

Bibliometric analysis of anaesthesia journal editorial board members: correlation between journal impact factor and the median *h*-index of its board members

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Editor's key points

- The *h*-index has been used to assess scholarly output.
- The *h*-index of members of the editorial boards of 10 anaesthesia journals was assessed.
- The median *h*-index for all editorial board members was 14 (range 11–20).
- The *h*-index appeared to be higher for higher impact factor journals and for European board members.

Background. *h*-index is useful for quantifying scholarly activity in medicine, but this statistic has not been extensively applied as a measure of productivity in anaesthesia. We conducted a bibliometric analysis of *h*-index in editorial board members and tested the hypothesis that editorial board members of anaesthesia journals with higher impact factors (IFs) have higher *h*-indices.

Methods. Ten of 19 journals with 2009 IF > 1 were randomly chosen from Journal Citation Reports®. Board members were identified using each journal's website. Publications, citations, citations per publication, and *h*-index for each member were obtained using Scopus®.

Results. Four hundred and twenty-three individuals filled 481 anaesthesia editorial board positions. The median *h*-index of all editorial board members was 14. Board members published 75 papers (median) with 1006 citations and 13 citations per publication. Members serving on journals with IF greater than median had significantly ($P < 0.05$; Wilcoxon's rank-sum test) greater median *h*-index, citations, and citations per publication than those at journals with IF less than median. A significant correlation between the median *h*-index of a journal's editorial board members and its IF ($h\text{-index} = 3.01 \times \text{IF} + 6.85$; $r^2 = 0.452$; $P = 0.033$) was observed for the 10 journals examined. Board members of subspecialty-specific journals had bibliometric indices that were less than those at general journals. The *h*-index was greater in individuals serving more than one journal. European editorial board members had higher *h*-index values than their American colleagues.

Conclusions. The results suggest that editorial board members of anaesthesia journals with higher IFs have higher *h*-indices.

Keywords: academic anaesthesia; bibliometrics; *h*-index; impact factor; performance measures

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The *h*-index is a bibliometric statistic that is useful for evaluating scholarly productivity in medicine. Unlike other citation indices,¹ *h*-index may be particularly applicable to the study of academic output because it is determined by how often a publication is cited in the literature. A researcher's *h*-index is defined as the number of their publications that have been cited in the peer-reviewed literature at least *h* times.² For example, if an investigator has published 30 papers, 15 of which have been cited 15 or more times, the researcher's *h*-index is 15. The remainder of the researcher's publications that do not have more than 15 citations are excluded from the index's calculation. Similarly, another investigator with a total of 20 papers, 10 of which are cited at least 10 times, has an *h*-index of 10. Thus, *h*-index is a measure of

the relative quality of an investigator's collective body of work, as publications of less significance are presumably cited less often.² The *h*-index for any researcher may be obtained from Scopus®, the Thompson Reuters Institute for Scientific Information (ISI) Web of Science®, and Google Scholar® online databases.³ The *h*-index was originally applied to assess academic output in theoretical physicists,² but the index has also been used to quantify and compare research productivity among faculty members in biological^{4 5} and health sciences^{6–11} including anaesthesia.¹² The *h*-index may also be used as a criterion when evaluating the suitability of a faculty member for promotion or tenure,^{7 11 13} in part because it is linearly related to academic rank.^{8 10} The *h*-index correlated with United States National

Institutes of Health (NIH) funding,¹⁰ has been used to assess the impact of biomedical research performed by institutions of differing size,¹⁴ and may predict future scientific achievement by investigators.¹⁵ To date, *h*-index has not been extensively applied as a measure of productivity in anaesthesia. We conducted a bibliometric analysis of *h*-index in editorial board members of 10 anaesthesia journals with impact factors (IFs) >1. We tested the hypothesis that editorial board members of anaesthesia journals with higher IFs have higher *h*-indices.

