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Case Report

Women in Surgery – Publication Activity in German University Departments of General and Visceral Surgery

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Abstract

Background: Women holding management positions in German university visceral and general surgery departments were registered and their publication performance compared to that of men.

Methods: All PubMed-listed publications published by chief or consultant physicians as first or last author in the 10 years preceding 2017 were registered, as was the publication's impact factor (IF). The cumulative impact factor acquired by each managing surgeon over the 10 year period was also totaled. Staffing was drawn from department websites as of July 1, 2017.

Results: On this date 442 surgeons were employed in management positions (chief and consultants) at 38 university departments, 365 men (82.6%), 77 women (17.4%). Three department chiefs were women (7.9%). On average, management teams consisted of 11.6 surgeons / department, including 2 female surgeons. In 9/38 departments (23.7%) the proportion of managing women averaged 37.4%. In 8 departments (21.1%) no female surgeons held management positions. A total of 5363 first

and last authorships were registered. The proportion of women holding authorship was 8.7%, with a cumulative IF of 7.0%. Only 59.7% of the women but 83.6% of the men had published. Compared to men, women achieved only half the cumulative IF (48.3 vs. 24.1, respectively). The average IF of individual publications was 2.4 for women and 3.0 for men.

Conclusions: The present study confirms a strong preponderance of men in academic visceral surgery. However, in nine of 38 departments the gender ratio was largely balanced. This does indicate a tendency towards revision of the traditional male dominance in university surgery.

Keywords: Surgery; Publication; Women

1. Introduction

In a narrative review of the position of women in academic medicine Edmunds et al. [1] assessed eight possible causes for underrepresentation of women. Four assessments received support as reasons for underrepresentation:

1. Women are more interested in teaching than in research.
2. Participation in research can encourage women into academic medicine.
3. Women lack adequate mentors and role models.
4. Women experience gender discrimination and bias.
5. Four assessments received less support as reasons for underrepresentation:
6. Women are less interested in research than men.
7. Women lose commitment to research as their education and training progress.
8. Women are deterred from academic careers by financial considerations.
9. Women are deterred by concerns about work-life balance.

The authors concluded that teaching should carry greater academic weight and changing from teaching to research should be less restrictive. This could motivate women who are more interested in teaching than research to pursue an academic career including research. Blumenthal et al. [2] examined the relationship between gender and academic rank in US medical schools with a total of 11,549 surgeons in various subspecialties, including general surgery, neurosurgery, orthopedic surgery, thoracic surgery and vascular surgery. Of these 1692 (14.7%) were women. A total of 26.7% of the academic surgeons held full professorships but the proportion of women holding a full professorship was only 7.0%. The proportion of female assistant professors was 19.4% and 12.8% associate professors. Compared to men, women were younger, had less work experience, and claimed fewer publications as well as fewer first and last authorships. A multivariate analysis confirmed that women were less likely than men to become full professors (adjusted OR 0.76; 95% CI 0.6-0.9). An imbalance between men and women in academic positions has also been noted in other medical fields. McDermott et al. [3] reviewed 29 leading academic neurological departments in the United States between December 2015 and April 2016. Of 1712 neurologists 528 (30.8%) were women. Men held full professorships twice as often as women (OR 2.06; 95% CI 1.40-3.01), claimed more publications and their publications were cited more frequently (higher Scopus h-index). Since gender distribution in German academic surgery has not to date been evaluated, the present study was designed to ascertain what percentage of women hold

management positions in German university visceral and general surgery and how their publication performance compares to that of men.

2. Material and Methods

The proportion of women and the publication activity of the management teams (chief, consultants and section heads) of all German visceral and general surgery departments in university hospitals were registered. All PubMed-listed publications with abstracts published by these surgeons as first or last author in the 10 years from January 1, 2007 to July 1, 2017 were registered (publication title, month and year of publication and journal of publication). The 5-year impact factor (IF) for each journal in 2016 was noted using the "Web of Science" under "Journal Citation Reports", "Journals by Rank", or "Select Journals". The cumulative impact factor generated over 10 years was totaled for each managing surgeon. Staffing was drawn from the department website as of July 1, 2017.

