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Gender trends in authorship in oral and maxillofacial surgery literature: A 30-year analysis

Emeka Nkenke [a, *, 1], Rudolf Seemann [a, 1], Elefterios Vairaktaris [b], Hans-Günter Schaller [c], Maximilian Rohde [d], Florian Stelzle [d], Christian Knipfer [d]

[a] Department of Oral and Maxillofacial Surgery, Medical University of Vienna, Vienna, Austria
[b] Department of Oral and Maxillofacial Surgery, University of Athens Medical School, Attikon Hospital, Athens, Greece
[c] Department of Operative Dentistry and Periodontology, Halle University Hospital, Halle (Saale), Germany
[d] Department of Oral and Maxillofacial Surgery, Erlangen University Hospital, Erlangen, Germany

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ABSTRACT

The aim of the present study was to perform a bibliometric analysis of the gender distribution of first and senior authorships in important oral and maxillofacial journals over the 30-year period from 1980 to 2010.

Articles published in three representative oral and maxillofacial surgery journals were selected. The years 1980, 1990, 2000, and 2010 were chosen as representative points in time for article selection. Original research, case reports, technical notes, and reviews were included in the analysis. Case reports and technical notes were pooled in one group.

For each article, the gender of the first author as well as that of the senior author was determined, based on the inspection of their first name. The type of article was determined and the country of origin of the article was documented.

A total 1412 articles were subjected to the data analysis. A significant increase in female authorship in oral and maxillofacial surgery could be identified over the chosen 30-year period. However, the number of publications by male authors was still significantly higher at all points of time, exceeding those of female authors by at least 3.8 fold in 2010.

As there is a trend towards feminization of medicine and dentistry, the results of the present study may serve as the basis for further analysis of the current situation, and the identification of necessary actions to accelerate the closure of the gender gap in publishing in oral and maxillofacial surgery.

1. Introduction

Today, women comprise approximately 50% of medical school students. The number of women in medicine has rapidly increased during the last three decades (Ahmed et al., 2014). However, the distribution of women across medical fields and specialties is not equal. In fields such as obstetrics, gynecology, pediatrics or primary care women represent more than half of the full-time faculty. Conversely, they are substantially underrepresented in surgical disciplines (Ahmed et al., 2014). Although women will form >50% of all doctors in a few years, currently only 9% of the doctors who work in the field of surgery are female (Crolla et al., 2011). It is not surprising that only few women reach surgical leadership positions (Weiss et al., 2014). A number of barriers to the advancement of women as leaders have previously been identified. Amongst others they include obvious and covert discriminatory practices, traditional gender roles, the biological responsibility of childbirth and the lack of mentorship and sponsorship (Zhuge et al., 2011). Moreover, as far as oral and maxillofacial surgery is concerned, a unique situation is encountered. Specialization in this field requires a double qualification, with a dental as well as a medical degree in most European countries (Herford et al., 2001). It can be assumed that the obvious increase of duration of qualification, compared with the situation in other medical specialties, poses additional barriers for women in oral and maxillofacial surgery.

* Corresponding author. Department of Oral and Maxillofacial Surgery, Medical University of Vienna, Währinger Gürtel 18-20, 1090 Vienna, Austria. Tel.: +43 1 40400 42520; fax: +43 1 40400 42590.
E-mail address: emeka@nkenke.de (E. Nkenke).
[1] Equal contribution.

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As far as academic leadership positions are concerned, performing research and authoring it are important prerequisites (Quigley et al., 2012). While in some fields of medicine, such as dermatology, the percentage of female first authorship has increased from 12% in 1976 to 48% in 2006 (Feramisco et al., 2009), it stagnated at a low level in surgical fields such as orthopedics with a minimal increase from 0.8% in 1970 to 6.5% in 2007 (Okike et al., 2012). Having these data in mind, the gender disparity in leadership in surgical specialties is not surprising (Jonasson, 2002). However, as a consequence of the ongoing feminization of medicine, there is a risk that a number vacant surgical leadership positions cannot be filled with individuals who hold an adequate track record in published research. It is clear that the existing problems that hamper the academic careers of women cannot be overcome until they are understood in detail (Weiss et al., 2014).

