


RESEARCH

Open Access



The AANS Harvey Cushing Medal: a demographic and academic analysis of its recipients

Kevin Pierre^{1*} , Olgert Bardhi², Dimitri Laurent³, Sasha Vaziri³, Brandon Lucke-Wold³, Meghan M. Brennan⁴, Abeer Dagra⁵, Bankole Olowofela⁵ and Ernest Barthélemy⁶

Abstract

Background The Harvey Cushing Medal, awarded by the American Association of Neurological Surgeons, is the premier accolade in neurosurgery. The study's purpose was to examine the qualities and accomplishments of previous winners, emphasizing potential selection biases, with the aim to promote social justice and guide young neurosurgeons in their career paths.

Results Predominantly, recipients graduated from top-ranked United States News and World Report institutions and specialized in cerebrovascular and neuro-oncologic/skull base neurosurgery. A significant proportion held roles as department or division chairs and led neurosurgical organizations. All awardees were male, and there was a notable trend of increasing publication counts among more recent recipients.

Conclusions Commonalities among Harvey Cushing Medal winners include graduating from top institutions, holding significant leadership roles, and having an extensive publication history. However, the absence of female and underrepresented minority awardees underscores an urgent need for greater diversity in the selection process.

Keywords Cushing Medal, AANS, Harvey Cushing, American Association of Neurological Surgeons

Introduction

Harvey Cushing, the pioneer of neurosurgery, made invaluable contributions to both neurosurgery and endocrinology. He established the notion of a physician-scientist and discovered Cushing's Reflex and disease. His research paved the way for significant advancements

including the development of physiological salt solutions, intraoperative monitoring of vital signs, and the elucidation of pituitary gland and human somatosensory cortex functions. Cushing also served in the medical regiment in France during World War I and is the sole surgeon to have received a Pulitzer prize for his writings [1–5].

In response to barriers in the Society of Neurological Surgeons, a group of neurosurgeons established a more accessible organization. They sought to facilitate unbiased discussions of the latest developments and challenges in the field. Named in honor of Cushing, this society eventually evolved into the American Association of Neurological Surgeons (AANS) [6].

The AANS bestows the prestigious Harvey Cushing Medal, recognizing exceptional service and leadership in neurosurgery [7]. This article aims to analyze patterns, biases, and achievements of past recipients to help

*Correspondence:

Kevin Pierre
kpierre150@gmail.com

¹ Department of Radiology, University of Florida, 1600 SW Archer Rd, PO Box 100265, Gainesville, FL 32610-0265, USA

² Department of Medicine, University of Texas Southwestern, Dallas, TX, USA

³ Department of Neurosurgery, University of Florida, Gainesville, FL, USA

⁴ Department of Anesthesiology, University of Florida, Gainesville, FL, USA

⁵ College of Medicine, University of Florida, Gainesville, FL, USA

⁶ Division of Neurosurgery, SUNY Downstate Health Sciences University, Brooklyn, NY, USA

emerging neurosurgeons navigate their careers and counter biases. By examining the award recipients from 1977 until now, we seek to highlight key demographic and professional features to foster the modernization of neurosurgery [8].

Methods

Biographical information

Biographical data on award recipients, including undergraduate school, medical school, birthplace, and residency program, was collected primarily from the Congress of Neurological Surgeons (CNS) [9] and Society of Neurological Surgeons (SNS) [10] websites. In instances where information was missing, literature searches were performed using biographical websites, books, and journals. Chi-square testing was used to analyze the distribution differences among undergraduate schools, accredited medical schools, and ACGME approved residency programs that recipients attended and the actual distribution of those institutions in the U.S. This analysis was limited to U.S. institutions only [11–15].

In the absence of race or ethnicity data from the AANS (American Association of Neurological Surgeons, Personal Communication, 8/10/2022), alternative methods were used to infer whether any Cushing recipient was an underrepresented minority in medicine (URIM). Biographies were reviewed; memberships from a major neurosurgical organization largely composed of underrepresented individuals in medicine were checked, (American Society of Black Neurosurgeons, Personal Communication, 8/8/2022), and a PubMed search was performed using specific search terms ("Neurosurgery"[Mesh] OR "Neurosurgeons"[Mesh] OR "neurosurgery*" [tiab]) AND ("African Americans"[Mesh] OR "Blacks"[Mesh] OR "Hispanic or Latino"[Mesh] OR "Indians, North American"[Mesh] OR "Alaskan Natives"[Mesh] OR "Inuits"[Mesh] OR "Native Hawaiian or Other Pacific Islander"[Mesh] OR "black" [tiab] OR "african american" [tiab] OR "hispanic" [tiab] OR "latin*" [tiab] OR "native american" [tiab] OR "indigenous" [tiab] OR "american indian" [tiab] OR "native alaskan" [tiab] OR "inuit" [tiab] OR "pacific islander" [tiab] OR "BIPOC" [tiab]) AND (1977:2023 [pdat]). The search yielded 273 records which were screened for relevance to the topic of URIM representation in neurosurgery and leadership roles (Fig. 1).

