

Representation of Women in The Society of Thoracic Surgeons Authorship and Leadership Positions



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Background. Recent years have shown a promising increase in women constituting the cardiothoracic (CT) surgery workforce and training positions. It remains unclear whether such change has been accompanied by parallel increases in academic achievement.

Methods. Online archives from The Society of Thoracic Surgeons (STS) 2015 and 2018 Annual Meetings were reviewed for female representation among oral abstract authors, nominated STS leadership positions, and *The Annals of Thoracic Surgery* (ATS) Editorial Board. Differences were assessed with χ^2 analyses, Fisher's exact tests, and *t* tests.

Results. In 2015, 36 of 336 (10.7%) presenting and senior authors were women ($P < .001$ vs men): 22 (13.1%) were presenting authors, and 14 (8.3%) were senior authors ($P < .001$ vs men for both). Between 2015 and 2018, no increase was observed in female authorship, with 29 of 278 (10.4%) authorship positions filled by women ($P < .001$ vs men). In 2018,

women filled 18 (12.9%) presenting and 11 (7.9%) senior author positions. This lack of change in representation over time held true in the adult cardiac, congenital, and general thoracic subspecialties. Nevertheless, there was a trend toward women more often occupying nominated STS leadership positions in 2018 (68 [12.3%] vs 40 [9.1%], $P = .092$). Similarly, there were significantly more female ATS Editorial Board members in 2018 than in 2015 (14 [15.7%] vs 4 [5.4%], $P = .029$).

Conclusions. Despite increased representation in the CT surgery workforce, women remain stagnant in their underrepresentation in academic authorship and leadership, particularly at the senior level. There remains ample room for improvement, further validating STS's recent emphasis on diversity and inclusion.

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The field of cardiothoracic (CT) surgery has experienced a tremendous growth in the number of women trainees and practicing surgeons since 1961, when only 3 women had been board certified.¹ In parallel, women have also become increasingly involved on academic fronts, making great strides in patient care, research, and societal leadership over the past 60 years. Nevertheless, women still account for a significant minority in all areas of the specialty, particularly in certain domains such as invited lectureship and national leadership positions.

Limited studies have characterized the academic productivity of women in CT surgery over a broad scope.

This form of analysis is critical, because a greater proportion of women practice in academic settings compared with the entire CT surgery workforce.² Reports from other specialties have identified benchmarks for improvement in areas such as female authorship and participation in national meetings. Our study focuses on the engagement of women in The Society of Thoracic Surgeons (STS). Archived data from STS are readily available to assess trends over multiple Annual Meetings. STS-sponsored opportunities also serve to represent multiple means of academic achievement, with special attention to noteworthy contributions to scientific research and esteemed positions of national recognition. Moreover, recent initiatives begun by STS's 53rd President emphasize the importance of cultivating an environment of inclusion within STS and the specialty at large.³ Accordingly, it is vital to identify specific areas for growth in academic CT surgery where we may support and elevate women and thus realize greater potential for academic productivity and service to our diverse population of patients.

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In this study, we aimed to characterize the relative representation of women among STS authorship positions, assessing involvement at the first and senior author positions and leadership roles, and to evaluate changes over time. Finally, we attempted to evaluate different routes for intervention to increase diversity and inclusion in the specialty, aiming to recruit and retain the best and brightest.

Material and Methods

In order to quantify our variables of interest, we sought data regarding representation of women in various phases of their career as well as various STS authorship and leadership positions.

The Association of American Medical Colleges (AAMC) published 4 Physician Specialty Data Reports in 2008, 2012, 2016, and 2018, reflecting data from 2007, 2010, 2015, and 2017, respectively. These reports include primary data from the American Medical Association; the U.S. Census Bureau; and GME Track, a resident database and annual survey sponsored by the American Medical Association and AAMC with a response rate of roughly 95%. For the current study, we obtained data concerning the distribution of men and women among Accreditation Council for Graduate Medical Education (ACGME) residents/fellows and active CT surgeons in each year.

