Applying Sabermetrics to Academic Otolaryngology

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ABSTRACT

Outcome Objective: Over the past two decades, statisticians have used sabermetrics to predict success of athletes. Using similar principles, we aim to 1) determine baseline publication metrics among academic otolaryngologists 2) determine whether an otolaryngologist's training predicts academic productivity.

Methods: Publicly available data from departmental websites and Scopus were collected on 1,588 academic otolaryngologists from 99 departments across the United States. Variables included gender, medical school, Alpha Omega Alpha (AOA) membership, PhD degree, residency program, fellowship, number of publications, NIH grants, H-index, region of practice, and professorial rank. Bivariable and multivariable regression analyses were used to predict H-index, professorship, and NIH funding.

Results: Mean number of publications, H-index, and M-index were 40.6 (standard deviation [SD] = 50.7), 18.1 (SD= 19.4), and 0.57 (SD=0.38), respectively. In multivariable analysis, strongest predictors of higher H-index included NIH funding, greater number of years since graduation and higher number of publications (p <0.0001). Gender, region of practice, medical school type, and AOA were not significant predictors of higher H-index. Predictors of attainment of professorship included region of practice (Pacific [p=0.007] and Southern [p=0.012]), fellowship training (p=0.001), greater number of years since graduation (p<0.0001), PhD degree (p=0.041), AOA (p<0.0001) and higher H-index (p<0.0001). Medical school type and gender did not predict professorship. NIH funding was associated with PhD degree and higher H-index (p<0.0001).

Conclusion: Similar to athletes, physicians have a multitude of quantifiable "stats." We find several notable predictive factors for academic productivity. These bibliometric data may be readily used as benchmarks for academic otolaryngologists.

INTRODUCTION

- In the 1970's, an American sports writer and historian named Bill James collected statistical data on baseball players to scientifically analyze a team's chances of winning or losing. This practice, which he coined *sabermetrics*, is commonly used today by coaches and sports managers across the United States.
- In academic medicine, career advancement is based on several factors, including clinical volume, advanced training, research productivity, and acquisition of funding.
- Using such data points, sabermetrics principles could be applied to objectively predict success amongst academic faculty.

METHODS

- A list of U.S. Otolaryngology programs was compiled from the Electronic Residency Application Service (ERAS).
- Faculty members were identified from each department's website as of July 2014.
- Publicly available data was collected on each faculty member using department websites, state registries, and Scopus database of peer-reviewed literature (ElSevier). The following independent variables were obtained: gender, medical school type, AOA membership, PhD Degree, Residency Program, Fellowship-trained, NIH Grant Recipient, Region of Practice, Number of Publications, H-Index*, M-index[Ŧ], and Professorial Rank

  *__H-Index__ = researcher has published *h* papers each of which has been cited in other papers at least *h* times

  Ŧ__M-Index__ = H-index divided by the number of years since the researcher's first publication

- Statistical analysis including bivariable and multivariable regression were performed to determine predictive value of the determined measures.

RESULTS

A. Population Metrics

- Information was collected on 1,588 academic Otolaryngologists from 99 departments across the United States.

Table 1: Demographic characteristics of academic Otolaryngologists

Variable	Value
Gender	
Male	79.9%
Female	20.1%
Years Since Medical School Graduation (Mean)	22.6
Type of Medical School	
Foreign	9.3%
Private	44.0%
Public	46.5%
AOA Membership	38.0%
Fellowship Trained	72.0%
PhD Degree	6.1%

RESULTS

B. Geographic Distribution

Figure 1: Geographic distribution of academic Otolaryngologists, showing highest percentage in Northeast (30.2%) and lowest in West (11.4%)

C. Publications Metrics

Figure 2: Frequency distribution curve of academic Otolaryngologists by H-index, showing right-skewed distribution

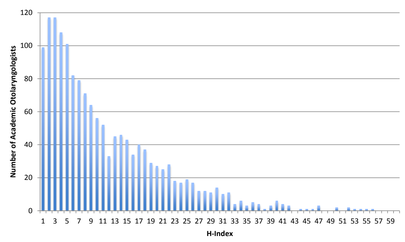

Table 2: Mean and Quartile (Q) ranges for publication data of academic Otolaryngologists

	Mean	Q1	Q2	Q3	Q4
Total Publications	40.6	0-8	9-21	22-53.5	54-546
H-Index	18.1	0-4	5-8	9-16	17-56
M-Index	0.57	0-0.36	0.37-0.58	0.59-0.83	0.84-5

C. Bivariable Analysis

Table 3: Bivariable comparison of faculty characteristics, analyzed by Assistant or Associate Professor vs. Professor. *Significant values are in grey*