Primary subspecialty focus was obtained from the AANS "Find a Board-certified Neurosurgeon" tool [16], available for 21 out of 46 award recipients. Chi-square testing was done to compare the distribution of subspecialties among award recipients and all academic neurosurgeons in the United States [9].

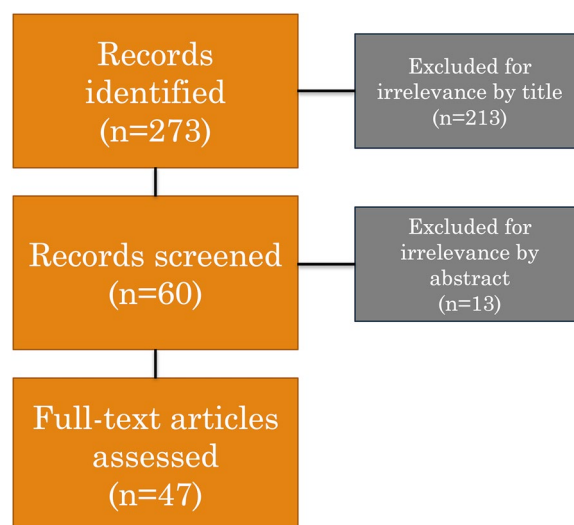


Fig. 1 Literature review methodology

The age of recipients when awarded the Harvey Cushing Medal was calculated using available data from Healthgrades databases [10]. Information on hospital chairmanship, residency program directorship, and presidency of significant organizations was reviewed from various sources including the CNS and SNS websites, and the websites of respective organizations [17–20].

The number of publications by recipients was determined using Elsevier’s Scopus database [21], considering only publications up to the year before the receipt of the award. Five recipients were excluded because of unclear results. Regression analyses were performed on this data. All analyses were performed using the JMP v15 statistical software. All the aforementioned information was accessed online in 2023.

Results

Demographics

Information regarding the specific institution attended was available for 42 out of 46 (91.3%), 45 out of 46 (97.8%), and 44 out of 46 (95.6%) individuals for undergraduate schools, medical schools, and residency programs, respectively. Regional distributions of the undergraduate schools, medical schools, and residency programs attended by recipients are listed in Table 1. With an $\alpha < 0.05$, the distribution was what would be expected for undergraduate schools, medical schools, and residency programs when considering the total distribution of US schools by region as the p value from chi-square testing was equal to 0.11, 0.21, and 0.15 for undergraduate schools, medical schools, and residency programs, respectively.

Table 1 Demographics, education, birthplace, primary subspecialty focus, age at receipt of award, and number of publications of Harvey Cushing Medal recipients

Year	Name	Undergraduate school (region)	Medical school (region)	Birthplace (region)	Residency program	Primary subspecialty focus [14]	Age when given award [15, 16]	# of publications [21]
1977	Frank Henderson Mayfield [15, 16, 22]	UNC (SE)	Medical College of Virginia (SE)	Garnett, South Carolina (SE)	–	–	69	54
1978	William H. Sweet [15]	UW (W)	Harvard (NE)	Kerriston, Washington (W)	MGH/University of Chicago (MW)	–	68	151
1979	Henry G. Schwartz [15, 16]	Princeton (NE)	Johns Hopkins (NE)	NYC (NE)	WASHU (MW)	–	70	38
1980	Paul C. Bucy [15, 16]	Ulowa (MW)	Ulowa (MW)	Hubbard, Iowa (MW)	Univ of Chicago (MW)	–	75	250
1981	Bronson S. Ray [15, 16]	Franklin College (MW)	Northwestern (MW)	New Albany, Indiana (MW)	BWH (NE)	–	77	67
1982	W. James Gardner [15, 16, 23]	Washington and Jefferson College (NE)	UPenn (NE)	McKeesport, Pennsylvania (NE)	UPenn (NE)	–	84	–
1983	Guy L. Odom [15, 16]	Tulane (SE)	Tulane (SE)	Harvey, Louisiana (SE)	Montreal Neurological Institute (CA)	–	72	83
1984	Eben Alexander Jr [15]	UNC (SE)	Harvard (NE)	Knoxville, TN (SE)	BWH (NE)	–	71	–
1985	Francis Murphey [15]	Vanderbilt (SE)	Harvard (NE)	Macon, Mississippi (SE)	UTennessee (SE)	–	78	34
1986	Lyle French [15]	UMinnesota (MW)	UMinnesota (MW)	Worthing, SD (MW)	UMinnesota (MW)	–	71	119
1987	William F. Meacham [16]	Western Kentucky (SE)	Vanderbilt (SE)	Washington, DC (SE)	Vanderbilt (SE)	–	87	51
1988	Charles G. Drake [15]	–	Western University (CA)	Ontario, Canada (CN)	Toronto (CA)	–	68	95
1989	Lester A. Mount [16]	–	UCincinnati (MW)	Lebanon, Ohio (MW)	Columbia (NE)	–	79	41
1990	Robert B. King [24]	UPittsburg (NE)	URochester (NE)	–	WASHU (MW)	–	68	–
1991	William F. Collins [25]	Yale (NE)	Yale (NE)	New Haven, CT (NE)	WASHU (MW)	–	67	66
1992	W. Eugene Stern [16]	UCBerkeley (W)	UCBerkeley (W)	Portland, Oregon (W)	UCSF (W)	–	72	–
1993	Sidney Goldring [15]	WASHU (MW)	WASHU (MW)	Kremnitz, Poland (EU)	WASHU (MW)	–	70	74
1994	Byron C. Pevehouse [16]	Baylor (SW)	Baylor (SW)	Lubbock, Texas (SE)	UCSF (W)	–	67	13
1995	Richard DeSausure [16]	UVA (SE)	UVA (SE)	Macon, Georgia (SE)	UVA (SE)	–	77	15
1996	Shelley N. Chou [16]	St. John's University in Shanghai (CN)	UUtah (W)	Kanpu, China (CN)	UMinnesota (MW)	–	72	–
1997	Robert G. Ojemann [15]	Ulowa (MW)	Ulowa (MW)	–	–	–	61	130
1998	Albert H. Rhoton [15, 26]	OSU (MW)	WASHU (MW)	Parvin, Kentucky (SE)	WASHU (MW)	–	65	144
1999	David J. Kelly [15]	UNC (SE)	UNC (SE)	Elkin, NC (SE)	Bowman Gray School of Medicine (SE)	–	64	76
2000	Russel H. Patterson Jr [16, 27]	Stanford (W)	Cornell (NE)	NYC (NE)	The New York Hospital (NE)	Neuro-oncology	71	–
2001	Julian T. Hoff [15]	Stanford (W)	Cornell (NE)	Boise, Idaho (W)	The New York Hospital (NE)	–	64	162
2002	Edward R. Laws [15]	Princeton (NE)	Johns Hopkins (NE)	NYC (NE)	Johns Hopkins (NE)	Pituitary	64	348
2003	Stewart B. Dunsker [28]	Harvard (NE)	UCincinnati (MW)	–	WASHU (MW)	Spine	69	41