Data surrounding the STS were obtained from the publicly available STS Annual Meeting 2015 and 2018 Archives, including the Annual Meeting Abstract Books and Program Guides. An individual's gender was determined by initially inspecting the first name and then searching the Internet for a photograph depicting the individual as a man or woman and/or a profile using the pronouns "he" or "she". A single researcher performed the necessary Web searches. First, we identified the representation of men and women among the STS membership body at large. Membership subgroup data including Pre-Candidate (medical student or general surgery resident), Candidate (CT surgery resident), Active (CT surgeon), Senior (CT surgeon who is over 70 years old or retired), and Associate (non-CT surgery physician) membership were supplemented from the 2015 and 2018 STS Membership Databases. We also obtained gender data surrounding academic contributions to STS in 3 categories: oral abstract authors, leadership roles at the Annual Meetings, and nominated societal leadership positions.

We identified the gender of presenting and senior authors of oral abstracts. Presenting authors were defined as those with bolded names listed before each abstract. Senior authors were defined as the last author listed in each abstract's group of authors. Eight authors in 2015 and six in 2018 served as both the presenting and senior author. Two abstracts in 2018 listed only 1 author. Individuals serving as both presenting and senior authors and sole authors of abstracts were counted as both first and senior authors for the respective study. Only oral presentations published in the Abstract Books were included in the study. Oral presentations were chosen for

analysis because these have tended to be more selective and thus potentially more reflective of academic distinction and societal priority. Subspecialty was designated based on the name of the session during which the abstract was presented: Adult Cardiac, Congenital, General Thoracic, Education, or Quality Improvement. Abstracts presented outside of these sessions were included in the totals and not further classified into subspecialties.

Among STS Annual Meeting leadership roles, we determined the gender of session chairs, invited lecturers, and STS University (STSU) course directors. Session chairs were defined as moderators, facilitators, and judges. Invited lecturers encompassed panelists and individuals who gave talks without accompanying abstracts, excluding those who led the "welcome" introduction periods at the beginning of sessions. Session chairs who also served as invited lecturers were included in both groups. Invited lecturers who gave more than 1 presentation were counted for each presentation. STSU course directors were defined as individuals designated as such, excluding those who served as assisting faculty in 2018.

Finally, we reported the gender of individuals holding nominated societal leadership positions, including committee members, committee chairs, and *The Annals of Thoracic Surgery* (ATS) Editorial Board members. Committee members were defined as STS standing committees, council operating boards, and workforces. Committee chairs represented the designated leaders of each standing committee, council operating board, and workforce. ATS Editorial Board members included the Editors-in-Chief, Deputy Editors, Associate Editors, and Editorial Board members.

Statistical analysis included χ^2 and Fisher's exact tests between men and women within a single category and Student *t* tests to assess changes in gender representation over time and was performed with Microsoft (Redmond, WA) Excel Analysis ToolPak software.

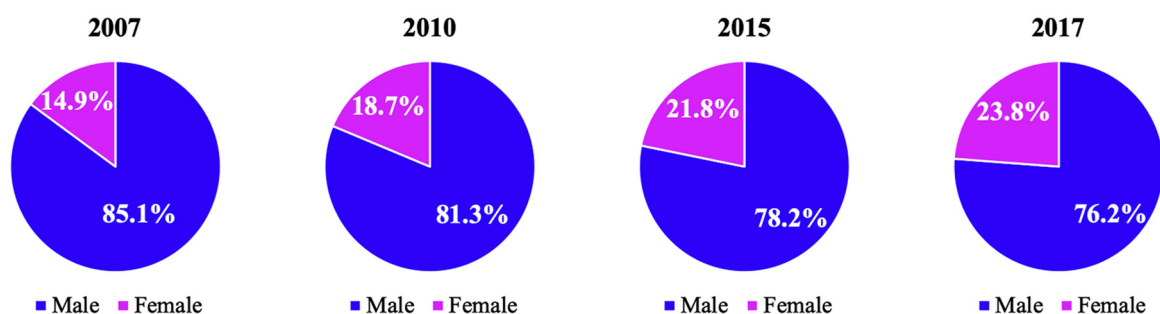
This study was exempted by the institutional review board, as no human participants were included and data are represented as aggregated totals.