Unfortunately, data on gender trends in authorship in oral and maxillofacial surgery are missing. Therefore, it was the aim of the present study to perform a bibliometric analysis of the gender distribution of first and senior authorships in the most important oral and maxillofacial journals over the 30-year period from 1980 to 2010.

2. Materials and methods

The study was limited to articles published in the field of oral and maxillofacial surgery. Three representative journals were selected. The *International Journal of Oral and Maxillofacial Surgery*, the *Journal of Craniomaxillofacial Surgery*, and the *Journal of Oral and Maxillofacial Surgery* were included in the study.

As representative points in time for article selection the years 1980, 1990, 2000, and 2010 were chosen. The choice of these years was based on the current literature on the topic from other medical specialties in order to allow comparison of the results (Ahmed et al., 2014).

For each article the type of article was determined. Original research, clinical research, case reports, technical notes, and reviews were included in the analysis. Original research and clinical research were pooled in one group, and case reports and technical notes were pooled in another.

For each article, the gender of the first author as well as that of the senior author were determined, based on the inspection of their first names. Articles for which the first name of the first or the senior author could not be attributed safely to one of the genders were excluded from further analysis. In addition, the country of origin of the articles was documented.

2.1. Statistical analysis

The retrieved data were saved to a comma separated value (CSV) file. Data analysis was performed using the open source statistical programming environment "R" (Version 2.15.1, 2012 The R Foundation for Statistical Computing, http://www.r-project.org). The change in gender proportion of authorship was examined over time from 1980 to 2010 with 10-year intervals. The year 1980 was chosen as the reference point for comparison.

Count data was analyzed in univariate Poisson regression models. The most frequent group was defined as the reference group, i.e. original research articles of European male first and senior authors. The effect was reported as incidence density ratio (IDR). This reflects the logic of the odds ratio, i.e. a multiplier with the characteristics that <1 reduces, and >1 enlarges the count number.

For each model the significance of the IDR was reported as a *p*-value of the Wald test, testing for significant deviations of the IDR from 1. In the multivariate model the *p*-value of the likelihood ratio tests comparing the full model to the model reduced by each parameter was added.

3. Results

A total of 1642 relevant articles were identified. 12.1% ($n = 199$) of these articles were excluded from further analysis due to missing gender of the first author ($n = 20$), the last author, ($n = 166$) or both ($n = 13$). The review articles ($n = 31$) were excluded from the statistical analysis as a consequence of small group sizes (Table 1). A total of 1412 articles were subjected to the data analysis (Tables 2–4).

3.1. Gender

Over the last three decades the ratio of male to female first and senior authorship decreased from 42.3:1 in 1980 to 12.1:1 in 1990; to 10.1:1 in 2000; and to 4.5:1 in 2010 (Tables 2 and 3). In particular, the male to female ratio of first authors dropped from 33.6 to 3.8.

Table 1
Distribution of review articles.

Continent	Combination of genders of first and senior authors	Year			
		1980	1990	2000	2010
Europe	Male first author:male senior author	0	1	1	4
	Female first author:male senior author	1	0	0	1
	Male first author:female senior author	0	0	0	2
	Female first author:female senior author	0	0	0	2
North America	Male first author:male senior author	3	1	1	4
	Female first author:male senior author	0	0	0	1
	Male first author:female senior author	0	0	0	0
	Female first author:female senior author	0	0	0	0
South America	Male first author:male senior author	0	1	0	2
	Female first author:male senior author	0	0	0	0
	Male first author:female senior author	1	0	0	1
	Female first author:female senior author	0	0	0	0
Asia	Male first author:male senior author	0	0	0	0
	Female first author:male senior author	0	0	0	0
	Male first author:female senior author	0	0	0	0
	Female first author:female senior author	0	0	0	0
Africa	Male first author:male senior author	0	0	0	2
	Female first author:male senior author	0	0	0	1
	Male first author:female senior author	0	0	0	0
	Female first author:female senior author	0	0	0	0

Table 2
Distribution of original articles.

