Demographics and Scholarly Productivity of American Board of Anesthesiology Volunteers: Results of an Internet-Based Bibliometric Analysis

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Objective: **The American Board of Anesthesiology (ABA) has been responsible for certification of anesthesiologists since 1938. Selected ABA diplomates provide their expertise to write the ABA's written and oral examinations and to administer the oral examination required for primary certification. The demographics, administrative and educational duties, and scholarly productivity of ABA volunteers and their dependence on subspecialty certification, transesophageal echocardiography (TEE) credentials, and grant funding are unknown.**

Design: **Observational study.**

Setting: **Internet analysis.**

Participants: **ABA volunteers who participated in the 2015 primary certification examinations identified from the 2016 issue of *ABA News*.**

Interventions: **None.**

Measurements and Main Results: **The 2016 issue of *ABA News* was downloaded from the public ABA website and was used to identify all volunteers who participated in any aspect of the 2015 primary certification process. Each individual's practice type, faculty rank if applicable, and affiliation were identified using Google with the keyword "anesthesiology." The practice location, time, and interval after original ABA certification; additional ABA subspecialty certification; the number of publications and citations; publication rate; citations per publication; and the H-, M-, and i-10 indices were obtained using the ABA and Scopus databases. Credentials in TEE were identified for each individual using the National Board of Echocardiography database. National Institutes of Health (NIH) and Foundation for Anesthesia Education and Research (FAER) funding for each volunteer was evaluated using NIH Research Portfolio Online Reporting Tools and the FAER alumni databases, respectively. Three hundred ninety-three ABA volunteers were identified and analyzed. Three hundred ten individuals currently hold academic appointments (83.5%), whereas 83 (16.5%) hold private practice or military positions. Sixty-seven volunteers have major administrative roles (eg, dean, chief executive officer, associate or assistant dean, chair, vice chair). Thirty-five individuals are program directors of anesthesiology residencies or fellowships. Volunteers published 10,072 manuscripts that have been cited 194,835 times. Volunteers also received 51 NIH grants and 36 FAER grants. The median H-, M-, and i10-indices of volunteers were 4, 0, and 3, respectively. Scholarly productivity was dependent on academic rank, career duration, additional degrees, and extramural funding, but not on practice location, subspecialty certification, TEE credentials, or sex.**

Conclusions: **These results indicated that ABA volunteers are leaders in anesthesiology with established records of administrative, educational, and scholarly accomplishment.** ***Published by Elsevier Inc.***

THE AMERICAN BOARD OF ANESTHESIOLOGY (ABA) is a nonprofit, volunteer organization that has been exclusively responsible for certification of anesthesiologists since its formation in 1938. The ABA has certified more than 50,000 anesthesiologists to date.[1] Selected ABA diplomates provide their expertise to write the ABA's written and oral examinations and to administer the oral examination required for primary certification. ABA volunteers also are responsible for writing examinations for subspecialty certification, maintenance of certification in anesthesiology (MOCA), and resident evaluation (In-Training Examination). Even though it is assumed that ABA diplomates involved in these activities are leaders in the specialty, the demographics, administrative and educational responsibilities, and scholarly productivity of these individuals have not been documented formally. Accordingly, the author conducted an internet-based analysis of ABA volunteers who participated in any aspect of the primary certification examination in 2015. Scholarly productivity was quantified using H-index, a bibliometric statistic that has been used to describe productivity in anesthesiology[2–12] and other medical specialties.[13–22] H-index is defined as the number of an investigator's publications that have been cited at least H times.[23] Despite its inherent limitations,[7,21] H-index is a well-established indicator of the relative strength and consistency of an investigator's collective work based on the assumption that publications of less value are not cited as frequently.[20,23–25] The ability to obtain grant support from the National Institutes of Health (NIH) and the Foundation for Anesthesia Education and Research (FAER) also was

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quantified. The relationship between National Board of Echocardiography (NBE) credentials in transesophageal echocardiography (TEE) and scholarly productivity in ABA volunteers was also evaluated. This investigation tested the hypothesis that ABA volunteers who participate in the ABA primary certification process are administrative, educational, and scholarly leaders in the specialty.