Results

During each year surveyed, men accounted for significantly more ACGME resident/fellow positions and active CT surgeons than did women ($P < .001$ for both; [Figure 1](#)). There was a significant increase in female trainees from 38 (14.9%) in 2007 to 105 (23.8%) in 2017 ($P < .001$), however. Likewise, there was a significant increase in active female CT surgeons from 181 (3.8%) in 2007 to 309 (7.0%) in 2017 ($P = .002$).

Men made up significantly more presenting, senior, and combined oral abstract author positions than did women in nearly all categories in 2015 and 2018 ([Table 1](#)). In 2015, women filled 36 (10.7%) of 336 presenting and senior author positions, compared with 300 (89.3%) positions filled by men ($P < .001$). In 2018, there were 29 (10.4%) female presenting and senior authors vs 249

ACGME Thoracic Surgery Residents and Fellows



Active Thoracic Surgeons

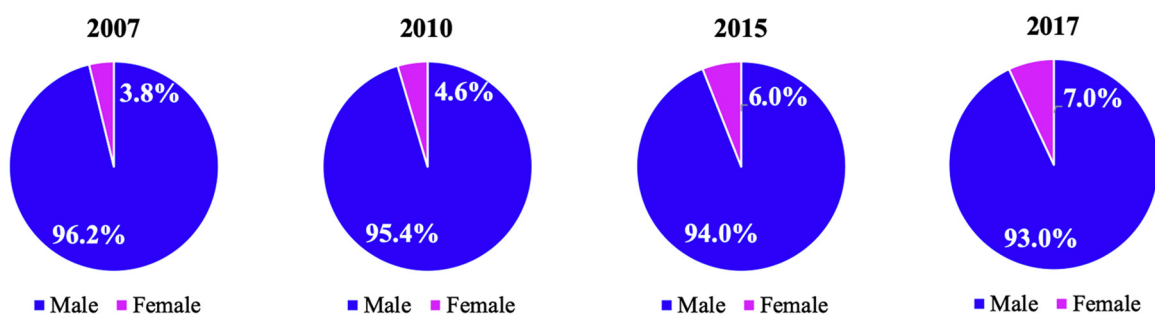


Figure 1. Gender distribution of cardiothoracic surgery trainees and active surgeons from 2007 to 2017. (ACGME, Accreditation Council for Graduate Medical Education.)

(89.6%) male authors ($P < .001$). There was a trend toward women more often occupying presenting author rather than senior author positions, both in 2015 (22 vs 14 [13.1% vs 8.3%], $P = .174$) and 2018 (18 [12.9%] vs 11 [7.9%], $P = .090$). Ultimately, when assessing for changes in

representation over time, no significant differences were found in female presenting, senior, and combined authorship between 2015 and 2018. This result held true for the Adult Cardiac, Congenital, and General Thoracic subspecialties.

Table 1. Gender Distribution of STS Oral Abstract Authorship in 2015 and 2018 by Author Rank And Subspecialty