Continent	Combination of genders of first and senior authors	Year			
		1980	1990	2000	2010
Europe	Male first author:male senior author	29	48	65	89
	Female first author:male senior author	1	8	10	21
	Male first author:female senior author	0	7	4	18
	Female first author:female senior author	0	1	0	10
North America	Male first author:male senior author	37	57	41	38
	Female first author:male senior author	2	4	7	10
	Male first author:female senior author	1	5	6	7
	Female first author:female senior author	0	1	1	1
South America	Male first author:male senior author	2	3	2	6
	Female first author:male senior author	0	1	0	1
	Male first author:female senior author	0	1	0	5
	Female first author:female senior author	0	0	0	0
Asia	Male first author:male senior author	10	24	45	96
	Female first author:male senior author	1	2	4	28
	Male first author:female senior author	1	1	3	15
	Female first author:female senior author	0	0	0	8
Africa	Male first author:male senior author	2	3	0	4
	Female first author:male senior author	0	0	0	1
	Male first author:female senior author	0	0	0	0
	Female first author:female senior author	0	0	0	0

Slightly higher male to female ratios were observed for senior authors (1980, 56.7:1; 1990, 13.2:1; 2000, 10.2:1; 2010, 5.4:1). Regarding the gender mix of author teams, the largest number of articles had male first and male senior authors ($n = 1117$). In comparison to this reference group the univariate Poisson regression model revealed significantly fewer articles written by female first authors with male senior authors ($n = 151$; IDR = 0.135; $p_{Wald} < 0.001$), and male first authors with female senior authors ($n = 115$; IDR = 0.103; $p_{Wald} < 0.001$); and only 29 articles by teams of female first and senior authors (IDR = 0.026; $p_{Wald} < 0.001$). The multivariate model confirmed these results and additionally revealed that teams of mixed gender in particular increased significantly over the observation period (Table 4).

3.2. Confounder time

Over the 30-year time interval the yearly number of publications increased from 173 in 1980 to 548 in 2010 (Tables 2 and 3). This increase in number of publications was identified as statistically significant in the count regression model (IDR = 1.392 per decade; $p_{Wald} < 0.001$). In comparison to the reference group (male first author and male senior author) teams of female first and male senior authors in particular showed a significantly steeper increase over the decades, resulting in a significant interaction term of the multivariate model (Table 4).

As far as the different continents were concerned, the most pronounced increase in original articles by male first and male senior authors were found for Asia (IDR = 1.230 per decade; $p = 0.003$) compared with Europe (IDR = 1; reference group). For male first and male senior authors the number of original research articles significantly decreased as far as North America was concerned (IDR = 0.637 per decade; $p < 0.001$).

The numbers of case reports and technical notes hinted at a decrease over time for North America and stagnation for Asia, while they tended to increase over time for Europe. However, the differences were not statistically significant ($p = 0.721$).

Table 3
Distribution of case reports and technical notes.

Continent	Combination of genders of first and senior authors	Year			
		1980	1990	2000	2010
Europe	Male first author:male senior author	12	43	46	60
	Female first author:male senior author	0	4	1	12
	Male first author:female senior author	1	2	8	6
	Female first author:female senior author	0	0	1	2
North America	Male first author:male senior author	64	74	40	36
	Female first author:male senior author	1	2	2	8
	Male first author:female senior author	0	5	2	2
	Female first author:female senior author	0	0	1	1
South America	Male first author:male senior author	1	3	3	4
	Female first author:male senior author	0	0	0	2
	Male first author:female senior author	0	0	0	1
	Female first author:female senior author	0	0	0	1
Asia	Male first author:male senior author	8	34	46	37
	Female first author:male senior author	0	5	4	8
	Male first author:female senior author	0	1	5	8
	Female first author:female senior author	0	0	0	1
Africa	Male first author:male senior author	0	2	2	1
	Female first author:male senior author	0	0	1	0
	Male first author:female senior author	0	0	0	0
	Female first author:female senior author	0	0	0	0

Table 4
Multivariate Poisson regression model of the publication distribution analysis.