Table 1 (continued)

Year	Name	Undergraduate school (region)	Medical school (region)	Birthplace (region)	Residency program	Primary subspecialty focus [14]	Age when given award [15, 16]	# of publications [21]
2004	John A. Jane Sr [15]	UChicago (MW)	UChicago (MW)	Chicago (MW)	UChicago/ UIllinois Psychiatric Institute (MW)	Pediatric	73	–
2005	Martin H Weiss [16]	Dartmouth College (NE)	Dartmouth College (NE)	Newark, NJ (NE)	University Hospitals of Cleveland (MW)	Pituitary	66	161
2006	David G. Kline [16]	UPenn (NE)	UPenn (NE)	Philadelphia, PA (NE)	UMichigan (MW)	Peripheral Nerve	71	235
2007	Robert G. Grossman [16]	–	Columbia (NE)	NYC (NE)	Columbia (NE)	Neuro-oncology	74	202
2008	Charles B. Wilson [15]	Tulane (SE)	–	Neosho, Missouri (MW)	Tulane (SE)	Neuro-oncology	79	523
2009	Edward Hudson Oldfield [16]	UKentucky (SE)	UKentucky (SE)	Mt. Sterling, Kentucky (SE)	Vanderbilt (SE)	–	61	411
2010	Roberto Heros [15]	–	UTennessee (SE)	Havana, Cuba (CU)	MGH (NE)	Cerebrovascular	68	226
2011	A. John Popp [16]	URochester (NE)	Albany Medical College (NE)	Warsaw, NY (NE)	Albany Medical Center (NE)	Cerebrovascular	64	51
2012	Donald O. Quest [15, 29]	Ullinois (MW)	Columbia (NE)	St. Louis, Missouri (MW)	Columbia (NE)	Cerebrovascular	72	75
2013	Jon H Robertson [30]	Southwestern College (now Rhodes) in Memphis, Tennessee (SE)	UTennessee (SE)	–	UTennessee (SE)	Skull Base Lesions	67	54
2014	Troy M. Tippett [31]	UMissouri (MW)	UTennessee (SE)	–	UTennessee (SE)	Spine	68	8
2015	Arthur Day [32, 33]	Louisiana Tech University (SE)	Louisiana State University Medical School in NO (SE)	Boston, MA (NE)	UF (SE)	Cerebrovascular	67	151
2016	Ralph G. Dacey [15]	Harvard (NE)	UVA (SE)	Boston, MA (NE)	UVA (SE)	Cerebrovascular	68	276
2017	Robert F. Spetzler [16]	Knox College (MW)	Northwestern (MW)	Stierhoferstetten, Germany (EU)	UCSF (W)	Cerebrovascular	72	1120
2018	James R. Bean [16]	UVA (SE)	Tulane (SE)	–	UKentucky (SE)	Spine	70	–
2019	James T. Rutka [15]	Princeton (NE)	Queen's (CA)	Toronto, Canada (CA)	University of Toronto (CA)	Pediatric	63	693
2020	H. Hunt Batjer	University of Texas in Austin (SE)	University of Texas Southwestern (SE)	Burlington, Vermont (NE)	University of Texas Southwestern (SE)	Cerebrovascular	68	572
2021	Robert E. Harbaugh	Lebanon Valley College (NE)	Penn (NE)	–	Dartmouth-Hitchcock Medical Center (NE)	Cerebrovascular	69	196
2022	William T. Couldwell	Ubritish Columbia and Dalhousie University (CA)	McGill University (CA)	British Columbia (CA)	University of Southern California (W)	Skull Base Lesions	66	554