Abstract Authorship	2015			2018		
	Women	Men	P Value	Women	Men	P Value
Total presenting and senior authors	36 (10.7)	300 (89.3)	<.001 ^a	29 (10.4)	249 (89.6)	<.001 ^a
Total presenting authors	22 (13.1)	146 (86.9)	<.001 ^a	18 (12.9)	121 (87.1)	<.001 ^a
Adult cardiac	4 (6.3)	59 (93.7)	<.001 ^a	6 (12.8)	41 (87.2)	<.001 ^a
Congenital	1 (3.1)	31 (96.9)	<.001 ^a	2 (8.0)	23 (92.0)	<.001 ^a
General thoracic	11 (26.8)	30 (73.2)	<.001 ^a	6 (14.3)	36 (85.7)	<.001 ^a
Education	3 (37.5)	5 (62.5)	.619	2 (40.0)	3 (60.0)	1
Quality improvement	1 (16.7)	5 (83.3)	.080	1 (25.0)	3 (75.0)	.486
Total senior authors	14 (8.3)	154 (91.7)	<.001 ^a	11 (7.9)	128 (92.1)	<.001 ^a
Adult cardiac	6 (9.5)	57 (90.5)	<.001 ^a	3 (6.4)	44 (93.6)	<.001 ^a
Congenital	1 (3.1)	31 (96.9)	<.001 ^a	1 (4.0)	24 (96.0)	<.001 ^a
General thoracic	4 (9.8)	37 (90.2)	<.001 ^a	2 (4.8)	40 (95.2)	<.001 ^a
Education	0 (0)	8 (100.0)	<.001 ^a	2 (40.0)	3 (60.0)	1
Quality improvement	2 (33.3)	4 (66.7)	.567	1 (25.0)	3 (75.0)	.486

^a $P < .05$ is statistically significant.

Values are presented as n (%).

STS, The Society of Thoracic Surgeons.

Table 2. Gender Distribution of STS Annual Meeting Leadership in 2015 and 2018

Leadership	2015			2018		
	Women	Men	P Value	Women	Men	P Value
Session chairs	24 (13.0)	160 (87.0)	<.001 ^a	17 (13.0)	114 (87.0)	<.001 ^a
Invited lecturers	27 (11.1)	216 (88.9)	<.001 ^a	33 (10.7)	274 (89.3)	<.001 ^a
STSU course directors	3 (10.0)	27 (90.0)	<.001 ^a	4 (19.0)	17 (81.0)	.005 ^a

^aP < .05 is statistically significant.

Values are presented as n (%).

STS, The Society of Thoracic Surgeons; STSU, STS University.

We next assessed representation of women among STS Annual Meeting session chairs, invited lecturers, and STSU course directors, given their roles as nominated leaders and recognized experts in their respective subspecialties. Men accounted for significantly more session chairs, invited lecturers, and STSU course directors than did women in both 2015 and 2018 ($P < .005$ for all; Table 2). Notably, women constituted only 27 of 243 (11.1%) and 33 of 307 (10.7%) invited lecturers in 2015 and 2018, respectively. These results are comparable to women authors of oral abstracts. Again, when we conducted analyses to assess for changes over time, there were no significant differences in female representation among these STS Annual Meeting leadership roles between 2015 and 2018.

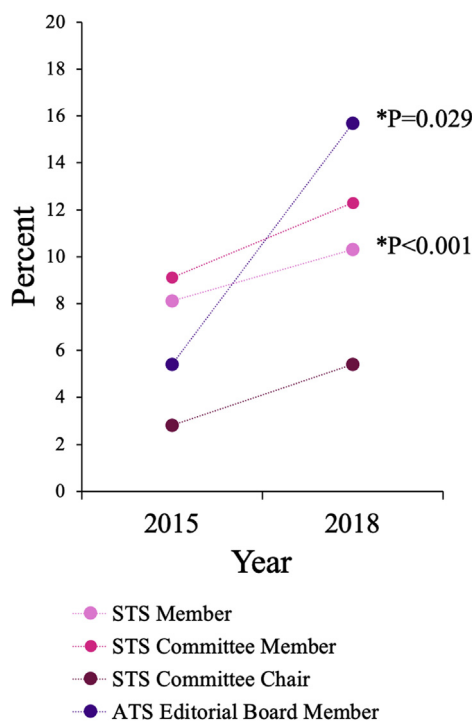


Figure 2. Gender distribution of The Society of Thoracic Surgeons (STS) membership, STS leadership committees, STS committee chairs, and The Annals of Thoracic Surgery (ATS) Editorial Board membership in 2015 and 2018. *P < .05 is statistically significant.