Methods

All data were collected in November 2010. Ten of the 19 anaesthesia journals with 2009 IFs >1 were chosen from the Web of Knowledge Journal Citation Reports® for the 'anaesthesiology' subject category using a random number generator (Microsoft Excel, Microsoft, Redmond, WA, USA). Editorial board members were identified using each journal's website. The number of publications, total citations, citations per publication, and *h*-index for each editorial board member were obtained using the Scopus® database (www.scopus.com). Self-citations were excluded using the available software option in 'Author Results' because such citations may falsely elevate *h*-index.^{16 17} The authors chose to use the Scopus® database alone because a strong correlation in *h*-index calculations between Scopus® and Google Scholar® databases was previously shown.⁷ The number of publications was subsequently verified using the PubMed® database (www.ncbi.nlm.nih.gov) to minimize inaccuracy in raw *h*-index values. Affiliation history and primary research interests in the health sciences were used to distinguish investigators with similar names.

Bibliometric data are presented as median (95% upper and lower confidence limits) because Kurtosis analysis indicated that the data were not normally distributed. Comparisons of data between groups were performed using the Wilcoxon rank-sum test. The null hypothesis was rejected

when $P < 0.05$. The relationship between mean *h*-indices and journal IFs was defined using linear regression analyses. Statistical calculations were performed using NCSS 2001 (NCSS, Kaysville, UT, USA).

Results

The average number of anaesthesia editorial board positions at the 10 journals included in this study was 48 (27) [mean (standard deviation)]. A total of 423 individuals filled 481 editorial board positions. Fifty individuals served on more than one editorial board (43 held appointments on two different boards and seven served on three boards), whereas the remainder ($n=373$) served on a single board. The median *h*-index of all editorial board members was 14 (range of a median of 11 for board members serving the *Journal of Cardiothoracic and Vascular Anesthesia* to a median of 20 for *Anesthesiology* board members; Table 1). Editorial board members published a median of 75 papers (95% lower and upper confidence limits of 62–114, respectively) and their work has been cited a median of 1006 times in the literature (95% lower and upper confidence limits of 632–1800, respectively). The median number of citations per publication was 13 (95% lower and upper confidence limits 10–17, respectively). Editorial board members serving on journals with IFs greater than the median had significantly ($P < 0.05$) greater *h*-index values, total citations, and citations per publication than their counterparts who hold editorial board positions at journals with IFs below the median (Table 2). The number of publications was similar between the groups. Linear regression analysis demonstrated a significant correlation between the median *h*-index of a journal's editorial board members and its IF ($h\text{-index} = 3.01 \times \text{IF} + 6.85$; $r^2 = 0.452$; $P = 0.033$) for the 10 journals examined. Editorial board members of subspecialty-specific anaesthesia journals (*Regional Anesthesia and Pain Medicine*, *Journal of Neurosurgical Anesthesiology*, and *Journal of Cardiothoracic and Vascular Anesthesia*) had lower *h*-indices, publications,

Table 1 Anaesthesia journal editorial board member bibliometric data. Data are median (95% upper and lower confidence limits); *impact factors are listed for each journal from the 2009 Journal Citation Reports®; †fifty editors are members of more than one editorial board; total publications, total citations, publications per citation, and *h*-index are listed for members of each anaesthesia journal editorial board