Factor	IDR	95% CI		P_{Wald}	$P_{LR\text{-}test}$
Intercept	27.241	21.388	34.695	<0.001	
Gender of authors first author:senior author (reference = M:M)					<0.001
F:F	.021	.003	.150	<0.001	
F:M	.062	.035	.110	<0.001	
M:F	.072	.038	.134	<0.001	
Year					<0.001
Per decade	1.530	1.381	1.695	<0.001	
Continent (reference = Europe)					<0.001
Africa	.090	.032	.249	<0.001	
Asia	.484	.340	.689	<0.001	
North America	1.685	1.262	2.249	<0.001	
South America	.062	.026	.147	<0.001	
Article type (reference = originical research)					<0.001
Case report/technical note	.991	.751	1.309	.949	
Interaction between author team and year					<0.001
F:F × year	1.674	.833	3.365	.140	
F:M × year	1.592	1.300	1.950	<0.001	
M:F × year	1.355	1.080	1.698	.007	
Interaction between author team and continent					.136
F:F × Africa	NA	NA	NA	NA	
F:M × Africa	1.963	.375	10.276	.415	
M:F × Africa	NA	NA	NA	NA	
F:F × Asia	.849	.345	2.087	.715	
F:M × Asia	1.096	.720	1.666	.664	
M:F × Asia	.896	.553	1.450	.647	
F:F × North America	.470	.158	1.392	.164	
F:M × North America	.836	.523	1.336	.445	
M:F × North America	.801	.479	1.337	.386	
F:F × South America	7.429	.738	74.818	.082	
F:M × South America	1.814	.563	5.840	.308	
M:F × South America	4.147	1.572	10.939	.003	
Interaction between author team and article type					.027
F:F × case report/technical note	.386	.151	.983	.042	
F:M × case report/technical note	.690	.475	1.002	.047	
M:F × case report/technical note	.769	.509	1.162	.203	
Interaction year × article type					<0.001
year × case report/technical note	.835	.751	.929	<0.001	
Interaction between year and continent					<0.001
year × Africa	.721	.445	1.168	.175	
year × Asia	1.230	1.070	1.415	.003	
year × North America	.637	.563	.721	<0.001	
year × South America	.963	.671	1.380	.832	
Interaction between article type and continent					.027
Africa × case report/technical note	.909	.311	2.654	.859	
Asia × case report/technical note	1.092	.827	1.443	.525	
North America × case report/technical note	1.533	1.170	2.007	.0016	
South America × case report/technical note	1.161	.563	2.394	.681	

Null deviance: 2301.448 on 100 degrees of freedom; residual deviance: 93.855 on 66 degrees of freedom. Akaike's information criterion: 521.81. CI: confidence interval; F: female; IDR: incidence density ratio; M: male; NA: not applicable; $P_{LR\ test}$: likelihood ratio test; P_{Wald}: probability value of Wald test.

As far as the absolute numbers of technical notes and case reports were concerned, Africa (IDR = 0.909; $p = 0.859$), South America (IDR = 1.161; $p = 0.681$) only played a limited role in comparison to Europe. In North America significantly more technical notes and case reports of male first and last authors were published compared with Europe.

3.3. Confounder continent

Overall, significantly more articles were written by authors living in the western world, i.e. Europe (IDR = 1 as reference group) and North America (IDR = 0.896; $p = 0.088$) compared with authors living in Asia (IDR = 0.776, $p_{Wald} = 0.001$), South America (IDR = 0.071; $p_{Wald} < 0.001$) and Africa (IDR = 0.031, $p_{Wald} < 0.001$; Table 4). However, Asia played a relevant role as far as the number of original research articles published over time by male first and male senior authors was concerned (Table 2). Moreover, as far as the number of male first authors and female senior authors, and female first authors and female senior author combinations were concerned, Asia also reached the second place in 2010 behind Europe (Table 2).

3.4. Confounder article type

The reference type of article was found to be original research with a total of 896 articles. Compared with the reference type, the univariate count regression model showed significantly fewer articles in the case reports and technical notes group ($n = 746$; IDR = 0.769; $p = 0.001$). In the multivariate model this difference was confirmed. Female first and senior author teams published significantly fewer case reports and technical notes compared with male teams (Table 1).

4. Discussion

Although there is a trend towards feminization of medicine and dentistry, this is not reflected by the number of women in leadership positions. The percentages of female, full professors in general

surgery, orthopedics, and otolaryngology are 9%, 7% and 11%, respectively (Weiss et al., 2014). In the US only 5% of the university departments for general surgery are run by women chairs (Weiss et al., 2014).