Even though significantly more men compose the STS membership body each year ($P < .001$ vs women), STS has seen a significant growth in female members, from 570 (8.1%) in 2015 to 785 (10.3%) in 2018 ($P < .001$; Figure 2 and Table 3). In 2015 and 2018, women constituted a greater proportion of Pre-Candidate, Candidate, and Associate members than they did Active and Senior members. There was, however, a significant increase in female Active members from 2015 to 2018 (142 [5.2%] vs 209 [7.1%], $P = .0028$). Although there were no significant differences in female representation among STS leadership committees between 2015 and 2018, there has been a trend toward more women serving on committees in 2018 compared with 2015 (68 [12.3%] vs 40 [9.1%], $P = .092$). One (2.8%) woman in 2015 and 2 (5.4%) women in 2018 served as committee chairs, and this difference was not significant. There was, however, a significant increase in women serving on the ATS Editorial Board from 4 (5.4%) in 2015 to 14 (15.7%) in 2018 ($P = .029$), although men continue to fill the majority of positions each year ($P < .001$ vs women). ATS Editors-in-Chief have always been men. Finally, of the 52 Presidents who have served STS, 100% have been men; Carolyn Reed was elected posthumously and never officially served.

Comment

CT surgery has seen an increasing number of women entering residency and graduating into the workforce. However, among surgical specialties designated by the American College of Surgeons and included in the AAMC Physician Specialty Data Reports, in 2017, Thoracic Surgery ranked 8 out of 10 in the percentage of female ACGME residents/fellows and 9 out of 10 in the percentage of female active physicians (#1: Obstetrics and Gynecology and #10: Orthopedic Surgery in both categories).⁴ These disparities are concerning, as recent studies have projected a critical shortage of at least 1500 CT surgeons (25% of the estimated need) by 2025 and a 61% increase in the national case volume by 2035.^{5,6} Issues of gender inequality have also been suggested to have a direct impact on patient safety.⁷ The stability of the specialty and wellbeing of our future patients depend on actions we take in the present to foster early interest among female trainees and ensure their successful transition into independent practice.

Table 3. Gender Distribution of STS Membership, STS Leadership Committees, STS Committee Chairs, and ATS Editorial Board Membership in 2015 and 2018

Societal Role	2015			2018		
	Women	Men	P Value	Women	Men	P Value
STS member	570 (8.1)	6442 (92.9)	<.001 ^a	785 (10.3)	6830 (89.7)	<.001 ^a
Pre-candidate	64 (25.7)	185 (74.3)	<.001 ^a	101 (27.9)	261 (72.1)	<.001 ^a
Candidate	96 (20.1)	382 (79.9)	<.001 ^a	112 (20.2)	442 (79.8)	<.001 ^a
Active	142 (5.2)	2610 (94.8)	<.001 ^a	209 (7.1)	2755 (92.9)	<.001 ^a
Senior	3 (0.2)	1811 (99.8)	<.001 ^a	7 (3.4)	2064 (96.6)	<.001 ^a
Associate	14 (23.7)	45 (76.3)	<.001 ^a	152 (33.1)	307 (66.9)	<.001 ^a
STS committee member	40 (9.1)	398 (90.9)	<.001 ^a	68 (12.3)	474 (87.7)	<.001 ^a
STS committee chair	1 (2.8)	35 (97.2)	<.001 ^a	2 (5.4)	35 (94.6)	<.001 ^a
ATS editorial board member	4 (5.4)	70 (94.6)	<.001 ^a	14 (15.7)	75 (84.3)	<.001 ^a

^aP < .05 is statistically significant.

Values are presented as n (%).

ATS, *The Annals of Thoracic Surgery*; STS, The Society of Thoracic Surgeons.