METHODS

All data were collected in April and May 2016. The 2016 issue of *ABA News* was downloaded from the public ABA website[1] and was used to identify all volunteers who participated in any aspect of the 2015 primary certification process, including as question writers, editors, or examination committee members of the part I, basic, or advanced examinations; question writers, editors, or examination committee members of the part II examination (soon to become part of the applied examination); or associate examiners responsible for administration of the part II examination to candidates. Writers, editors, and examination committee members of the 5 ABA subspecialty examinations (care medicine, hospice and palliative medicine, pain medicine, pediatric anesthesiology, and sleep medicine); the MOCA examination; the recently introduced "MOCA minute" continuous evaluation program; and the In-Training Examination were not included in this analysis. The date of original primary certification, the type and date of any subspecialty certification if applicable, and the most recent practice location of each volunteer were identified using the ABA website's "Verify a Physician's Certification" search engine.[1]

The current academic (including faculty rank, administrative title[s]; and educational leadership position[s]), private practice (including administrative title), or military affiliation of each ABA volunteer was identified using the Google search engine combined with the keyword "anesthesiology." Academic practice was defined as a full-time appointment as noted on the corresponding anesthesiology department's website. The duration of scholarly activity, number of publications, publications per year, number of citations, citations per publication, and H-index for each individual were obtained using the Scopus database. The number of publications was verified using PubMed to reduce possible inaccuracies in H-index values. The M-index (rate of increase of H-index) was calculated from these data as the ratio of H-index to the years of scholarly activity.[26] The i10-index (number of publications that have been cited at least 10 times) also was recorded from the Scopus database; the number of publications with 10 or more citations was identified in each author's list of cited work. Credentials in basic or advanced perioperative TEE ("testamur" or "certification") for each individual were quantified using the NBE database.[27]

Each ABA volunteer's history of NIH funding was defined using NIH Research Portfolio Online Reporting Tools.[28] The number and type of NIH grants (mentored basic or clinical scientist development awards [K-series] and research grants [R-series]), the total number of grants, the years of grant funding, and the amount of grant awards were quantified. Affiliation history and primary research interests in the health sciences were used to distinguish grant recipients with similar names. The number of FAER grants and the number of individuals who had participated previously in the FAER "Resident Scholar" program also were recorded from the FAER alumni database.[29]

Statistics

Categorical variables are presented as numbers with percentages. Continuous variables are expressed as median (interquartile range [range]) because they are not distributed normally (Kolmogorov-Smirnov test). Comparison of continuous variables was performed using the Mann-Whitney *U* test for 2 independent samples or the Kruskal-Wallis test for multiple independent samples where appropriate. The null hypothesis was rejected when $p < 0.05$. Statistical calculations were performed using StatPlus:mac LE software (AnalystSoft, Vancouver, BC, Canada).

RESULTS

Three hundred ninety-eight individuals were identified as ABA volunteers. Five volunteers could not be identified uniquely because of common names; these individuals were excluded from subsequent analysis. As a result, a total of 393 individuals who participated in the primary certification process were evaluated.

ABA volunteers published 10,072 manuscripts that have been cited 194,835 times in the peer-reviewed literature (Table 1). Approximately 40% of these articles have been cited at least 10 times. The H-, M-, and i10-indices of ABA volunteers were 4 (2-10 [0–52]); 0 (0-1 [0–2]); and 3 (1-10 [0–155]), respectively (data are median [interquartile range [range]). ABA volunteers received 51 NIH grants (to 27 individuals), including 12 (to 12 individuals) and 39 (to 22 individuals) K- and R-series awards, respectively, for a