Research authorship is an important prerequisite for qualification for leadership positions in the different specialties of medicine. The existence of a gender gap in authorship of academic medical literature is a well known fact (Jagsi et al., 2006). Several analyses show that women tend to publish fewer papers than their male counterparts. It is difficult to take adequate action against the existing problems that hamper the academic careers of women until they are understood in detail (Weiss et al., 2014). Up to this point, the situation in oral and maxillofacial surgery has not been comprehensively analyzed. Even basic data on gender trends in authorship in this specific field are still missing. Without insight into the current situation, it is impossible to judge the extent of a potential gender gap in publishing in oral and maxillofacial surgery. Therefore, it was the aim of the present study to perform a bibliometric analysis of the gender distribution of first and senior authorships in the most important oral and maxillofacial journals over the 30-year period from 1980 to 2010.

In recent years a general increase in the number of published articles in oral and maxillofacial surgery has been identified (Brennan and McCaul, 2007). This aspect is reflected by the results of the present study. However, the data also show that there is still very limited potential for performing research and publishing it in South America and in Africa. As far as original research is concerned, the situation is Asia is comparable to that of Europe and North America.

The number of female as well as male authorships increased significantly over the three-decade observation interval. The ratio between male and female first authors reduced significantly. However, in 2010 still only 26.3% of first authorships and 18.5% of senior authorships were held by women. This percentage is comparable with that found for otolaryngology in 2008 (Bergeron et al., 2012). It exceeds the number of female first authorships in orthopedics by far (6.5% in 2007) (Okike et al., 2012), while it is far behind the situation in dermatology (48% in 2006, Feramisco et al., 2009). Keeping in mind the need for the double degree as the basis for qualification for specialization in oral and maxillofacial surgery, the midfield position in female authorship among the other specialties is a positive result. It seems that the double degree does not prevent women from entering oral and maxillofacial surgery and becoming active in authoring research. As in other fields in surgery, the analysis of the situation in oral and maxillofacial surgery shows that there is a slow but steady reduction of the gender gap over the last three decades (Bergeron et al., 2012). The present analysis shows that women especially catch up as far as original research is concerned. On the other hand, they publish significantly fewer case reports and technical notes compared with their male counterparts. An explanation for this fact may be that women tend to concentrate on high quality original research and do not consider case reports and technical notes important. The limited number of female senior authors may directly reflect the small number of female department heads.

The data found in the present study reveal that there is still an obvious disparity in gender distribution in authorship in oral and maxillofacial surgery. There has been speculation that such a disparity may be at least partly the result of some kind of discrimination (Zhuge et al., 2011). An analysis of 2507 manuscripts submitted to a specific journal over a 9-year period showed that papers of women were more often rejected immediately compared with papers of their male counterparts if there was no anonymization of the authorship (Heckenberg and Druml, 2010). It seems that even little changes in the policy of journals – namely the anonymization of authorship – can contribute significantly to a reduction of the gender gap. So far, for the three selected journals there is no anonymization of the authorship details.

With the increasing feminization of medicine and dentistry, there is an obvious need to facilitate the promotion of women in leadership positions in oral and maxillofacial surgery in order to secure future research activities in the field. Success and advancement in academic medicine depends, to an extent, on the number of publications. It has been stated that the discouraging gender situation in medical publication reflects more general inequalities that exist, even in the modern societies of highly developed industrialized countries (Heckenberg and Druml, 2010). Therefore, it seems to be most important that professional medical associations and scientific journals recognize the problem and actively contribute to improving the situation. The steady increase of female authorship should be considered a relevant step in the intended direction.

5. Conclusion

The bibliometric analysis of authorship in oral and maxillofacial surgery shows a significant increase in female authors over a 30-year period. However, the number of publications by male authors was significantly higher at all time points, and was at least 3.8 times higher than those of female authors in 2010. In particular, female senior authorship is still were very uncommon, even in 2010.

As there is a trend towards feminization of medicine and dentistry, the results of the present study may serve as the basis for further analysis of the current situation, and the identification of the necessary actions that need to be taken to accelerate the closure of the gender gap in publishing in oral and maxillofacial surgery.

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