NE Northeast, SE Southeast, MW Midwest, SW Southwest, W West, CA Canada, CN China, EU Europe, CU Cuba, UNC University of North Carolina at Chapel Hill, UW University of Washington, MGH Massachusetts General Hospital, NYC New York City, WASHU Washington University in St. Louis, U Iowa University of Iowa, Univ University, BWH Brigham and Women's Hospital, UPenn University of Pennsylvania, UTennessee University of Tennessee, UMinnesota University of Minnesota, UCincinnati University of Cincinnati, UPittsburg University of Pittsburg, URochester University of Rochester, UC Berkeley University of California, Berkeley, UCSF University of California, San Francisco, UVA University of Virginia, UUtah University of Utah, OSU Ohio State University, UChicago University of Chicago, UMichigan University of Michigan, UKentucky University of Kentucky, Ullinois University of Illinois, UF University of Florida, NE Northeast, SE Southeast, MW Midwest, SW Southwest, W West, CA Canada, CN China, EU Europe, CU Cuba

The most attended undergraduate schools were Princeton and UNC, each of which had 3 of 39 (7.7%) award recipients as alumni. The most attended medical schools were Harvard and the University of Tennessee, both of which 3 of 42 (7.1%) award recipients had attended. The most attended residency program was that of Washington University in St. Louis, which 6 out of 41 (14.6%) award recipients attended. Columbia

University, the University of California, San Francisco, and the University of Tennessee each had 3 recipients (7.3%) who attended their residency programs.

The birthplaces of award recipients are also described in Table 1. The most common birthplace was New York City, a city that 4 out of 39 (10.2%) award recipients were from. 46 out of 46 (100%) of the award recipients were male. The youngest age at receipt of the award was

61 years old. In contrast, the oldest age was 87 years old. The mean age was 70.1 ± 5.5 (Standard Deviation) years (Fig. 2). To objectively assess whether a Cushing medal recipient was an URIM, we communicated with a representative from the American Society of Black Neurosurgeons (ASBN) who confirmed that no Cushing recipient has been a part of their organization (American Society of Black Neurosurgeons, Personal Communication, 8/8/2022). We performed a search on the literature on underrepresented minorities in neurosurgery. No article suggested that a Cushing recipient belonged to a URIM group or female. Furthermore, the articles unanimously concluded that individuals from URIM groups, including women, have less academic research and leadership role representation in the field, compared to their white male counterparts. Hence, the development of measures to promote recruitment such as URIM group-specific support, early exposure, mentorship, and expanded protected personal time, in addition to measures to reduce attrition, can enhance diversity and position the underrepresented in neurosurgery for academic accomplishments in the field [22, 23].

Academics

Data regarding primary subspecialty focus was only available for 21 of 46 (45.7%) recipients. The subspecialties included cerebrovascular, neuro-oncologic, pediatric, peripheral nerve, pituitary, skull base, and spine surgery. A chi-test comparing the distributions of the award recipients’ specialties and the distribution of specialties for all academic neurosurgeons found a statistically significant difference in distribution, with a p value of 0.0002 ($\alpha < 0.05$). The most common subspecialties were cerebrovascular and neuro-oncology/skull base/pituitary surgeries, which 8 out of 21 (38.0%) and 7/21 recipients (33.3%) subspecialized in, respectively. The others were pediatric (2/21—9.5%), peripheral nerve (1/21—4.8%), and spine (3/21—14.3%) neurosurgeons

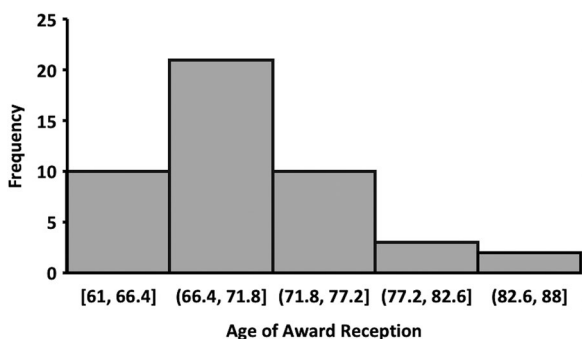


Fig. 2 Histogram representing the ages of award reception

(Fig. 3). The expected numbers were 2 general, 3 pediatric, 6 spine, 2 functional, 0 peripheral, 1 radiosurgery, 4 neuro-oncologic/skull base/pituitary, and 3 cerebrovascular neurosurgeons.

25 of 41 (59%) of recipients attended undergraduate schools in the top 50 U.S. News and World Report (USNWR) National University Rankings. Similarly, 28 of 44 (64%) of recipients attended medical schools in the top 50 USNWR National University Rankings.

The award recipient with the least number of published documents up until the receipt of their award had 8 publications, using the database found. In contrast, the recipient with the most had 1146 publications. The mean number of publications was 200 ± 228 . The distribution had a rightward skew (Fig. 4). Regression analyses revealed that more recent award recipients were more likely to have a greater number of publications ($r^2 = 0.2$, $p < 0.003$) (Fig. 5).

