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Gender differences in the authorship of contemporary anaesthesia literature: a cross-sectional study

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Editor—Previous analyses have described a gender gap in authorship in the anaesthesiology literature.^{1–5} However, there is a lack of recent data to determine if the gender gap is improving in the current era. We sought to update the literature on the topic; we also aimed at identifying factors associated with woman authorship as compared with man authorship.

For this purpose, we evaluated the prevalence of woman first author and last author in articles published from 2008 to 2018 in the five general anaesthesia journals with the highest 2018 impact factor (excluding subspecialty journals).

This study was registered with the International Prospective Register of Systematic Reviews (registration number: 151092). The journals *Anesthesiology*, *British Journal of Anaesthesia*, *Anaesthesia*, *European Journal of Anaesthesiology*, and *Anesthesia and Analgesia* were included (based on Thomson Reuters–Clarivate Analytics; [Supplementary Fig. S1a](#)). Original research articles, systematic reviews, and meta-analyses published in 2008, 2010, 2012, 2014, 2016, and 2018 were selected. For each article, year of publication, departmental affiliations, number, genders, academic degrees and titles of the first and last authors, type of study, country of origin, and source of funding were extracted. Gender was assigned according to the name and appearance of the person. Where author genders could not be determined by name and institutional website of the authors, the US Social Security Administration database of names and naming websites were used.⁶ Studies for which author genders could not be determined (<0.6%) were excluded. Articles with either a first or last woman author were classified as ‘woman-authored’. All others were classified as ‘man-authored’.

Continuous variables were all not normally distributed and were reported as medians and inter-quartile range (IQR) and compared using the Mann–Whitney U-test. Categorical variables were reported as counts and percentages, and compared using the χ^2 test. Logistic regression analysis was used to determine factors associated with woman authorship. Results were reported as odds ratio (OR) and 95% confidence interval (95% CI). Two-sided significance testing was used and *P*-values <0.05 were considered significant.

Of the 4720 articles, 1872 (39.6%) were woman authored, with a woman first author in 1084 (22.9%) articles, woman last author in 475 (10.1%) articles, and woman first and last author in 313 (6.6%) articles. The median number of authors was 6 (IQR: 5–8) of which a median of 1 (IQR: 1–2) was a woman. Woman-authored articles constituted 37.3% of articles in 2008, compared with 45.7% in 2018 (*P*<0.001) ([Table 1](#)). The number of woman first authors increased over the course of the study period (*P*-trend <0.001), whilst the number of woman last authors remained stable (*P*-trend=0.15) ([Supplementary Fig. S1b](#)).

Compared with men, woman first authors mostly held PhD (48.1% vs 51.9%; *P*<0.001) or non-medical academic degrees (45.6% vs 54.4%; *P*<0.001); woman last authors mostly held non-medical degrees (38.0% vs 62.0%; *P*<0.001). On multivariable regression, woman-authored articles were significantly associated with first author holding a PhD (OR: 1.64; 95% CI: 1.20–2.24; *P*<0.01) or non-medical degree (OR: 1.71; 95% CI: 1.21–2.41; *P*<0.01), last author holding a non-medical degree (OR: 3.28; 95% CI: 1.87–5.79; *P*<0.001), and the number of woman co-authors (OR: 2.08; 95% CI: 1.94–2.23; *P*<0.01). Compared with articles originating from North America, articles from Europe were more likely to be woman-authored (OR:

Table 1 Summary of the anaesthesia articles analysed by gender (percentages are per row, not per column)