Table 1. Summary of Scholarly Productivity for All ABA Volunteers

	Total	Median (IQR [range])	Mean ± SD
Years after certification	6,827	16 (9-25 [2–38])	17 ± 9
Publications	10,072	10 (3-30 [0–347])	26 ± 40
Publications/year	—	1 (0-2 [0–14])	1 ± 2
Citations	194,835	92 (15-470 [0–8,293])	496 ± 1,064
Citations/publication	—	9 (4-18 [0–76])	13 ± 12
H-index	—	4 (2-10 [0–52])	7 ± 9
M-index	—	0 (0-1 [0–2])	0 ± 0
i10-index	3,994	3 (1-10 [0–155])	10 ± 19
FAER grants	36	0 (0-0 [0–2])	0 ± 0
Number of individuals	35 (8.9%)		
K-series NIH grants	12	0 (0-0 [0–1])	0 ± 0
Number of individuals	12 (3.1%)		
R-series NIH grants	39	0 (0-0 [0–5])	0 ± 1
Number of individuals	22 (5.6%)		
Total NIH grants	51	0 (0-0 [0–5])	0 ± 1
Number of individuals	27 (6.9%)		
Years of NIH funding	177	0 (0-0 [0–24])	1 ± 2
NIH support ($ million)	38.42	0 (0-0 [0-5.75])	0.10 ± 0.58

Abbreviations: FAER, Foundation for Anesthesia Education and Research; IQR, interquartile range; NIH, National Institutes of Health; SD, standard deviation.

Table 2. Scholarly Productivity of ABA Volunteers by Position and Rank

	Administrators	Program Directors	Professors	Associate Professors	Assistant Professors	Instructors	Private Practice/Military	p Value
Number (%)	67 (17.0)	35 (8.9)	59 (15.0)	74 (18.8)	95 (24.2)	4 (1.0)	83 (16.5)	—
Years after certification	24 (20-30 [9–36])	15 (1-21 [3–31])	24 (17-29 [8–38])	14 (10-21 [4–36])	9 (7-12 [2–31])	3 (2-4 [2–5])	16 (9-26 [4–34])	<0.0001
Publications	33 (15-72 [0–202])	15 (4-27 [0–347])	40 (19-78 [1–247])	14 (8-29 [0–121])	4 (2-7 [0–58])	2 (1-3 [0–4])	2 (1-8 [0–26])	<0.0001
Publications/year	2 (1-3 [0–8])	1 (1-2 [0–14])	2 (1-4 [0–9])	1 (0-2 [0–7])	1 (0-1 [0–7])	1 (0-2 [0–2])	0 (0-0 [0–4])	<0.0001
Citations	570 (138-1,575 [0–5,651])	137 (67-419 [0–8,166])	632 (195-1,451 [1–8,293])	110 (55-320 [0–2,070])	13 (0-53 [0–587])	3 (0-21 [0–68])	19 (3-81 [0–858])	<0.0001
Citations/publication	16 (7-26 [0–57])	14 (7-19 [0–54])	16 (13-24 [1–47])	8 (5-16 [0–48])	4 (0-7 [0–57])	3 (0-9 [0–23])	7 (2-16 [0–76])	<0.0001
H-index	11 (6-20 [0–41])	6 (3-10 [0–52])	13 (7-21 [1–48])	5 (3-9 [0–25])	1 (0-3 [0–10])	0 (0-1 [0–3])	2 (1-4 [0–10])	<0.0001
M-index	1 (0-1 [0–2])	0 (0-1 [0–2])	1 (0-1 [0–2])	0 (0-1 [0–2])	0 (0-0 [0–2])	0 (0-0 [0–2])	0 (0-0 [0–1])	<0.0001
i10-index	14 (3-30 [0–77])	4 (2-10 [0–155])	15 (7-38 [0–138])	3 (2-8 [0–38])	1 (0-2 [0–10])	0 (0-0 [0–1])	1 (0-2 [0–10])	<0.0001
Professors (%)	73.1%	37.1%	—	—	—	—	—	—

NOTE. Data are expressed as median (interquartile range [range]). Six administrators (vice chairs) also had appointments as program directors.