Leadership

34 of 46 (74.0%) award recipients were chairman of a medical facility’s department at some point in time. John Popp was chairman of two departments in his lifetime. Roberto Heros and Arthur Day were at one point the chair of one department and at another time the co-chair of another.

13 out of 46 (28.3%) award recipients were director of a residency program at a certain point in time. Roberto Heros and Arthur Day were program director of two residency programs in their lifetimes.

45 out of 46 (98.0%) award recipients were at some point president of the Congress of Neurological Surgeons, the Society of Neurological Surgeons, the

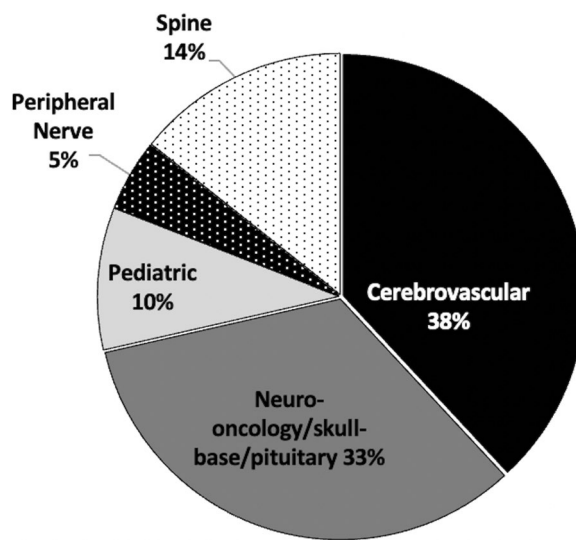


Fig. 3 Subspecialties of recent Harvey Cushing Medal recipients

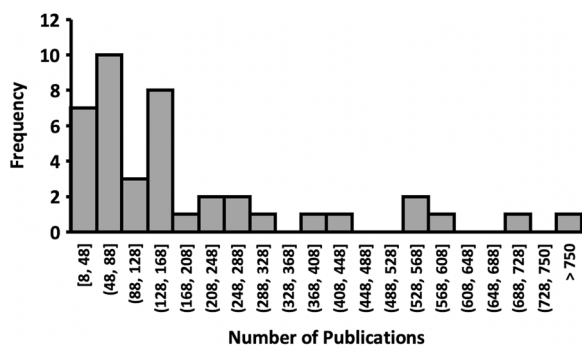


Fig. 4 Histogram representing the number of published documents prior to award reception

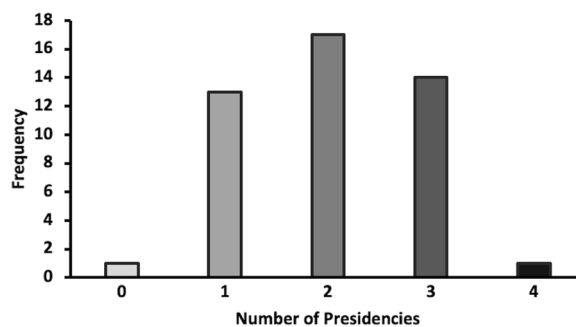


Fig. 6 Histogram portraying the number of presidencies in the 4 societies held by Harvey Cushing Medal recipients

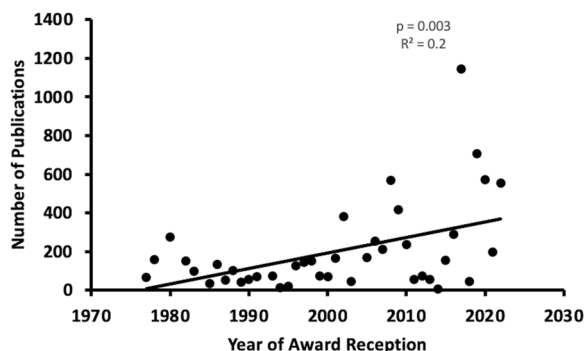


Fig. 5 Regression analysis of number of publications by year awarded

American Association of Neurological Surgeons, or the American Academy of Neurological Surgery (Fig. 6). The average program recipient was president of 2.02 ± 0.88 of these organizations. Charles B. Wilson held no presidency positions within these four organizations, whereas Robert G. Ojemann was president of all four organizations during his lifetime.

Discussion

Recipients of the AANS Harvey Cushing Medal have made major contributions to the field of neurosurgery. For example, Frank H. Mayfield, the first recipient of this award, founded the Mayfield Clinic, an institution known to contribute significantly to advancements within the field, and invented the Mayfield three-pin skull clamp, Mayfield horseshoe, Mayfield aneurysm clip, and collaborated with Fletcher Platt to develop automobile seat belts, among his many other achievements [24].

As the field of neurosurgery continues to grow as advancements in education and technology give rise to newer roles, neurosurgeons should identify biases,

generate systems to overcome them, and create new opportunities for our field. This article aims to elucidate various biases—including the gender bias as well as common themes and professional achievements among medal recipients. The Harvey Cushing Medal is an important milestone to ensure that the field of neurosurgery is inclusive of all demographics.