Journal name	Impact factor*	Editors (n)	Total publications	Total citations	Citations per publication	<i>h</i> -index
<i>Anesthesiology</i>	5.354	45	114 (85, 129)	1800 (1384, 2711)	16 (13, 20)	20 (18, 22)
<i>Regional Anesthesia and Pain Medicine</i>	4.157	64	64 (48, 70)	884 (620, 1064)	13 (11, 17)	14 (12, 16)
<i>British Journal of Anaesthesia</i>	3.827	32	94 (67, 121)	1173 (857, 1803)	13 (10, 15)	18 (13, 23)
<i>Anesthesia and Analgesia</i>	3.083	79	91 (75, 112)	1521 (1210, 1984)	17 (14, 19)	16 (14, 18)
<i>Journal of Neurosurgical Anesthesiology</i>	2.412	49	67 (55, 83)	903 (528, 1098)	13 (11, 15)	14 (12, 15)
<i>Canadian Journal of Anaesthesia</i>	2.306	24	62 (45, 112)	806 (492, 1391)	12 (10, 17)	12 (9, 18)
<i>Acta Anaesthesiologica Scandinavica</i>	2.260	22	91 (58, 133)	1259 (582, 2303)	13 (9, 17)	16 (12, 20)
<i>European Journal of Anaesthesiology</i>	1.859	20	105 (78, 151)	1130 (899, 2110)	13 (9, 17)	18 (13, 22)
<i>Journal of Clinical Anesthesia</i>	1.324	42	93 (66, 123)	1099 (668, 1398)	13 (9, 14)	14 (10, 16)
<i>Journal of Cardiothoracic and Vascular Anesthesia</i>	1.062	104	64 (56, 73)	632 (454, 880)	10 (9, 12)	11 (9, 13)
Total	—	481†	75 (68, 80)	1006 (901, 1092)	13 (12, 14)	14 (13, 15)

Table 2 Comparison of anaesthesia journal editor board member bibliometric data between the groups. Data are median (95% upper and lower confidence limits); total publications, total citations, publications per citation, and *h*-index are listed for members of each anaesthesia journal editorial board. *Significantly ($P < 0.05$) different from the editors of journals with impact factor greater than median. †Significantly ($P < 0.05$) different from the editors of generic journals. ‡Significantly ($P < 0.05$) different from the editors serving multiple journals. §Significantly ($P < 0.05$) different from the editors serving North American journals. ¶Significantly ($P < 0.05$) different from the editors from Europe journals

	Editors (n)	Total publications	Total citations	Citations per publication	<i>h</i> -index
Editors of journals with impact factor > median	239	78 (68, 87)	1113 (994, 1360)	14 (13, 15)	15 (14, 17)
Editors of journals with impact factor < median	194	72 (62, 81)	869 (668, 1022)*	11 (10, 13)*	13 (12, 14)*
<i>P</i> -value	—	0.256	0.002	<0.0001	<0.0001
Editors of generic journals	239	93 (84, 106)	1354 (1173, 1493)	14 (13, 15)	16 (15, 17)
Editors of subspecialty journals	212	65 (58, 69)†	777 (617, 903)†	12 (11, 13)†	13 (12, 14)†
<i>P</i> -value	—	<0.0001	<0.0001	0.0007	<0.0001
Editors serving multiple journals	50	113 (84, 130)	1493 (1106, 2081)	15 (13, 18)	18 (15, 20)
Editors serving a single journal	373	69 (65, 78)‡	918 (799, 1030)‡	13 (12, 13)‡	14 (13, 14)‡
<i>P</i> -value	—	<0.0001	<0.0001	0.007	0.0006
Editors serving European journals	66	97 (79, 119)	1179 (963, 1573)	13 (11, 14)	17 (16, 20)
Editors serving North American journals	356	71 (65, 78)§	1002 (880, 1092)§	13 (12, 14)	14 (13, 15)§
<i>P</i> -value	—	0.001	0.035	0.918	0.001
Editors from Europe	104	100 (85, 119)	1127 (963, 1495)	15 (13, 17)	17 (15, 18)
Editors from the USA	235	68 (64, 78)¶	1020 (882, 1212)	13 (10, 13)¶	14 (12, 15)¶
<i>P</i> -value	—	0.001	0.08	0.004	0.0007

citations, and citations per publication than their colleagues serving on general journals that were not subject-specific. The *h*-index, total number of publications, citations, and citations per publication were greater in editorial board members who hold positions on multiple journals compared with those serving a single journal. Anaesthesia journals based in Europe ($n=3$) had significantly ($P < 0.05$) fewer editorial board members per journal [25 (6)] than those based in North America [$n=7$; 58 (27) members per journal]. European editorial board members had higher *h*-index values, more publications, and more citations than their North American colleagues, but the number of citations per publication was similar between the groups. Editors from Europe had also higher *h*-indices, more publications, and more citations per publication than those from the USA regardless of the country of origin of the journal on which they served.