total of 177 grant-years and $38.42 million in federal support. ABA volunteers also received 36 FAER grants (to 35 individuals). Twenty-seven individuals were identified as previous participants in the FAER Resident Scholar program. Three hundred ten individuals currently hold academic anesthesiology appointments (83.5%; Table 2), whereas 83 (16.5%) hold private practice or military positions. Sixty-seven volunteers are major administrators in their institutions, medical schools, or anesthesiology departments (1 dean, 3 assistant or associate deans, 3 chief executives or medical officers/hospital vice presidents, 20 department chairs, 33 department vice chairs, and 5 Veterans Affairs department chiefs), and 35 individuals are current anesthesiology residency (22) or American College of Graduate Medical Education-accredited fellowship program directors (5 adult cardiothoracic anesthesiology, 4 critical care medicine, 2 pediatric anesthesiology, 1 pain medicine, and 1 obstetric anesthesiology). The number of publications; publication rate; total citations; citations per publication; and H-, M-, and i10-indices were academic rank–dependent ($p < 0.0001$). Scholarly productivity also was dependent on the number of years after original certification in a time-dependent manner (Table 3).

ABA volunteers most commonly practice in the Eastern United States (136; 34.6%), followed in descending order by the South (109; 27.7%), Central (78; 19.9%), and West (70; 17.8%) (Table 4). Individuals who practice in the West had fewer years of activity and publications than their peers, but no other differences in scholarly output were observed among geographic areas. The majority of ABA volunteers practiced in 10 states (234; 59.5%) led by California and New York (Table 5).

A large minority (163; 41.5%) of ABA volunteers have subspecialty certification in critical care medicine (77; 19.6%), pediatric anesthesiology (67; 17.1%), pain medicine (23; 5.9%), and hospice and palliative medicine (4; 1.0%). Eight individuals hold certification in 2 subspecialties (Table 6). Approximately one-quarter (98 of 393) of ABA volunteers have credentials in advanced perioperative TEE from the NBE (Table 7). Scholarly output was similar in ABA volunteers with versus without subspecialty certification or TEE credentials.

Individuals who participated in multiple aspects of the primary certification process had more years of experience; greater scholarly output; and higher H-, M-, and i10-indices than did their colleagues who participated in a single activity (Table 8). ABA volunteers with additional degrees (55, 14.0%) had greater productivity than did their colleagues with medical degrees alone (Table 9). Similarly, those with NIH or FAER grants (45; 11.5%) had greater output than those who did not (348; 88.5%) (Table 10). Male ABA volunteers had more years of experience, publications, and citations than did women (Table 11). The H- and i10-indices of men who serve as ABA volunteers also was greater than those of women, but the number of publications per year, the citations per publication, and the M-index were similar between sexes.

DISCUSSION

These results demonstrate that ABA volunteers have a solid record of administrative, educational, and scholarly activity. More than three-quarters of ABA volunteers are academic anesthesiologists, but a substantial minority (16.5%) of ABA

Table 3. Scholarly Productivity of ABA Volunteers Based on Years of Activity After Certification

	≤10 Years	11-20 Years	>20 Years	P value
Number (%)	120 (30.5)	128 (32.6)	145 (37.9)	–
Years after certification	8 (7-9 [2–10])	15 (12-17 [11–20])	28 (24-31 [21–38])	<0.0001
Publications	4 (1-10 [0–62])	11 (3-22 [0–103])	25 (9-59 [0–347])	<0.0001
Publications/year	1 (0-1 [0–7])	1 (0-2 [0–6])	1 (0-2 [0–14])	0.0270
Citations	17 (0-81 [0–736])	76 (16-256 [0–2,735])	456 (87-1194 [0–8,293])	<0.0001
Citations/publication	5 (0-9 [0–57])	7 (4-17 [0–64])	16 (9-25 [0–76])	<0.0001
H-index	2 (0-4 [0–14])	4 (2-8 [0–31])	10 (4-17 [0–52])	<0.0001
M-index	0 (0-1 [0–2])	0 (0-1 [0–2])	0 (0-1 [0–2])	0.0329
i10-index	1 (0-3 [0–19])	3 (1-7 [0–65])	10 (3-26 [0–155])	<0.0001

NOTE. Data are expressed as median (interquartile range [range]).

volunteers practice in the private sector or at military hospitals. Nearly 20% of ABA volunteers hold major administrative appointments in their hospitals, medical schools, or departments, whereas approximately 9% serve in a key educational capacity as anesthesiology residency or fellowship program directors.

