborators by their men associates.

Academic success is based on publication and grant productivity. Therefore, it is important that academic surgeons conduct and publish research in the surgical literature. Publishing as a first author indicates primary responsibility, because first authors are more likely to be principal investigators and to have additional specific knowledge about the topic.

Authorship patterns may indicate the integration of women into academic surgery. Previous studies have documented women authors in medical fields such as otolaryngology, mental retardation, epidemiology, and psychiatry. All of these studies showed increases in the number of women authors over time. However, few data are available about women’s participation as first authors in the surgical literature. The objective of this study was to determine the trends of women authors in 2 top surgical journals. Our hypothesis is that the number of women authors has increased during the past 20 years but is still lower than the number of men authors in the same journals.

METHODS

Two surgical journals, Archives of Surgery and Annals of Surgery, were reviewed for this study. Odd-year issues from January 1, 1985, through December 31, 2003, were examined. We analyzed data from 3 issues of each journal for each included year. A random number table generated in Microsoft Office Excel 2003 (Microsoft Corporation, Redmond, Wash) was used for issue selection.
The final analysis included only original research articles. For each included article, we recorded the gender of the first author. All study authors were classified as men or women according to their first names. Author gender was based on knowledge that the first name was associated exclusively with one gender (eg, “Jennifer” for women and “Christopher” for men). In some cases, we were unable to determine the gender of the first author based on his or her name alone. Some of the authors used initials instead of first names. In addition, a few of the authors’ first names were not associated with one gender (eg, “Reid”), or we did not know the gender with which the name was connected (eg, “Reiping”). In these cases, different techniques were used to identify the gender of the first author. If the author used an initial in place of a first name but listed a middle name, the middle name was used to classify the gender of the author, if possible. If there was no middle name or if the origin of the first name was unknown, colleagues with the same institutional affiliation as the first author were contacted to determine if they knew the gender of the first author. If that system did not result in a classification of the name, an Internet search was used to determine the gender of the first author. This gender identification strategy has been used elsewhere.4,11 There were some first authors for whom we were unable to identify their gender. These authors were included in the total number of authors but were excluded from other analyses.

We tallied the total number of women first authors for each year and for each journal. The frequency of women first authors was calculated as a percentage of the total number of first authors whose gender was known from the articles examined that year for each of the 2 journals. We also collected data on the gender of all study authors, determined in the same way as the gender of the first author, and the educational background of the first authors.

All data were collected and entered into a computer spreadsheet (Microsoft Office Excel 2003). Descriptive statistics are presented on the incidence of women authors among articles, and simple linear regression analyses were used to test our hypothesis of increasing numbers of women authors over time using commercially available software (SPSS for Windows, version 12.0; SPSS Inc, Chicago, Ill).

RESULTS

A total of 426 articles from Archives of Surgery and 404 articles from Annals of Surgery were included in this study. In both journals, the number of women first authors of articles increased over time. The gender was unknown for fewer than half of 1% of the first authors from Archives of Surgery (0.469%) and from Annals of Surgery (0.495%).

The percentage of women first authors in Archives of Surgery at the beginning of the study period was low. Approximately 2% of the first authors were classified as women. However, there was a continual rise during the mid-1980s to the mid-1990s. In 1997, the percentage of women first authors had dropped 11.5% from 1995, followed by a 12.3% increase from 1997 to 1999 (Figure 1). The rise in the number of women first authors was statistically significant (P = .04). Including the articles on which they were first authors, women in any authorship role constituted approximately 20% of the total number of authors in 2001 and 2003. This is consistent with the percentages of women first authors in those 2 years. Only 60% of the women first authors in 2001 and 2003 were physicians, compared with 83% and 96.3%, respectively, of men first authors in those years who were physicians, and there was a significant difference between women and men in their educational backgrounds (P = .03). Among the nonphysician women first authors, the first authors held advanced degrees of doctor of philosophy, master of science in public health, doctor of pharmacy, and fellow of the Royal Australasian College of Dental Surgeons in oral and maxillofacial surgery (Table 1).

In Annals of Surgery, 11.1% of the first authors were women in 1985. By 2003, women composed 25.6% of the first authors. In the early 1980s through the mid-1990s, a fluctuation was observed, with the percentage of women first authors decreasing from 11.1% in 1985 to 3.9% in 1991 and increasing to 18.5% in 1993. A steady rise in the number of women first authors has been seen since 1997 (Figure 2); however, the rising trend was not statistically significant (P = .24). Similar to Archives of Surgery, 20% of all authors in 2001 and approximately 27% of all authors in 2003 were women. These numbers parallel the percentages of women in first author roles. Fewer than 30% of the women first authors in 2001 were physicians, but the number rose to 81.8% in 2003. In those 2 years, more than 90% of the men first authors were physicians. There was no difference between women and men authors in their educational backgrounds (P = .28). The nonphysician women first authors held degrees of doctor of philosophy, doctor of veterinary medicine, master of science, bachelor of science, and registered nurse (Table 2).

Table 1. Educational Background of Women First Authors in Archives of Surgery

<table>
<thead>
<tr>
<th>Year</th>
<th>MD</th>
<th>MD and Other Degrees</th>
<th>PhD</th>
<th>PharmD</th>
<th>FRACDS</th>
</tr>
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<tr>
<td>2001</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2003</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
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</tbody>
</table>

Abbreviations: FRACDS, Fellow of the Royal Australasian College of Dental Surgeons; MD, doctor of medicine; PharmD, doctor of pharmacy; PhD, doctor of philosophy.
There has been an increase in the number of women first authors in the surgical literature, particularly in Archives of Surgery, in which the increasing trend was statistically significant. However, the proportion of women who were first authors is still low compared with men, and the percentage of all women authors is a small fraction of the total number of authors. We also looked at 2 other well-known surgical journals, Journal of Surgical Research and Surgery. In 2003, women composed 25.5% of the identifiable first authors in Journal of Surgical Research (the gender of 4.6% of authors was unknown), and among all authors, only 23.6% were categorized as women authors. Twenty-one percent of the identifiable first authors were women in Surgery (the gender of 2% of authors was unknown), while only 18.2% of all authors were identified as women. The results from these 2 journals are comparable to the 2003 outcomes seen in Archives of Surgery and Annals of Surgery of the percentages of women as first authors and as authors overall. All of these journals demonstrate that women are underrepresented as part of the research team, not only as first authors but also as authors in the surgical literature.