When performing a regional analysis of the education of the award recipients, it did not appear that the undergraduate school, medical school, or residency program that the award recipients attended was different in distribution than what would be expected when considering the total distribution of US schools by region. However, our findings suggest that attendance at a top-ranked school was an important factor in becoming an award recipient, considering that more than half of recipients attended undergraduate or medical schools ranked in the top 50 of the U.S. News and World Report [25]. These institutions include Princeton, Harvard, the University of North Carolina, the University of California (San Francisco), Columbia University, and Washington University in St. Louis. For example, Washington University in St. Louis was commonly attended by recipients for their residency program ($n=6$). Other prestigious schools were also well represented—3 award recipients attended the University of Tennessee for undergraduate studies, 3 attended it for medical school and 3 attended it for their residency program. It is important to note that USNWR is not an objective measure but is a commonly known measure that can be used for classifying schools attended. Many recipients were born in the Northeast and Southeast ($n=13$), with New York City being where most ($n=4$) recipients were from.

In analyzing more recent recipients, most subspecialized in either cerebrovascular, neuro-oncologic or spine surgery. This is expected, as cerebrovascular and neuro-oncologic surgery are commonly overrepresented in research and in academic settings; they are

overrepresented among NIH-funded neurosurgeons in comparison with all neurosurgeons [26]. However, more recipients subspecialized in either cerebrovascular or neuro-oncologic/pituitary/skull base surgery than was expected when comparing them to the distribution of subspecialties in academic practice. Cerebrovascular and neuro-oncologic neurosurgeons have a higher average h-index compared to other subspecialties [9]. This serves as further evidence for the importance of research for candidacy of this award.

Most of the neurosurgeons were awarded in their mid-60s to early 70s. No recipient was awarded at an age younger than 60. Assuming the completion of residency in the fourth decade of life, this may imply that it normally takes 30–40 years of productivity and innovation as an attending neurosurgeon to receive this award. A significant number (13 of 46) served as residency program director at some point. Notably, 31 of 47 Cushing Medal recipients were at one point appointed as hospital chairman. More impressively, 45 of 46 award recipients were at some point president of the Congress of Neurological Surgeons, the Society of Neurological Surgeons, the American Association of Neurological Surgeons, or the American Academy of Neurological Surgery.

The Harvey Cushing Medal recipients consistently had a high number of published documents leading up to the receipt of their award, with an average of 200 publications. Still, some had very few publications and some had immense numbers, up to 1146. Interestingly, there was a statistically significant increase in the number of publications for award recipients in the most recent years. Some potential reasons include that academic research and productivity are becoming more important in the field. Conversely, this could be because of the increasing amount of NIH funding over the last few decades [27], the increasing number of publication formats, including video [28], and the increasing number of journals [29].

Women were completely underrepresented, as all the award recipients were male. A potential explanation is that most neurosurgeons were historically male [30, 31]. The first female neurosurgeon did not practice until the mid-1940s [32]. While the number of female neurosurgeons has only slowly grown since then, recent trends show the potential for increased progress moving forward. There are increasing numbers of females in residency programs and that some neurosurgery residency programs are beginning to place emphasis on the recruitment and mentorship of women [33]. There is also a record number of four women serving as chair in their respective neurosurgery departments [10, 26, 34–36]. Importantly, Shelly D. Timmons served as the first female president elect of the AANS [37]. We did not find any evidence that any Cushing medalist was URIM.

Those URIM, including African Americans, Latin Americans, and Native Americans, were underrepresented in award recipients. URIM in neurosurgery have increasingly joined the ranks of neurosurgery, but current trends are unfavorable in regard to the future diversification of the field. URIM in Neurosurgery make up around 10% of neurosurgery residents despite making up 40% of the US population [38]. The number of Black applicants to neurosurgery residency fell from 9% in 2013 to 5% by 2018 and Hispanic applicants also decreased from 10 to 8% from 2011 to 2018 [39]. Of note, URIM currently hold 5% of department chair positions in neurosurgery [38].

A few things likely contribute to this precedent as well as the lack of progress. Pressures from historic structures of racism and its subsequent byproducts like segregation and poverty endured by many URIM have detrimentally influenced access to higher education and career direction. Exposure to field and mentorship have been shown to increase medical student interest, but there is currently no group specifically working on the recruitment and mentoring of URIM students in neurosurgery [39, 40]. As a diverse workforce that reflects the patients being served is associated with improved outcomes, the field of neurosurgery stands to benefit from efforts of inclusion [41].

Considering that the Cushing Medal rewards lifetime achievement, it may lag as an indicator of progress and change in the neurosurgical field. Assessing presidency of major organizations, department chairmanship, and number of women or underrepresented minorities in residency programs could serve as better indicators.

One limitation of this study is that the sample size of 46 award recipients is small and results in limited statistical power. Complete data were also not available for all candidates, as with the calculations for primary subspecialty focus where data were only obtainable for 18 of the recipients. Some data were excluded in the calculations for the number of publications to ensure consistency since the Scopus database often listed the same author separately. Lastly, there was no objective measure to determine recipient race. The AANS does not track ethnicity or racial data on Cushing Medal recipients. However, efforts are underway to begin tracking this information going forward. (American Association of Neurological Surgeons, Personal Communication, 8/10/2022).