ABA volunteers make important scholarly contributions, producing more than 10,000 peer-reviewed publications that have accumulated more than 190,000 citations to date. Almost 40% of these articles have been cited at least 10 times. The median H-index value of ABA volunteers observed in this investigation was 4, somewhat larger than the previously reported median H-index of US academic anesthesiologists (between 1 and 3). This may be related to the higher proportion of senior faculty members (professors and associate professors) in the current compared with the previous samples.[7,11] H-index is highly dependent on academic rank and career duration,[7,21,30–33] and as a result, the median H-index observed in this study was expected to be larger than that observed in previous surveys that included more assistant professors and instructors. Nevertheless, the median H-indices of professors, associate professors, and program directors (13, 5, and 6, respectively) who serve the ABA also were larger than those previously reported for academic anesthesiologists (9, 4, and 3, respectively),[7,11] suggesting that ABA volunteers have relatively greater scholarly output than do their peers who do not participate in ABA certification activities.

The current H- and M-indices of ABA volunteers were less than those reported for former FAER grant recipients (eg, median H index of 13) for whom clinical or basic science research plays a central role in their careers.[12] The ability to secure extramural funding may not be a major objective for most ABA volunteers, but many of these individuals (11.5%) have been successful in this regard, obtaining 51 NIH and 36 FAER grants while amassing more than $38 million in NIH support.

The results also indicate that 2015 ABA volunteers originated primarily from the eastern and southern United States with fewer individuals practicing in central or western locations. The ABA oral examinations are no longer held biannually at various locations throughout the United States but now are conducted in 9 separate sessions exclusively at the ABA's North Carolina office in anticipation of the addition of the Objective Structured Clinical Examination to the applied examination in 2018.[1] It seems likely that use of this permanent eastern US site (which began in 2015 [the year that this survey covers]) may have discouraged some volunteers from traveling longer distances from central or western regions to participate in examination activities. Despite this geographic disparity, the scholarly output (H- and M-indices) of ABA volunteers was quite similar among different parts of the country, although individuals from the western United States had fewer publications concomitant with fewer years of activity compared with their eastern, southern, and central US counterparts. These data contrast to some degree with previous findings among academic otolaryngologists, for whom geographic variations in scholarly impact were suggested.[34] The reasons for this difference between specialties are unclear, but the otolaryngology study[34] had a substantially larger sample size (n = 1,109) than the investigation presented here (n = 393) that may have allowed greater statistical power to discriminate among geographic regions.

More than 40% of ABA volunteers have ABA subspecialty certification, and 8 individuals hold certification in 2

Table 4. Scholarly Productivity of ABA Volunteers Based on Geographic Area

	East	South	Central	West	P value
Number (%)	136 (34.6)	109 (27.7)	78 (19.9)	70 (17.8)	–
Years after certification	18 (11-26 [2–36])	16 (9-26 [4–38])	17 (9-26 [2–34])	12 (9-18 [3–35])	0.0369
Publications	10 (4-30 [0–178])	11 (3-31 [0–202])	18 (4-40 [0–347])	5 (2-12 [0–202])	0.00524
Publications/year	1 (0-2 [0–8])	1 (0-2 [0–8])	1 (0-2 [0–14])	0 (0-1 [0–8])	0.0569
Citations	83 (23-433 [0–8,263])	110 (17-482 [0–4,191])	186 (14-703 [0–8,166])	61 (10-160 [0–5,280])	0.0843
Citations/publication	9 (4-17 [0–57])	9 (4-17 [0–64])	10 (5-18 [0–76])	8 (4-24 [0–54])	0.711
H-index	4 (2-10 [0–48])	5 (2-11 [0–34])	6 (2-12 [0–52])	3 (1-6 [0–37])	0.0850
M-index	0 (0-1 [0–2])	0 (0-1 [0–2])	0 (0-1 [0–2])	0 (0-1 [0–2])	0.565
i10-index	3 (1-10 [0–94])	3 (1-12 [0–76])	4 (1-17 [0–155])	2 (0-5 [0–88])	0.0276