Discussion

The current data demonstrate that the median *h*-index of anaesthesia journal editorial board members is 14 (95% lower and upper confidence limits of 13 and 15, respectively). The only previous study of *h*-index in anaesthesia surveyed 151 Canadian paediatric anaesthetists and demonstrated that *h*-index ranged between 0 and 32 (mean of 2), thereby providing baseline data about research output across all academic groups within this relatively small cohort.¹² The *h*-index values observed in the 481 editorial board members examined in the current investigation ranged between 2 and 47. In general, editorial board members of medical journals are established in clinical or basic science researches, and represent a subpopulation of academically productive investigators in their field of study.

Thus, the current observation that anaesthesia editorial board members have relatively greater *h*-index values and other indices of academic output compared with paediatric anaesthetists¹² is not entirely unexpected. Interestingly, editorial board members of anaesthesia journals with higher IFs had evidence of greater academic output as indicated by *h*-index, total literature citations, and citations per publication than their counterparts at journals with lower IFs. Indeed, a significant ($P=0.033$) correlation ($r^2=0.452$) between the median *h*-index of a journal's editorial board members and its IF was demonstrated using linear regression analysis for the 10 journals examined. Despite its well-recognized limitations,^{18–22} IF (calculated as the average number of citations per paper published by a journal in the preceding 2 yr) continues to be a frequently used measure of a journal's relative quality in North America and Europe.²³ Thus, the results suggest that a relationship exists between the overall scientific relevance of an anaesthesia journal and the collective research productivity of its editorial board members.

The academic output of editorial board members is not widely studied in other medical disciplines. A recent analysis of the *h*-indices of senior editors of three major radiology journals (*Radiology*, *American Journal of Radiology*, and *American Journal of Neuroradiology*)¹¹ found an average *h*-index of ~30 (range 24.5–32).¹¹ Mean *h*-index values also varied between 27 and 33 among editorial board members of major general surgery, urology, oncology, neurosurgery, and cardiology journals.⁷ Nevertheless, comparison of *h*-index values between medical specialities may be inappropriate as it is most likely discipline-dependent,¹¹ as investigators who work in more highly specialized fields of study tend to have lower *h*-indices than their counterparts whose research has

a broader audience. For example, members of orthopaedic surgery journal editorial boards had an average h -index of 16 compared with their peers in general surgery (mean of 33).⁷ In his original paper, Hirsch² described similar results when the h -indices of physicists were compared with those in the biological sciences. The current results concur with these observations^{2,7} and suggest that research published in anaesthesia journals is cited primarily within the speciality. We further demonstrated that editorial board members of subspecialty-specific anaesthesia journals (*Regional Anaesthesia and Pain Medicine*, *Journal of Neurosurgical Anesthesiology*, and *Journal of Cardiothoracic and Vascular Anesthesia*) had lower h -index values than their colleagues who served on journals that were not focused on a subspecialty. As a result, the h -index appears to be most appropriately applied when determining the relative rating of investigators within their specific peer group rather than across subspecialties within a broad field of study or across disciplines in the health sciences.⁸ Our results also indicated that individuals ($n=50$) who served on more than one editorial board had greater h -index values (median of 18 compared with 14), publications, citations, and citations per publication than their peers who held a position for a single journal. The reasons for this are unknown, but recognition of the contributions of higher profile, more productive investigators through editorial board appointments may be at least partially responsible. Interestingly, editorial board members serving on European anaesthesia journals had significantly higher h -indices than their counterparts on North American editorial boards. European boards also had significantly fewer numbers of members than those in North America. These data suggest that editors-in-chief and their senior colleagues of European anaesthesia journals may be more selective about academic productivity when identifying potential new editorial board members for their journals because fewer positions are available. Indeed, editors from Europe had also higher h -indices, more publications, and more citations per publication than those from the USA regardless of the country of origin of the journal on which they served. There were also fewer editors from Europe than from the USA (104 vs 235), again suggesting editorial board appointment of European anaesthetists may reflect relatively greater selectivity for demonstrated scholarly activity.