Potential future research can analyze the specific accomplishments and contributions of the recipients of this award. An analysis of advanced degrees, like PhD, MBA, MSc, Med, and how they factor in these award recipients' careers may also be fruitful.

Conclusions

The AANS Harvey Cushing Medal honors people who have significantly advanced the profession of neurosurgery with technological breakthroughs, academic productivity, research advancements, and leadership roles within universities and national surgical organizations. When one looks more closely at the recipients of this lifetime award, there is still inequality and bias present. The most glaring examples is the lack of inclusion of women and URIM. In the future, we hope that there will be a shift toward a more inclusive representation of neurosurgeons among those who get this award, with more women and URIMs being recruited into leadership positions and residency programs. Additional investigation into educational training, resource availability, and leadership training may offer guidance for training programs to implement tactics that may position future neurosurgeons for success, allowing rising neurosurgeons to contribute to the development of the field and make noteworthy contributions in neurosurgery.

Abbreviations

AANS	American Association of Neurological Surgeons
NIH	National Institutes of Health
URIM	Underrepresented in Medicine
PhD	Doctor of Philosophy
MBA	Master of Business Administration
MSc	Master of Science
Med	Master's in Education

Acknowledgements

None.

Author contributions

All authors contributed equally to the conception, design, statistical analysis, drafting of the manuscript, and final review and approval of the version to be published.

Funding

No funding was received for this research.

Availability of data and materials

Data generated or analyzed during this study are included in this published article.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable as no personal data or details were used in this manuscript.

Competing interests

The authors declare that they have no competing interests.

Received: 11 August 2023 Accepted: 28 October 2023
Published online: 15 November 2023

References

- Doyle NM, Doyle JF, Walter EJ. The life and work of Harvey Cushing 1869–1939: a pioneer of neurosurgery. *J Intensive Care Soc.* 2017;18(2):157–8. <https://doi.org/10.1177/1751143716673076>.
- Harvey C. The basophil adenomas of the pituitary body and their clinical manifestations (pituitary basophilism). *J Neurosurg.* 1964;21(4):318–47. <https://doi.org/10.3171/jns.1964.21.4.0318>.
- Osborn I, Sebeo J. "Scalp block" during craniotomy: a classic technique revisited. *J Neurosurg Anesthesiol.* 2010;22(3):187–94.
- Long DM. Harvey Cushing at Johns Hopkins. *Neurosurgery.* 1999;45(5):983–9. <https://doi.org/10.1097/00006123-199911000-00005>.
- Michael EC. Major Harvey Cushing's difficulties with the British and American armies during World War I. *J Neurosurg.* 2014;121(2):319–27. <https://doi.org/10.3171/2014.5.JNS122285>.
- AANS. History. <https://www.aans.org/en/About-Us/History>. Accessed 26 Sept 2020.
- Surgeons AAoN. AANS award winners. <https://www.aans.org/en/Annual-Scientific-Meeting/2017/Main/AANS-Award-Winners/>. Accessed 5 June 2020.
- Barthélemy E. Racial background in neurosurgery's eco-system. *AANS Neurosurgeon* <https://www.aansneurosurgeon.org/feature/racial-background-in-neurosurgerys-eco-system/>.
- Khan NR, Thompson CJ, Taylor DR, et al. An analysis of publication productivity for 1225 academic neurosurgeons and 99 departments in the United States. *J Neurosurg.* 2014;120(3):746. <https://doi.org/10.3171/2013.11.Jns131708>.
- Healthgrades. Find a Doctor. <https://www.healthgrades.com/find-a-doctor>. Accessed 10 Oct 2019.
- Congress of Neurological Surgeons. Charles G. Drake. <https://www.cns.org/Default.aspx>. Accessed 10 Oct 2019.
- The Society of Neurological Surgeons. <https://societyns.org/>. Accessed 10 Oct 2019.
- UnivSearch. Colleges & Universities in the United States of America (USA). <http://www.univsearch.com/>. Accessed 5 Oct 2019.
- ABMS. The Official ABMS Directory of Board Certified Medical Specialists. <https://abmsdirectory.com/abms/static/home.htm?sessionId=C8E943471D368B38AD214DB5FDBEBB07>. Accessed 10 Oct 2019.
- AAMC. Careers in Medicine—Residency and Fellowship Program Search. <https://apps.aamc.org/cim-residency/#/residency-search>.
- AANS. Find a Board-certified Neurosurgeon.
- CNS. Past Presidents. <https://www.cns.org/about/past-presidents>. Accessed 10 Oct 2019.
- AANS. AANS Presidents. <https://www.aans.org/About-Us/Governance/AANS-Presidents>. Accessed 10 Oct 2019.
- SocietyNS. Past Officers of the Society. <https://www.societyns.org/about/history-detail/past-officers-of-society>. Accessed 10 Oct 2019.
- AmericanAcademyNS. Past Presidents. <https://americanacademyns.org/presidents-and-vice-presidents>. Accessed 10 Oct 2019.
- Scopus. Search for an author profile. <https://www.scopus.com/free/lookup/form/author.uri?zone=TopNavBar&origin=NO%20ORIGIN%20DEFINED>. Accessed 10 Oct 2019.
- Agaronnik N, Xiong GX, Uzosike A, et al. The role of gender in academic productivity, impact, and leadership among academic spine surgeons. *Spine J.* 2022;22(5):716–22. <https://doi.org/10.1016/j.spinee.2021.12.003>.
- Arya S, Franco-Mesa C, Erben Y. An analysis of gender disparities amongst United States medical students, general surgery residents, vascular surgery trainees, and the vascular surgery workforce. *J Vasc Surg.* 2022;75(1):5–9. <https://doi.org/10.1016/j.jvs.2021.09.029>.
- Tew JM, Frank H, Mayfield, M.D., 1908–1991. *J Neurosurg.* 1991;75(3):347. <https://doi.org/10.3171/jns.1991.75.3.0347>.
- Report USNW. 2020 Best National University Rankings. <https://www.usnews.com/best-colleges/rankings/national-universities>. Accessed 5 June 2020.
- Flanigan PM, Jahangiri A, Golubovsky JL, et al. A cross-sectional study of neurosurgical department chairs in the United States. *J Neurosurg.* 2018;129(5):1342. <https://doi.org/10.3171/2017.7.Jns17567>.
- Service CR. National Institutes of Health (NIH) Funding: FY1995-FY2021. 2020. May 12. <https://fas.org/sgp/crs/misc/R43341.pdf>. Accessed 5 June 2020.