Studies in other disciplines have found similar low percentages of women first authors, but the percentages of women as first authors were increasing. In the otolaryngology literature, Bhattacharyya and Shapiro observed that the percentage of women who were first authors increased from 3.2% to 11.4% from 1978 to 1998. In a study of US epidemiology journals between 1982 and 1994, women were first authors of 28.7% of the articles. Similarly, in the psychiatry literature, women published fewer articles than men. Men were also more likely than women to have been principal investigators, served as mentors, engaged in research activities, and had research training in medical school and at the postdoctoral level.

We proposed possible explanations for the low proportion of women first authors in the surgical literature. One possibility is the low percentage of women in academic surgery. Although half of the graduates from medical schools are women, far fewer than half of them choose surgery as a career, while the number of women medical school graduates choosing other medical subspecialties such as pediatrics is increasing. Fields such as mental retardation, educational psychology, and pediatrics have more women authors than surgery. A study conducted by Porter et al showed that about 41% of the authors in the mental retardation literature were women. In the field of educational psychology, Robinson et al demonstrated that the female-male ratio of first authors was equalizing and that the increase in the number of women authors and editors from 1976 to 1996 was statistically significant (P < .001).

In this study, we found that approximately 15% to 25% of the first authors in the surgical journals examined were women. These percentages compare favorably with the percentage of women in academic surgery. However, a much higher proportion of publications by women are authored by nonphysician researchers in the field of surgery. These women have educational backgrounds in different areas, including public health, engineering, pharmacy, dentistry, veterinary medicine, nursing, epidemiology, and health services administration, and some hold positions as clinical specialists, assistant clinical professors, senior research fellows, associate professors, and epidemiologists. These researchers bring knowledge from their diverse disciplines and integrate that information with research in surgery.

Although more women are entering academic medicine, they are not yet reaching the level of traditional success that men have attained. Women researchers also tend to have less financial support and research space than men researchers. Grant reviewers may believe that women perform at a lower level than men; therefore, they may assign lower scores to research teams led by women. Women have a lower rate of acquiring grants overall, and that may persuade reviewers to allocate funds to men and to overlook the women applicants. We speculate that these inequalities may be especially difficult for women surgeons who must balance the clinical and academic components of their positions. Without additional resources and with typically greater responsibilities in the home, it presumably becomes increasingly difficult for women to conduct research, publish their findings, and advance in their academic careers. In addition, women perceive that they are less likely to be sought out as research collaborators by male colleagues. This may be evidenced by our find-

![Figure 2. Percentage of women first authors in Annals of Surgery.](image)

<table>
<thead>
<tr>
<th>Year</th>
<th>MD</th>
<th>MD and Other Degrees</th>
<th>MD and PhD</th>
<th>PhD</th>
<th>PhD and Other Degrees</th>
<th>BSc</th>
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<td>0</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2003</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2. Educational Background of Women First Authors in Annals of Surgery

Abbreviations: BSc, Bachelor of Science; MD, doctor of medicine; PhD, doctor of philosophy.
tating that women are not coauthors more often than they are first authors in the journals we reviewed.

Women surgeons also lack mentors.\(^1,10,14,16,17\) Mentors are essential guides, critical to the advancement of surgeons’ careers. Mentors are typically men, who may be more willing to work with men surgeons because they can relate more easily to other men or because they continue to harbor biased opinions of women surgeons. Surgeons with mentors are inclined to publish more, have more career opportunities, and be more confident in their abilities than fellow surgeons without mentors.\(^14\) Increasing the availability of mentors to women surgeons will provide them with role models, give them career advice, steer them toward the best possible training, provide them with a network of contacts, and sponsor them for opportunities of advancement.

Surgery is customarily considered a male specialty.\(^16\) This is exacerbated because women surgeons may find it more difficult than their male colleagues to allot time for their professional and family roles. The issue of pregnancy and the notion that childbearing years may interfere with residency training may lead women to other specialties.\(^1,14,18\) Women generally prioritize their family over work, and the long hours of residency may strain family life.\(^7,19\) Men, on the other hand, put their preferences into their work, and it is more acceptable that men spend the longer hours committed to their careers, whereas women are expected to spend those hours with their families. Women who bear children early in their professions and spend time with their families lose many opportunities during those important years to conduct research and publish their findings.\(^14\) By the time the children are grown, the woman surgeon may be in a stage of her life in which she is content with where she is, so she does not want to advance further in her career, or she may have to play catch-up to her male colleagues for the time she missed while her family was a higher priority than research and publication.

The results of our study indicate that the number of women first authors is increasing in the surgical literature. Lower percentages of women authors in the surgical literature arise from a combination of factors, some structural and others cultural. Although the low number of women first authors corresponds to the low representation of women in surgery, the important role of women as contributors to research in the field of surgery should be acknowledged, and efforts to provide women with the resources and opportunities to conduct and publish research should be a focus for surgical departments with the goal of increasing their research productivity.

Accepted for Publication: December 28, 2004.
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REFERENCES