2.1 Statistics

Significant differences between groups were checked using a two-sample t-test, with $P < .05$ chosen as the significance level. Correlation between the individual parameters was calculated using the Pearson correlation coefficient (r). Values <0.3 were interpreted as a weak relationship, between 0.3 and 0.6 as a moderate relationship and >0.6 as a close relationship, assuming a significance of $P < .05$.

3. Results

3.1 Staffing

On the cutoff date 442 surgeons were employed in management positions in 38 university departments of visceral and general surgery: 365 men (82.6%) and 77 women (17.4%). Three of the 38 department chiefs were women (7.9%). On average, management teams consisted of 11.6 surgeons / department, including 2 female surgeons. In 9/38 departments (23.7%) the proportion of women in management teams averaged 37.4%. In 8 departments (21.1%) there were no female surgeons in management positions at all. The highest proportion of women on a management team of a general surgery university department was 45.5%.

3.2 Publication activity

A total of 5363 first and last authorships in 702 journals was registered. The proportion of authorship by women was 8.7% and their cumulative IF 7.0%. Only 59.7% of women, but 83.6% of the men had published. Compared to men, women averaged only half the cumulative IF per publishing surgeon (48.3 vs. 24.1, respectively), with the individual average IF per publication being 2.4 for women and 3.0 for men. Percentage wise, women were more often first than last author, compared to men. Further details can be found in Table 1. Only a slightly decreasing trend in publication number was apparent with an increase in women in management positions (Figure 1). The inverse correlation between the percentage of managing women in a department and the average cumulative IF per managing surgeon ($P = 0.073$) was in trend somewhat clearer (Figure 2).

However, if the average publications per publishing managing surgeon are listed separately for women and men for the individual departments, there were 4 departments in which women published more than men and 5 departments where the gender ratio was largely balanced (overall 23.7% of all the general surgery university departments) (Figure 3).

3.3 Department Benchmarking

Based on the cumulative IF per managing surgeon, the 38 departments were anonymously ranked (Table 2). The highest ranking first three departments in cumulative IF only took 21st, 27th and 31st place in terms of the percentage of women in the management team, and 4th, 6th and 7th place in terms of publications per surgeon. In contrast, the top three departments in terms of the proportion of women only came in 10th, 19th and 26th place in terms of publications per surgeon (for further details see Table 2).

	Total number of surgeons	**Women**	**Men**	***P***
Publications FA + LA, n (%)	5363	466 (8.7)	4897 (91.3)	<.001
Publications as first author, n (%)	2259	248 (11,0)	2011 (89.0)	<.001
Publications as last author, n (%)	3104	218 (7.0)	2886 (93.0)	<.001
Publications (FA + LA) per surgeon, n	12.1	6.1	13.4	<.001
Publishing surgeons (FA + LA), n (%)	351 (79.4)	46 (59.7)	305 (83.6)	<.001
Publications (FA and LA) per publishing surgeon, n	15.3	10.1	16.1	0.012
Cum-IF, FA + LA (%)	15835	1107 (7.0)	14729 (93)	<.001
Cum-IF first authorship	6804	613	6191	<.001
Cum-IF last authorship	9031	494	8537	<.001
Cum-IF per surgeon (FA + LA)	35.8	14.4	40.4	<.001
Cum-IF per publishing surgeon (FA + LA)	45.1	24.1	48.3	0.003
IF per publication (FA + LA)	2.95	2.38	3.01	0.019

FA = first authorship, LA = last authorship, IF= impact factor, Cum-IF = cumulative impact factor

Table 1: Publication activity of female and male visceral/general surgeons in German university hospitals.