NOTE. Data are expressed as median (interquartile range [range]).

Table 5. Top 10 States Where ABA Volunteers Practice

State	Number (%)
California	33 (8.4)
New York	33 (8.4)
Massachusetts	29 (7.4)
Pennsylvania	25 (6.4)
Texas	24 (6.1)
Illinois	20 (5.1)
Florida	19 (4.8)
Maryland	19 (4.8)
North Carolina	17 (4.3)
Ohio	15 (3.8)

NOTE. 159 examiners were based in 30 other states.

subspecialties (see Table 6). Critical care medicine, pediatric anesthesiology, and pain medicine were the 3 most common subspecialty certifications that ABA volunteers have earned. Scholarly output was similar in ABA volunteers holding additional subspecialty certification compared with those who did not. These findings are not entirely surprising considering that only 12 months of fellowship training generally are required to qualify for ABA certification in these subspecialties, and this training most likely emphasizes clinical experience rather than research. Similar observations have been made in other medical specialties. For example, fellowship training (presumably leading to subspecialty certification if available) increased H-index values in academic ophthalmologists[35] and otolaryngologists,[34] but it did not affect the H-index in urologists[36] or neurosurgeons.[37] The duration of formal research commitment and the degree to which research is emphasized during fellowship training may account for the differences in scholarly output between those with versus without fellowship training in these other specialties. Scholarly productivity of ABA volunteers was similar in those with versus without credentials in advanced perioperative TEE (see Table 7), consistent with previous observations in academic adult cardiothoracic anesthesiologists.[7] These findings were expected considering that obtaining TEE credentials requires cultivation of clinical skills that are unrelated to research or its dissemination.

Table 6. Influence of Subspecialty Certification on Scholarly Productivity of ABA Volunteers

	With Subspecialty	Without Subspecialty	p Value
Number (%)	163 (41.5)	230 (58.5)	—
Years after certification	17 (10-26 [2–38])	15 (9-24 [2–36])	0.120
Publications	10 (4-31 [0–247])	10 (2-29 [0–347])	0.498
Publications/year	1 (0-2 [0–9])	1 (0-2 [0–14])	0.750
Citations	103 (22-473 [0–8,293])	86 (11-467 [0–8,166])	0.395
Citations/publication	9 (4-19 [0–76])	9 (3-18 [0–57])	0.608
H-index	4 (2-10 [0–48])	4 (1-10 [0–52])	0.395
M-index	0 (0-1 [0–2])	0 (0-1 [0–2])	0.601
i10-index	3 (1-11 [0–138])	3 (0-10 [0–155])	0.501

NOTE. Data are expressed as median (interquartile range [range]).

Table 7. Influence of TEE Credentials on Scholarly Productivity of ABA Volunteers

	With TEE Credentials	Without TEE Credentials	p Value
Number (%)	98 (24.9)	295 (75.1)	—
Years after certification	13 (9-22 [2–34])	17 (10-26 [2–38])	0.0540
Publications	10 (4-28 [0–347])	10 (3-32 [0–247])	0.710
Publications/year	1 (0-2 [0–14])	1 (0-2 [0–9])	0.215
Citations	86 (27-352 [0–8,166])	103 (13-518 [0–8,293])	0.775
Citations/publication	9 (4-16 [0–34])	9 (4-20 [0–76])	0.672
H-index	4 (2-9 [0–52])	4 (2-11 [0–48])	0.823
M-index	0 (0-1 [0–2])	0 (0-1 [0–2])	0.454
i10-index	3 (1-8 [0–155])	3 (0-11 [0–138])	0.752

NOTE. Data are expressed as median (interquartile range [range]).