Although women now occupy more positions at each level of training in CT surgery, the growth has been largest at the resident/fellow level and decreases with increasing academic rank and leadership role. From 2007 to 2017, the percentage of female CT surgery residents grew by 8.9%, whereas the percentage of active female CT surgeons grew by only 3.2%. This trend is apparent in the broader academic landscape: 61% of women surgeons certified by the American Board of Thoracic Surgery as of 2010 reported their academic appointment as assistant professor, followed by 20% of women serving as associate professors and 18% of women as full professors.² Similarly, in 2018 women constituted only 29.2% (2036 of 6976) of assistant professors, 21.5% (727 of 3382) of associate professors, and 12.2% (487 of 3982) of full professors in surgery at U.S. medical schools.⁸ These results may be due to the relatively slow ascent, attrition, and other barriers to the retention of women in academic CT surgery and surgery overall, even though no specific data exist to support that retention is a larger issue than recruitment. Moreover, there are published results from a recent survey of CT surgery residents to support that there are gender differences in the perception of technical preparedness and independent practice, a factor that could negatively affect the interests and goals of younger trainees.⁹ In light of this finding, programs for medical students and residents, such as the STS Looking to the Future Scholarship, should be recognized as successful best practices based on the proportionate increases in women at this career stage. Similar programs offering direct mentorship and increased visibility and sponsorship at the Annual Meetings, such as the early-riser sessions led by Women in Thoracic Surgery and the Thoracic Surgery Awards Foundation Nina Starr Braunwald Research Fellowship, are warranted for senior residents and early-career women surgeons to ensure their academic engagement at this critical upward transition.¹

The subject of overt and conscious gender bias raises significant concerns in the context of academic

achievement and promotion, as 55% of women CT surgeons have reported frequent or somewhat frequent gender discrimination that hindered career advancement.¹⁰ It is encouraging that STS leadership has become intentional about examining and correcting this issue.

Vertical gender segregation in academic CT surgery may also be explained by women's relatively greater allotment of time on activities that do not garner tangible progress towards academic promotion. Of note, Stephens and colleagues report that graduating women CT surgery residents desire to perform research less than men do.⁹ Future studies should seek to more fully elucidate the challenges of female academic promotion in CT surgery.

Our study examines the academic productivity of women in CT surgery through the objective measure of research output. We found that more men than women were authors of 2018 STS Annual Meeting oral abstracts, and this result did not change significantly from 2015. Gender discrepancy is most significant among academic surgical authorship compared with that of other medical specialties.¹¹⁻¹³ The phenomenon is apparently universal across disciplines, as a recent study of academic pediatricians found that women are underrepresented among last and coauthors, particularly of articles written by male first authors, suggesting that women are less frequently invited to collaborate on research.¹⁴ As such, the process remains inefficient for women researchers to secure authorship opportunities. Senior faculty should facilitate increased protected research time for women and inclusion of women in large authorship groups.

In our study, we used presenting author as a proxy for junior academic rank and senior author for more senior rank. Although we found that the proportion of female authorship (at roughly 10%) mirrors the proportion of women among the STS membership body at large, we recognize that many presenting authors are trainees and most female STS members are also students, residents, and non-CT surgeon physicians. Similarly, we identified a trend toward fewer women serving as senior compared

with presenting authors of STS oral abstracts. This result parallels the stagnation of women in climbing the ladder of academic ranks in CT surgery, since principal investigator roles are more often occupied by senior faculty, who are more often men. In contrast, early-career surgeons, who are more likely to serve as first authors, perform a greater proportion of work for less sustainable tangible benefits. Notably, women surgeons have been shown to produce higher manuscript publication rates after oral abstract presentations, with a higher average impact factor.¹³ Evidently, women excel at seeing projects through to completion and producing high-quality work. As such, quality should additionally be recognized as a superior measure of academic productivity and one in which women surgeons greatly excel. Future studies will aim to survey publications in major CT surgery journals for trends in female authorship.