Department rank according to cumulative IF per surgeon	**Cumulative IF per surgeon**	**Publications per surgeon**	**Rank according to publications per surgeon**	**Women in %**	**Rank according to proportion of women**
1	73.3	17.7	4	15.4	21
2	56.3	15.8	6	9.1	27
3	54.4	14.6	7	0	31
4	50.4	14.2	8	0	31
5	48.1	21.7	1	0	31
6	47.4	19	3	20	17
7	46.8	13.8	9	5.9	30
8	43,7	17.1	5	0	31
9	43.4	12.4	11	13.3	25
10	40.4	12.2	12	30	8
11	38.8	10.4	20	14.3	23
12	36.6	10.7	19	42.9	2
13	34.2	11.8	14	25	11
14	33.9	11.4	15	22.2	14
15	33.8	20.6	2	14.3	23
16	32	12	13	20.8	16
17	31.3	7.3	27	13.3	25
18	30.7	11.3	16	18.2	19
19	29.5	8.,2	24	33.3	6
20	29.2	9,6	22	0	31
21	28.6	9.8	21	22,2	14
22	26.6	7.8	25	0	31
23	25.8	12.5	10	45.5	1
24	24.8	11.2	17	28.6	9
25	22.7	11.2	18	27.3	10
26	19.1	71	28	6.7	29
27	18.1	86	23	40	5
28	17.8	58	31	0	31
29	15.1	59	30	7.1	28

30	14.2	77	26	42.9	2
31	13.4	68	29	25	11
32	11.3	54	33	42.9	2
33	10,5	52	34	30.8	7
34	10.4	3.4	37	25	11
35	9.2	5.8	31	20	17
36	8	4.2	36	15	22
37	5.9	4.5	35	16.7	20
38	4.9	2.3	38	0	31

Note: Departments were ranked anonymously from 1-38 according to the cumulative IF/managing surgeon. These ranking numbers are retained for the ranking according to publications per surgeon and ranking according to the proportion of women. Department #1 is always #1, #2 is #2 and so on.

Table 2: Department ranking according to publication activity.

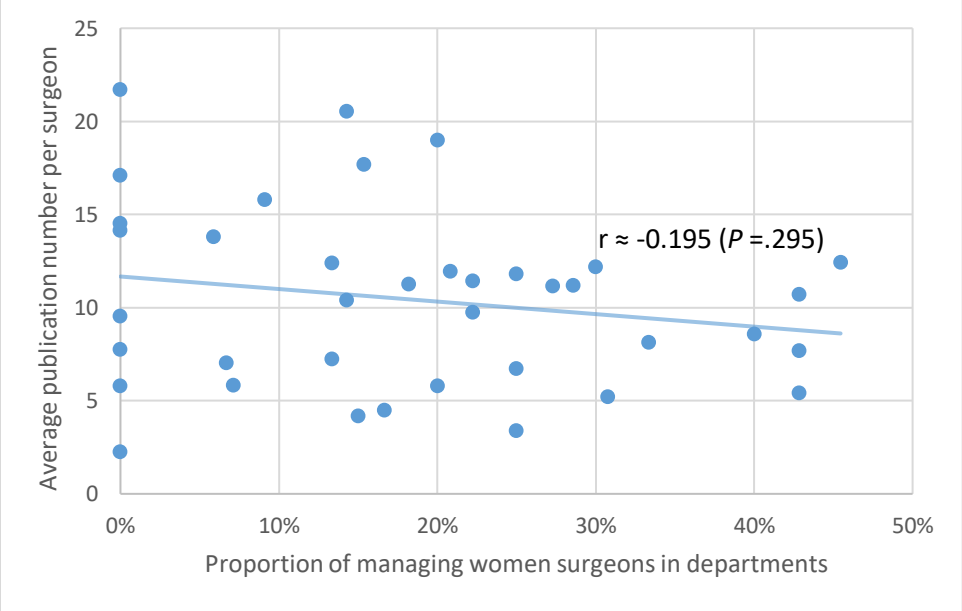

Figure 1: Relationship between the average number of publications per managing surgeon and the proportion of managing women surgeons in a department.