ABA volunteers with additional degrees had greater scholarly output than those without additional degrees (see Table 9). Many ABA volunteers with an additional degree earned a doctor of philosophy or a master of science degree for which research is a requirement. These data support previous findings among academic anesthesiologists with doctor of medicine and doctor of philosophy degrees who produced more publications than those with medical degrees alone.[38] In contrast, FAER grant recipients with combined doctor of medicine and doctor of philosophy degrees had similar scholarly productivity as those with doctor of medicine degrees alone,[12] but it seems likely that doctor of medicine FAER grant recipients may represent a highly research-motivated subset of anesthesiologists as a whole. Interesting, 20 ABA volunteers earned master of business administration degrees and 3 hold law degrees. This observation supports the contention that ABA volunteers are important contributors to the administrative mission of their institutions.

As expected, ABA volunteers with NIH or FAER grant support had higher scholarly output than did their peers (see Table 10). Extramural funding has been linked strongly to scholarly productivity and academic advancement in many medical specialties,[25,39–43] including anesthesiology.[12] The results of this study also suggest that modest differences in scholarly output exist between men and women who volunteer for the ABA: Men had more publications, a greater number of citations, and larger H- and i10-indices than did women concomitant with careers of longer duration, but the publication rate and M-index (rate of increase of H-index) were similar between the groups (see Table 11). These data concur with the findings of a previous study demonstrating that men and women had equivalent rates of scholarly output in a survey of nearly 10,000 academic physicians.[44] Other studies of a variety of medical specialties, including anesthesiologists,[10,22,45,46] have shown that scholarly output of women initially may trail men early during their careers, but productivity of women subsequently increases to equal or exceed that of their male peers as their careers progress.

The results of this study should be considered within the constraints of several potential limitations in addition to those that already have been mentioned. The H-index has widely recognized limitations as a bibliometric statistic that the author

Table 8. Scholarly Productivity of ABA Volunteers Based on Type of Examination Participation

	Administration of Oral Examinations	Writing of Examinations	Both	p Value
Number (%)	268 (68.2)	62 (15.8)	145 (16.0)	—
Years after certification	16 (10-26 [4–36])	9 (4-17 [2–38])	20 (14-24 [7–34])	<0.0001
Publications	9 (2-27 [0–202])	7 (3-28 [0–202])	18 (7-38 [0–347])	0.00953
Publications/year	1 (0-2 [0–8])	1 (0-2 [0–8])	1 (0-2 [0–14])	0.00646
Citations	81 (12-456 [0–8,263])	64 (11-252 [0–4,191])	243 (66-709 [0–8,166])	0.00135
Citations/publication	8 (4-18 [0–76])	8 (2-14 [0–40])	14 (8-21 [0–58])	0.0178
H-index	4 (2-10 [0–48])	4 (1-8 [0–34])	7 (4-13 [0–52])	0.00123
M-index	0 (0-1 [0–2])	0 (0-1 [0–2])	0 (0-1 [0–2])	0.00519
i10-index	2 (0-10 [0–94])	2 (0-7 [0–76])	6 (3-17 [0–155])	0.0004

NOTE. Data are expressed as median (interquartile range [range]).