	Anaesthesia (overall)	Woman-authored study	Man-authored study	P-value
Total	4720	1872 (39.7)	2848 (60.3)	
Woman first author	1084 (22.9)	1084 (100.0)	—	<0.001*
Woman last author	475 (10.1)	475 (100.0)	—	<0.001*
Woman first and last authors	313 (6.6)	313 (100.0)	—	
Median year of publication	2012 [2010–6]	2014 [2010–6]	2012 [2010–6]	<0.001*
Number by year (%)				<0.001*
2008	958 (20.3)	357 (37.3)	601 (62.7)	
2010	684 (14.5)	227 (33.2)	457 (66.8)	
2012	853 (18.1)	314 (36.8)	539 (63.2)	
2014	653 (13.8)	271 (41.5)	382 (58.5)	
2016	701 (14.8)	305 (43.5)	396 (56.5)	
2018	871 (18.5)	398 (45.7)	473 (54.3)	
Median number of co-authors per study	6 [5–8]	6 [5–8]	6 [5–8]	0.001*
Median number of man co-authors per study	4 [3–6]	3 [2–5]	5 [3–6]	<0.001*
Median number of woman co-authors per study	1 [1–2]	2 [1–3]	1 [0–2]	<0.001*
Retrospective study (%)	673 (14.3)	273 (40.6)	400 (59.4)	0.64
Prospective study (%)	4030 (85.4)	1593 (39.5)	2437 (60.5)	0.68
Single-centre study (%)	3422 (72.5)	1346 (39.3)	2076 (60.7)	0.48
Academic hospital (%)	3307 (70.1)	1258 (38.0)	2049 (62.0)	0.001*
Study origin				0.97
Africa	40 (0.8)	16 (40.0)	24 (60.0)	1.00
Asia	708 (15.0)	278 (39.3)	430 (60.7)	0.85
Australia	178 (3.8)	69 (38.8)	109 (61.2)	0.86
Europe	2039 (43.2)	818 (40.1)	1221 (59.9)	0.59
North America	1607 (34.0)	632 (39.3)	975 (60.6)	0.76
South America	68 (1.4)	30 (44.1)	38 (55.8)	0.53
Multi-continental	80 (1.7)	29 (36.3)	51 (63.7)	0.60
Academic degrees of first authors (%)				<0.001*
MD	2380 (50.4)	930 (39.1)	1450 (60.9)	0.42
MD and others	1196 (25.3)	379 (31.7)	817 (68.3)	<0.001*
PhD	414 (8.8)	215 (51.9)	199 (48.1)	<0.001*
Others	307 (6.5)	167 (54.4)	140 (45.6)	<0.001*
Not reported	423 (9.0)	181 (42.8)	242 (57.2)	0.19
Academic degrees of last authors (%)				<0.001*
MD	2090 (44.3)	792 (37.9)	1298 (62.1)	0.02*
MD and others	1621 (34.3)	635 (39.2)	986 (60.8)	0.64
PhD	567 (12.0)	258 (45.5)	309 (54.5)	<0.01*
Others	92 (1.9)	57 (62.0)	35 (38.0)	<0.001*
Not reported	350 (7.4)	130 (37.1)	220 (62.9)	0.35
Median number of author departmental affiliations	3 [2–4]	3 [2–4]	3 [2–4]	0.52
Funding (%)				
Internal	1608 (34.1)	653 (40.6)	955 (59.4)	0.19
National	1057 (22.4)	460 (43.5)	597 (56.5)	0.21
Industrial	455 (9.6)	162 (35.6)	293 (64.4)	<0.01*
Private	723 (15.3)	327 (45.2)	396 (54.8)	0.04*
Journal (%)				
Anaesthesia	608 (12.9)	242 (39.8)	366 (60.2)	0.97
Anesthesia & Analgesia	1661 (35.2)	723 (43.5)	938 (56.5)	<0.001*
Anesthesiology	1056 (22.4)	345 (32.7)	711 (67.3)	<0.001*
British Journal of Anaesthesia	933 (19.8)	365 (39.1)	568 (60.9)	0.74
European Journal of Anaesthesiology	462 (9.8)	197 (42.6)	265 (57.4)	0.18

*P<0.05.

1.28; 95% CI: 1.05–1.55; P=0.01) (Supplementary Table S1). The field of basic research was inversely associated with woman authorship (OR: 0.69; 95% CI: 0.54–0.88; P=0.003).

Our data showed that the proportion of woman-authored studies increased from 37.3% in 2008 to 45.7% in 2018 (P<0.001), mostly driven by an increase in woman first authorship. Compared with men, woman first and last authors were more likely to hold a PhD or non-medical degree. Articles originating from Europe were more likely to be woman-authored compared with articles from North America. Our results show a continued rise of woman first authors, but a plateau in the percentage of woman last author in the past 10 yr.

In 2018, women accounted for 25.5% of practising physicians in anaesthesia in the USA, 35% in the UK, and 32% in Canada,⁷ and an even higher percentage as trainees: 39% in Canada, 37% in the USA, and 48% in the UK.² Whilst the proportion of woman first authors is similar to the number of woman anaesthetists, the proportion of woman last authors is much lower. When considering anaesthesia trainees, the gender gap appears even wider.

Previous studies have found that the overall proportions of woman first and senior authors in medicine have increased from 5.9% and 3.7% in 1970 to 29.3% and 19.3% in 2004, respectively.³ In anaesthesia, during the years 2002–17,

woman first authors increased by about 10%.⁴ Another article demonstrated that in the years 1954–2017 in Canada, there was a slow rise in authorship with 22% woman first authors and 22% woman last authors in 2017.²

There are several limitations to this study. Only the general anaesthesia journals with the highest impact factor were included; differences in woman authorship may be present in lower-impact factor or in subspecialty journals. We were unable to confirm gender for a small percentage (0.6%) of the authors. We were unable to identify individuals with non-binary gender, or gender that did not align with their names or appearance. We focused on the first and last authors assuming that the first author was the junior author and the last author was the senior author, but this may not be true in some countries. We used name and appearance to classify gender, which is likely to misclassify non-gender conforming individuals. For a small number of authors (~5%), we used naming databases and websites, which may also resulted in some misidentifications. Finally, journals that asked for the highest degree only may have affected the classification of degrees.

To conclude, we have found that woman authorship in anaesthesia has increased significantly over the past decade, mostly driven by an increase in the number of woman first authors. However, the proportion of woman last authors is significantly less than the representation of women in the field and has not increased in the past decade. Our data suggest that resources should be invested on overcoming barriers for junior woman investigators to rise to senior ranks.

Declarations of interest

LQR is a *British Journal of Anaesthesia* editorial fellow. KOP is a member of the *British Journal of Anaesthesia* associate editorial board. The other authors declare that they have no conflicts of interest.

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Appendix A. Supplementary data

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Transient involuntary fixation on a second language following exposure to general anaesthetics

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Editor—In 2005, we reported a patient who, during recovery from a general anaesthetic, was unable to speak his native language, English, despite attempts to do so to communicate with his English-speaking carers, and found himself able to

speak only in his second language of Spanish.¹ This language disturbance spontaneously resolved without sequelae once he had fully recovered from anaesthesia. Given recent published interest in this phenomenon, the appearance of