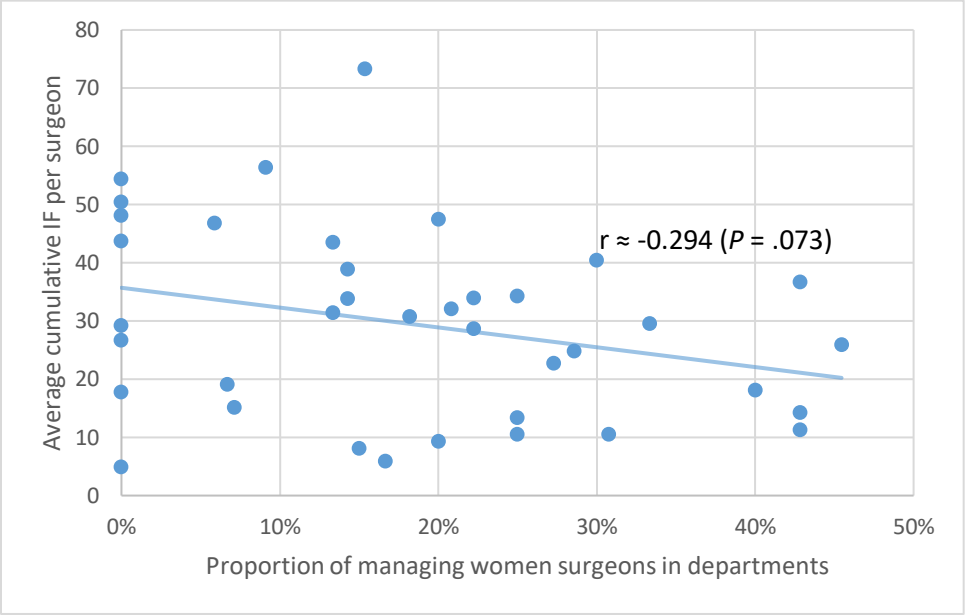

Figure 2: Relationship between the average cumulative IF per managing surgeon and the proportion of managing women surgeons in departments.

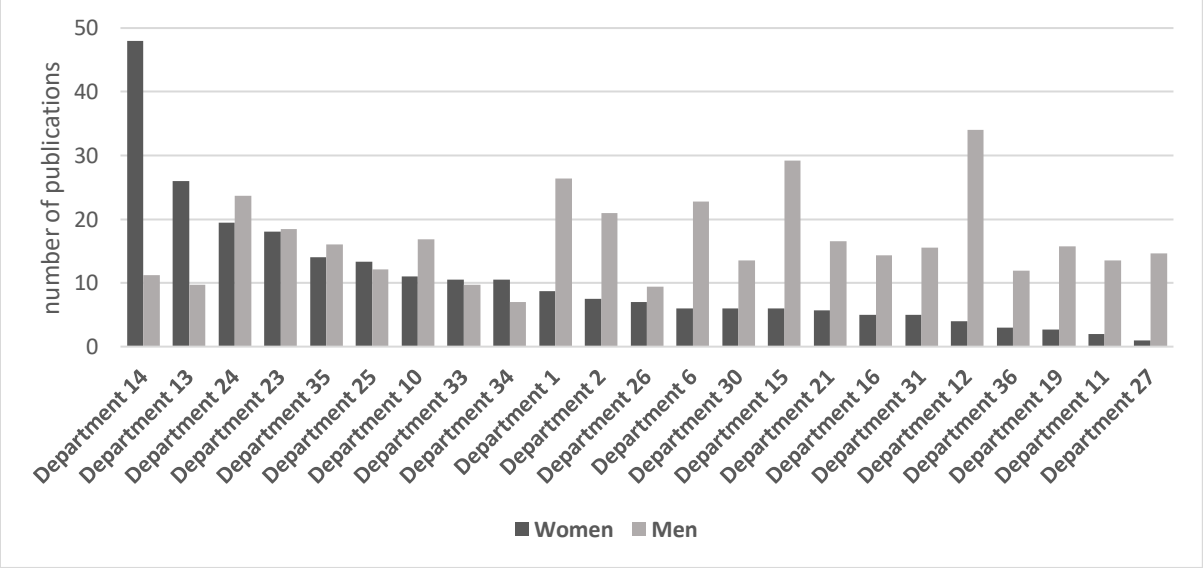

Figure 3: Average number of publications per publishing surgeon in university departments of general/visceral surgery. Department numbering corresponds to that in Table 2 (ranking according to cumulative IF per managing surgeon). 15 of 38 departments are not displayed because of missing female publication activity.