The current results should be interpreted within the constraints of several possible limitations. h -index derived from the Scopus[®] database evaluates citations of work published after 1995. Thus, the true h -index of an editorial board member with a substantial number of highly cited manuscripts that were published before this date may be underestimated.²⁴ Nevertheless, significant differences in mean Scopus[®]-derived h -index were observed between journal editorial boards independent of the inherent temporal bias of the database. The h -index does not define whether a journal citation is positive or negative in its opinion of a given publication. For example, a highly controversial paper may be very frequently cited, especially when its principle findings directly contradict other, more established results. The h -index is

dependent on the duration of time spent in working in research and may inappropriately favour well-known researchers.^{7,25} These potential limitations are applicable to the current investigation because most editorial board members have participated in research for most if not all of their careers and many are well known in the academic anaesthesia community as a result. Self-citation has been identified as another potential problem of the h -index,^{16,17} but we specifically excluded self-citation using the available software in the Scopus[®] website. A high h -index in a given discipline is certainly a strong indication of academic productivity, but investigators with a relatively small number of highly cited papers (and hence, a low h -index) may also be viewed as very influential.¹² Thus, editorial board members with higher h -index values are certainly not exclusive in their scholarly contributions to the speciality. A researcher who is a frequent participant in large multicentre clinical trials with many co-investigators may also have a disproportionately high h -index because the publications resulting from these studies are often extensively cited.^{2,24} Whether this factor played a role in the current results is unknown, but many editorial board members have conducted or participated in important clinical research, including multicentre trials, throughout their careers. We were unable to ascertain whether some editorial boards had more members who were more active in such large-scale clinical research projects.

Other potential limitations also need to be considered when interpreting our results. The h -index does not discriminate between original research publications and review articles, which may also be extensively cited.²⁶ We did not attempt to exclude review articles or other publication formats from the analysis. We did not conduct a comparison between relative 'ranks' on editorial boards (e.g. editors-in-chief, editors, associate editors), as some of the journals included in the current investigation do not have such distinctions. The median h -index (20) of editors-in-chief ($n=10$) was numerically higher than that (14) for all other editorial board members ($n=413$). This observation suggests that, collectively, editors-in-chief may be more academically productive than those serving on their editorial boards, but the small sample size of editors-in-chief in the current investigation precluded a formal statistical comparison between the groups. We randomly selected 10 of the 19 anaesthesia journals with IFs > 1 for analysis in an attempt to minimize selection bias. Our sample most likely reflects the scholarly activity of anaesthesia journal editorial boards in general, but we did not examine the entire cohort of editorial board members serving all 19 journals and cannot definitively draw this conclusion as a result. Publications written in languages other than English may not be as frequently cited, and the h -index values of such authors may be underestimated as a result.²⁷ Nevertheless, the current results indicated that European editors (many of whom will publish in languages other than English) had greater h -index values than their American colleagues. Finally, we were unable to account for the possible effects of gratuitous authorship on the current bibliometric analysis.

In summary, our results indicate that editorial board members of anaesthesia journals with higher IFs have higher *h*-indices. Board members participating in journals without subject-specificity, those holding more than one journal appointment, or those working for European journals had greater *h*-index values than their corresponding colleagues. The median *h*-index values observed in anaesthesia journal editorial board members may be less than those previously reported with other medical and surgical journals because anaesthesia may be a more specialized field of study with a narrower target audience.

Conflict of interest

None declared.

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