Variable	Associate/ Assistant Professor	Professor	P-value
Gender			
Male, No. (%)	893 (76.4)	377 (89.8)	<0.0001
Female, No. (%)	276 (23.6)	43 (10.2)	
Years since medical school graduation, Mean (SD)	19.9 (10.3)	33.8 (9.7)	
Region of United States			
Central	305 (26.2)	112 (26.7)	0.012
Northeast	367 (31.5)	112 (26.7)	
Pacific	136 (11.7)	72 (17.1)	
Southern	215 (18.4)	86 (20.5)	
West	143 (12.3)	38 (9.1)	
Type of Medical School			
Foreign, No. (%)	102 (8.8)	45 (10.7)	0.392
Private, No. (%)	508 (43.6)	190 (45.2)	
Public, No. (%)	554 (47.5)	185 (44.1)	
Unknown, No. (%)	2 (0.2)	0 (0)	
AOA Designation, No. (%)	418 (35.8)	186 (44.3)	0.002
PhD degree			
No, No. (%)	1,102 (94.4)	387 (92.1)	0.185
Yes, No. (%)	64 (5.5)	33 (7.9)	
Fellowship Training			
No, No. (%)	318 (27.3)	123 (29.4)	0.399
Yes, No. (%)	848 (72.7)	295 (70.6)	
Total Publications	22.5 (27.4)	91.2 (64.6)	<0.0001
Scopus H-Index, Mean (SD)	7.3 (6.6)	20.7 (9.9)	<0.0001

Table 4: Bivariable comparison of faculty characteristics, analyzed by Scopus H-Index. *Significant values are in grey*

Characteristic	Scopus H-Index, Mean (SD)	P-value	Characteristic	Scopus H-Index, Mean (SD)	P-value
Gender			**AOA Designation**		
Male	11.7 (9.0)	<0.0001	***No***	10.4 (9.2)	0.0164
Female	7.4 (7.4)		***Yes***	11.6 (10.2)	
Region of United States			**Fellowship**		
Central	11.0 (9.6)		***No***	10.6 (10.6)	0.4673
Northeastern	11.8 (10.6)	<0.0001	***Yes***	10.9 (9.2)	
Pacific	12.0 (9.4)		**PhD**		
Southern	10.0 (8.9)		***No***	10.6 (9.5)	<0.0001
West	8.0 (7.3)		***Yes***	15.4 (10.1)	
Type of Medical School			**NIH Grant (≥ 1)**		
Foreign	13.2 (10.3)	0.0004	***No***	9.1 (8.3)	<0.0001
Private	11.4 (9.6)		***Yes***	20.0 (11.0)	
Public	9.9 (9.4)		**Total Publications**		
Professor Status			***0-7 (N=385)***	2.0 (1.5)	<0.0001
Assistant/Associate	7.3 (6.6)	<0.0001	***8-19 (N=374)***	5.6 (2.2)	
Professor	20.7 (9.9)		***20-52 (N=418)***	11.2 (3.9)	

RESULTS

D. Multivariable Regression Analysis

Table 2: Multivariable Regression Analysis of H-index and Professorship. *Statistically significant values are in grey*

	H-Index		Professor	
	Beta Coefficient	P-value	Beta Coefficient	P-value
Gender (Female vs. Male)	-0.33	0.188	0.99	0.981
Years since medical school graduation	0.05	<0.0001	1.13	<0.0001
Region of Practice				
Central	REF		REF	
Northeast	0.18	0.501	0.76	0.232
Pacific	-0.05	0.876	2.07	0.007
South	-0.28	0.342	1.89	0.012
West	-0.36	0.299	1.29	0.394
Type of Medical School				
Foreign	REF		REF	
Private	-0.20	0.578	1.52	0.169
Public	-0.53	0.146	1.42	0.249
Fellowship (yes vs. no)	0.64	0.005	1.93	0.001
PhD (yes vs. no)	0.88	0.042	2.04	0.041
Total Publications	0.15	<0.0001	1.02	<0.0001
AOA (yes vs. no)	-0.04	0.042	2.18	<0.0001
NIH Grant	2.19	<0.001	n/a	n/a
Professor	1.98	0.042	n/a	n/a
H-Index	n/a	n/a	1.08	<0.001

DISCUSSION and CONCLUSIONS

- Physicians generate significant amounts of data that can be analyzed to reveal important predictors of academic productivity.
- While certain factors are associated with H-index and obtaining professorship on bivariable analysis, these do not always hold true in multivariable analysis.
- "Sabermetric"-type approaches can be used to establish interesting predictive models that may have implications for hiring and tenure status of academic Otolaryngologists.
- This is a preliminary study, and future research is needed to better delineate these factors.

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