4. Discussion

As of the cutoff date in July 2017, women held 17.4% of management team positions in German general and visceral surgery university departments, comparable to that reported by Blumenthal et al. [2] for academic surgeons in US medical schools in 2014 (14.7%). Three of 38 department chiefs (7.8%) were women, analogous to 7.0% women holding a full professorship in the Blumenthal analysis. With regard to publication activity, results obtained from US medical schools were also similar to those obtained in Germany. Only 59.7% of the women, but 83.6% of the men had published. On average, women achieved only half the cumulative IF per publishing surgeon, compared to men.

The gender imbalance in leadership positions in surgical disciplines has been reported elsewhere. Weiss et al. [4] found only 8 women (3%) among 248 general surgery "chairs" in the US, when analyzing surgical training programs. The proportion of women among subordinate associate directors was higher (35/113, 31%). Based on a survey of eight academic "medical centers", Cochran et al. [5] examined reasons for the disproportionate distribution of men and women in leadership positions in academic surgery. Seventy women and 84 men took part in the survey and believed that women experienced more discrimination in surgery than in most other academic medical fields. Decisions regarding marriage and childbearing and the challenges of childcare as an academic surgeon also appear to be significant barriers to the professional advancement of female surgeons. Webster et al. [6] point to discrimination against women, especially in academic surgery but emphasize that discrimination is becoming more difficult to prove because society finds it less and less acceptable. A study by Bernardi et al. [7] confirms that substantial gender-based barriers in surgery exist. Despite improvement in the number of women entering the field of surgery, fundamental issues persist including a lack of senior role models, limited support for surgeons with families, and disparities in hiring and promotion.

Career preferences, as well as family and lifestyle priorities of female surgeons in German liver transplant centres, have been analysed by Radunz et al. [8] based on 81 questionnaires. The authors concluded that female surgeons do want to fill leadership positions, but that creative individual and institutional modifications are necessary to promote the advancement of women in surgery.

In an analysis of 4015 surgical faculty members from 55 departments of surgery, female surgical faculty members were far more likely to be at a lower academic level [9] and overall median numbers of publications/citations were lower for female compared to male surgical faculty. The three divisions with the best representation of women included science/research (41%), surgical oncology (34%), and general surgery as an aggregate (26%). The lowest representation of women was in cardiothoracic surgery, with only 10% and for thoracic surgeons 8%. Factors possibly playing a role in low female representation include negative biases toward women within a specialty, lack of mentors and exposure to the field, unpredictable scheduling, and the persistence of strong male stereotypes.

In contrast to cardiac surgery, women were much better represented in colorectal fellowship programs of the American Society of Colon and Rectal Surgeons. Geltzeiler et al. [10] evaluated 358 faculty members within 55 training programs, of whom 77 (22%) were women. In this cohort, men had a seven year longer median career duration than women. There was no statistical difference in median

number of publications or publications per year between the sexes. Academic rank, however, was significantly associated with publication productivity, irrespective of sex. This implies a supportive working environment for female faculty within this field and suggests that publication productivity is not a barrier to academic career advancement for female colorectal surgeons.

Another analysis is available for neurosurgery [11]. Here, 841 faculty members at 48 academic medical institutions were evaluated, 761 (90%) of whom were men. Men and women authored a comparable number of publications, both before and after adjusting for years in practice. After controlling for institution and years in practice, there was no significant difference in the likelihood of attaining any academic rank, except for full professor. The authors infer that these data serve as encouragement to women to enter the field of neurosurgery. In contrast, Vora et al. [12] found that women published significantly less than men in academic foot and ankle research. Compared to male authors, female authors were less likely to continue publishing 5 years after an initial publication and on average published fewer articles.