28. Assadi R, Gasparyan AY. Editing, publishing and aggregating video articles: do we need a scholarly approach? *J Korean Med Sci*. 2015;30(9):1211–2. <https://doi.org/10.3346/jkms.2015.30.9.1211>.
29. Larsen PO, von Ins M. The rate of growth in scientific publication and the decline in coverage provided by Science Citation Index. *Scientometrics*. 2010;84(3):575–603. <https://doi.org/10.1007/s11192-010-0202-z>.
30. Odell T, Toor H, Takayanagi A, et al. Gender disparity in academic neurosurgery. *Cureus*. 2019;11(5):e4628. <https://doi.org/10.7759/cureus.4628>.
31. Jagsi R, Griffith KA, DeCastro RA, Ubel P. Sex, role models, and specialty choices among graduates of US medical schools in 2006–2008. *J Am Coll Surg*. 2014;218(3):345–52. <https://doi.org/10.1016/j.jamcollsurg.2013.11.012>.
32. Ciurea AV, Moisa HA, Mohan D. Sofia Ionescu, the first woman neurosurgeon in the world. *World Neurosurg*. 2013;80(5):650–3. <https://doi.org/10.1016/j.wneu.2013.02.031>.
33. Selden NR. Mentorship: service, education, progress. The 2015 CNS presidential address. *J Neurosurg*. 2017;126(1):158. <https://doi.org/10.3171/2016.2.Jns152606>.
34. UNMC. Colorado physician named chair of neurosurgery department. Updated November 15. <https://www.unmc.edu/news.cfm?match=22942>. Accessed 5 June 2020.
35. Neurosurgery UoM. Karin Muraszko, M.D. <https://medicine.umich.edu/dept/neurosurgery/karin-muraszko-md>. Accessed 5 June 2020.
36. Medicine IUso. Shelly D. Timmons, PHD, MD. <https://medicine.iu.edu/faculty/44883/timmons-shelly>. Accessed 5 June 2020.
37. American Association of Neurological Surgeons Names Shelly D. Timmons, MD, PhD, FAANS, as Organization's President Elect. April 26, 2017. <https://www.aans.org/-/media/Files/AANS/Media/PDFs/Shelly-Timmons-AANS-President-Elect.aspx?la=en&hash=62454CFD9B5ACED6C2DEEA2D9C6AA79D323E9B1B>. Accessed 5 June 2020.
38. Asfaw ZK, Soto E, Yeager K, et al. Racial and ethnical diversity within the neurosurgery resident and faculty workforce in the United States. *Neurosurgery*. 2022;91(1):72–9. <https://doi.org/10.1227/NEU.0000000000001920>.
39. Gabriel PJ, Alexander J, Karkliņa A. Diversity in neurosurgery: trends in gender and racial/ethnic representation among applicants and residents from U.S. neurological surgery residency programs. *World Neurosurg*. 2021;150:e305–15. <https://doi.org/10.1016/j.wneu.2021.02.127>.
40. Stumpo V, Latour K, Traylor JJ, et al. Medical student interest and recruitment in neurosurgery. *World Neurosurg*. 2020;141:448–454.e6. <https://doi.org/10.1016/j.wneu.2020.04.248>.
41. Marrast LM, Zallman L, Woolhandler S, Bor DH, McCormick D. Minority physicians' role in the care of underserved patients: diversifying the physician workforce may be key in addressing health disparities. *JAMA Intern Med*. 2014;174(2):289–91. <https://doi.org/10.1001/jamainternmed.2013.12756>.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Submit your manuscript to a SpringerOpen[®] journal and benefit from:

- Convenient online submission
- Rigorous peer review
- Open access: articles freely available online
- High visibility within the field
- Retaining the copyright to your article

Submit your next manuscript at ► [springeropen.com](https://www.springeropen.com)