After analyzing gender distribution among types of membership within STS, we found that women composed a much greater proportion of Pre-Candidate, Candidate, and Associate members than they did Active and Senior members. It remains to be understood whether underrepresentation at the podium discourages women's pursuit of Active membership or if the lack of female Active and Senior STS members leads to the gender disparity among academic achievements at Annual Meetings. As the number of women has now exceeded that of men entering American medical schools, the pipeline is as large as it has ever been. This disparity in academic appointments reflects not only the slow ascent of women into senior positions but also the hierarchical organizational structure of academic surgery and the pervasive self-perception among women that their gender hinders academic promotion.¹⁵

Lack of progress is also reflected in the relatively few women serving in leadership positions in STS. Although STS must continue to advance early career initiatives, much less obvious efforts exist for mid- to senior-career women, in part due to a relatively heavy focus on recruitment and because mid- to senior-career women are less often invited to serve in these positions. The Workforce on the Annual Meeting should work to recognize expertise beyond the confines of academic rank and implicit biases surrounding gender, thus increasing the number of tangible opportunities for otherwise overlooked individuals and enhancing the quality of review for academic content.

Despite much progress yet to be achieved, the percentage increases from 2015 of 3.2% and 10.3% in women who serve on STS committees and the ATS Editorial Board, respectively, are promising. As more women begin to rise into these leadership positions, they should seek to nominate other women, especially their qualified juniors. Particularly at the senior level, both women and men should extend their influence beyond mentorship to that of sponsorship to maintain the momentum.

A recognized limitation of this study is that it only accounts for the academic productivity of women CT surgeons contributing to the STS Annual Meetings. It is unclear how accurate and comprehensive the AAMC

database is beyond its primary sources. Given the constraints of publicly available data, we also recognize the limitations of including only 2 years in our analysis. Thus, we can characterize only short-term trends in gender representation with the caveat that either year may be an outlier. Future work will aim to more broadly assess women's involvement across the specialty and include additional time points wherever possible.

More so than diversity, inclusion is the action of providing a voice and opportunities to all. Not only is it important to attract and retain the best and brightest inclusive of gender, but it is also even more vital to enable these individuals to achieve their full potential at each stage in their careers. Our colleagues, selection committees, and professional societal leadership must become cognizant of the systemic processes and implicit biases that perpetuate female stagnation in academic CT surgery. Courage to legitimize these issues through tangible action will enhance the academic productivity and social environment of our specialty for years to come.

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INVITED COMMENTARY



In this issue of *The Annals of Thoracic Surgery*, Olive and colleagues¹ examine the state of cardiothoracic surgery academic achievement and leadership among women by comparing data from the 2015 and 2018 Society of Thoracic Surgeons Annual Meetings. The authors, successful in academia and leadership, and being champions of gender parity, are well qualified to analyze and discuss such data. The study is notable for its objective analysis. Prior studies in this arena have used survey methodology, which has inherent biases and subjectivity. However, the 2012 Women in Thoracic Surgery² survey had a remarkable 65% response rate, exceeding the 2010 general workforce survey³ and signifying the importance of these issues to women cardiothoracic surgeons. More than half of women respondents were in academic practices, nearly one third had secured research funding, and 20% reported protected research time. Thus, academic productivity is a timely topic, especially in light of recruitment needs.

We wish to comment on two aspects of the study. First, defining a trend with only two time points over a short period may only partially reflect reality. Public discourse about the need for broader diversity and inclusion has grown rapidly in the last few years, and rightly so. However, success in this arena should be not necessarily judged by looking for a similar rate of change. The pipeline is long, both for training and for meaningful academic achievement. What is required is the institution of inclusive mentoring efforts at the earliest stages of medical education. The Women in Thoracic Surgery scholarship, which has supported nearly 100 women trainees since 2005, and the inclusivity initiatives of The Society of Thoracic Surgeons are important contributors

to early successes. Credit is also due to all leaders of both sexes who have promoted diversity by sponsoring individuals and promoting institutional culture change. Second, we must recognize that the academic track is not for all. Focusing mentorship efforts solely on academic achievement and promotion may risk neglecting, or worse, deterring, those who wish to pursue nonacademic careers. Ultimately, however, efforts at the student and trainee level need to be sustained through the long career path. The work by Olive and colleagues¹ is an important first step in validating and promoting the many personal, institutional, and societal efforts toward this end.

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