Gender differences in the ranking of academic doctors do not only occur in surgery. Women in cardiology have also been found to publish less and be less likely than men to hold full professorships [13]. Based on 18,483 studies pertaining to critical care medicine Vranas et al. [14] registered 30.8% women with first authorship and 19.5% with senior authorship. Female first authors tended to publish in lower-impact journals. Despite comprising about one-third of the critical care international workforce, women remain underrepresented in leadership positions, including society presidents, board or council members, or symposium chairs [15]. Jena et al. [16] analysed sex differences in faculty rank using a cross-sectional comprehensive database of 91,073 US physician faculty members. Women claimed fewer total and first or last authorship publications (mean total, 11.6 vs. 24.8 for men), were less likely to receive NIH funding (6.8% vs. 10.3%), and were less likely to have conducted clinical trials (6.4% vs. 8.8%). Women were also less likely than men to have achieved full-professor status and these differences were present across all specialities.

In the present study, in addition to the number of publications (first and last authorship) attributed to management teams of general and visceral surgery departments in German university hospitals, the cumulative IF of all 442 surgeons over 10 years was registered. Men published roughly twice as much as women (13.4 vs. 6.1 publications), and the cumulative IF per surgeon was three times as much for men (40.4 vs. 14.4), comparable to that found for critical care medicine [14]. Bernardi et al. [17] reported no differences in the journal IF between female and male first or last authorships in 560 randomly selected articles from 195 different peer-reviewed journals. However, the cumulative IF was not taken into consideration. The journal IF is not equitable with the cumulative IF generated by an author. Specifically, it means that male and female authors published in journals with a similar IF. In the present study registering more than 5000 articles in 702 PubMed-listed journals the mean IF for individual articles was 2.4 for women and 3.0 for men. Although there is a difference it does not present a significant divergence. In contrast, the cumulative IF differs greatly (three times as much for men).

Nguyen et al. [18] examined the publication productivity of 544 surgical oncologists participating in 64 National Cancer Institute programs, 331 of whom were male (61%) and 213

females (39%). They employed the h-index, which is more accurate than IF due to its reflecting an article's citation frequency, and registered a significant increase with academic rank. However, they ultimately came to the same conclusion observed in the present study. The mean h-index was 26 ± 19 (median: 21, range: 0–111) for male surgeons versus 13 ± 11 (median: 11, range: 0–78) for female surgeons. Male gender and h-index were significantly, positively correlated, as was the total number of publications.

The present study confirms a strong male preponderance in management positions, publication number and generated IF in academic surgery in Germany, as has previously been recognized, especially in the USA. Nevertheless, gender inequality is not universal. In four of 38 German departments individual publishing women published more than individual publishing men (Figure 3). In a further five departments the gender ratio was largely balanced. This indicates a rethinking in who belongs in university surgery and is thought to be mainly due to an increasing shortage of applicants for surgical academic training [19]. More than a decade ago, Gargiulo et al. [20] reported that women and men are equally interested in pursuing a surgical career at the beginning of training. However, women are far more likely to experience discrimination, most often from male attending physicians or residents. Women were less likely to be deterred by diminishing rewards or workload considerations. They were also less likely to cite family as a deterrent and equally as likely as men to be dissuaded by lifestyle during residency. However, women were more likely to be discouraged by perceptions of the "surgical personality" and the perception of surgery as an "old boys' club".

Perceived poor access to postgraduate training and heavy workload hinder students worldwide from considering surgical careers [21]. Removing these barriers is essential to making surgery more attractive for (female) applicants. In view of more than half of the medical students in Germany being women, this in turn is fundamental to maximizing academic potential. Along with the desire for a satisfying work-life balance, flexible working hours and childcare, fixed time schedules incorporating research and publishing become increasingly more important. Management especially, but also all those responsible, should be aware that long-term motivated junior staff, particularly in surgery, can only be won through positive interaction with child-raising surgeons. Platforms like FamSurg [22] could assume a pioneering role in facilitating a gender balance in surgery.

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