Table 9. Influence of Additional Degrees on Scholarly Productivity of ABA Volunteers

	With Other Degree	Without Other Degree	p Value
Number (%)	55 (14.0)	338 (86.0)	—
Years after certification	19 (13-26 [4–32])	15 (9-25 [2–38])	<0.0001
Publications	21 (12-67 [0–347])	9 (2-27 [0–247])	<0.0001
Publications/year	2 (1-4 [0–14])	1 (0-2 [0–8])	<0.0001
Citations	246 (76-1154 [0–8,166])	78 (12-392 [0–8,293])	<0.0001
Citations/publication	14 (9-21 [0–57])	9 (4-17 [0–76])	<0.0001
H-index	7 (4-18 [0–52])	4 (1-9 [0–48])	<0.0001
M-index	0 (0-1 [0–2])	0 (0-1 [0–2])	<0.0001
i10-index	7 (3-27 [0–155])	2 (0-9 [0–138])	<0.0001
PhD	21	—	
JD	3	—	
MPH	6	—	
MBA	20	—	
MA	3	—	
MS	6	—	
MEd	1	—	

NOTE. Data are expressed as median (interquartile range [range]); 5 individuals earned 2 additional degrees.

Abbreviations: JD, doctor of jurisprudence; MA, master of arts; MBA, master of business administration; MEd, master of education; MPH, master of public health; MS, master of science; PhD, doctor of philosophy.

Table 10. Influence of NIH or FAER Grant Support on Scholarly Productivity of ABA Volunteers

	With Grant	Without Grant	p Value
Number (%)	45 (11.5)	348 (88.5)	—
Years after certification	21 (16-28 [3–36])	15 (9-25 [2–38])	<0.0001
Publications	58 (32-110 [5–347])	8 (2-22 [0–178])	<0.0001
Publications/year	3 (2-5 [0–14])	1 (0-1 [0–8])	<0.0001
Citations	1249 (426-2735 [8-8,166])	72 (12-282 [0–8,293])	<0.0001
Citations/publication	18 (11-26 [0–57])	8 (4-16 [0–76])	<0.0001
H-index	17 (11-29 [0–52])	4 (1-8 [0–48])	<0.0001
M-index	1 (1-1 [0–2])	0 (0-1 [0–2])	<0.0001
i10-index	25 (11-56 [0–155])	2 (0-8 [0–94])	<0.0001

NOTE. Data are expressed as median (interquartile range [range]).

Abbreviations: FAER, Foundation for Anesthesia Education and Research; NIH, National Institutes of Health.

Table 11. Influence of Sex on Scholarly Productivity of ABA Volunteers

	Men	Women	p Value
Number (%)	284 (72.3)	109 (27.7)	—
Years after certification	17 (10-26 [2–38])	13 (9-21 [2–34])	0.00529
Publications	11 (4-36 [0–347])	8 (2-18 [0–202])	0.00987
Publications/year	1 (0-2 [0–14])	1 (0-2 [0–6])	0.0659
Citations	113 (19-545 [0–8,293])	56 (9-279 [0–5,280])	0.00699
Citations/publication	10 (5-18 [0–76])	8 (3-18 [0–42])	0.106
H-index	5 (2-11 [0–52])	3 (1-8 [0–34])	0.0102
M-index	0 (0-1 [0–2])	0 (0-1 [0–2])	0.0747
i10-index	3 (1-12 [0–155])	2 (0-7 [0–70])	0.0160

NOTE. Data are expressed as median (interquartile range [range]).

will not repeat in this discussion.[7,14,16,20,21,23–25,33,35,47–49] Nevertheless, the H-index has been clearly linked to productivity, academic rank, and the ability to successfully obtain extramural support.[2–11,13–22] Information about academic rank, educational duties, and administrative commitments were obtained solely from department or medical school websites, which may not be entirely up to date. The websites of some private practice groups had limited information and the administrative responsibilities of ABA volunteers who are members of these practices may have been underestimated as a result. The author also did not examine other potential sources of extramural funding available to ABA volunteer-researchers (eg, Veterans Affairs, National Science Foundation). Thus, the current results may have underestimated grant support that ABA volunteers may have obtained.

In summary, these results indicate that ABA volunteers are leaders in anesthesiology with established records of administrative, educational, and scholarly accomplishment. The scholarly productivity of ABA volunteers was dependent on academic rank, career duration, additional degrees, and extramural funding but not on practice location, subspecialty certification, TEE credentials, or sex.

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