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Research Note

Comparison of *h* and *m* Indices among Departments in McGovern Medical School

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ABSTRACT
Measuring academic productivity is important in hiring, promoting and award selection. This study provides an example of a cross-sectional evaluation of faculty members in the UTHealth McGovern Medical School, Houston, TX, using *h* and m indices. We obtained *h* and *m* indices of 1287 faculty members from 29 departments using Scopus bibliographic website. We compared the indices according to Assistant Professor, Associate Professor and Professor ranks; as well as according to Basic Science, Surgical and Internal Medical Branches. We also studied the correlation between *h* or *m* indices and NIH research grants. *h* and m indices mean value showed significantly difference between all three academic ranks in general. *h*-index increased congruently with academic ranking. *m*-index presented different patterns according to medical branches. Basic Science Branches showed higher *h* and *m* indices compared to Surgical and Internal Medicine branches. *h*-index showed linear correlation with NIH grant amount. Although *m*-index may be helpful in evaluating junior faculty members, its result may vary with high academic productivity. On the other hand, *h*-index may be useful in monitoring departmental and institutional academic productivity. Both indices may be helpful in quantifying academic productivity, particularly if compared to related medical branches.

Keywords: *h*-index, *m*-index, Academic productivity, Academic ranks.

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INTRODUCTION

Academic productivity is a critical measure in evaluating scientific development of medical doctors and scientists. One of the most commonly used methods to evaluate academic productivity is *Hirsch* index (*h*-index). *h*-index provides an estimate for the significance and citation impact of a scientist`s cumulative research contribution.[1] However, *h*-index does not interoperate the period during which the *h*-index estimate was achieved. Therefore, the *h*-index may not be the optimal measure for academic productivity when time limitation is an important factor.[1,2] For instance, junior researchers and faculty members may require several years till their scientific contributions receive sufficient citations.[3]

In contrast, *m*-index (or *m*-quotient) is defined as *h*-index estimate divided by the number of years since the scientist`s first published article.[4] Compared to *h*-index, which never decreases with time and may favor "well known" scientists, *m*-index provides a changeable measure of current academic productivity and may correct some of these inequalities.[4] *m*-index is also beneficial in providing a good understanding about scientists who are able to maintain high degree of academic productivity throughout their career.[4,5]

Whether high indices contribute to obtain more grants or vice versa is unclear but several studies have shown a correlation between such indices and the amounts of the federal grants received.[6]

OBJECTIVE AND SCOPE OF THE STUDY

In this study we evaluated the ability of *h*-index and *m*-index in distinguishing academic ranks at the UTHealth McGovern Medical School Center in Houston, TX. McGovern Medical School is the sixth largest medical school in the United States. Located in the heart of the Texas Medical Center, the school was established by the Texas Legislature in 1969 to address the shortages of physicians and the then-untapped resources for medical education in Houston. We compared both estimates in three major medical fields, including basic science, internal and surgical fields. We also studied the correlation with research grand amount and developed an academic growth chart using the *h*-index and *m*-index to identify the productivity perspective. Our aim is to find out if those indices are correlated with academic ranking and federal funding. The result of this study will guide our plans to include other institutions in our analysis and examine the usage of these indices as a global measure in distinguishing academic ranks.

MATERIALS AND METHODS

Subjects

We obtained a list of faculty members from the website (www.med.uth.edu) of UTHealth McGovern Medical School, Houston, TX. Since all data including faculty names in the department, grants obtained through federal agencies and *h* indices in several databases are open to public and accessible by the web sites, an IRB approval is not needed. Moreover, the data was de-identified by analysis. All faculty members from 29 different departments were screened, including faculties in tenure and non-tenure tracks. We categorized the departments according to Basic Science, Surgical and Internal Branches (Table 2). For each department, only faculty members by academic ranks as assistant professor, associate professor and professor were enrolled. Residents/fellows, research assistants and staff physicians without academic title were excluded.

Calculation of indices and grant amount

We used Scopus, which is the largest peer-reviewed database, to find the number of publications for each author through searching his/her first and last names and university affiliation (UTHealth McGovern Medical School). *h* indices of each faculty is also obtained by Scopus, a common method that has been used in previous scientometrics studies. *m*-index is calculated by dividing *h*-index to active publication years. Active publication years were found out based upon Scopus. We reviewed the included publications by noting the journals in which they were published and confirming the authors name and contact information in the manuscripts.

From the NIH Research Portfolio Online Reporting Tools (RePort) we collected the obtained grant amount for each author using his/her first and last names and department. For repeated PI names, we combined the grand amount.[7] IRB approval was not required because access to the website is publicly available.

Statistical analysis

We used descriptive statistics made for every parameter by using median analysis for overall faculty members and mean analysis for academic ranks in case of normal distribution. By using SPSS for Windows 15.0 [Chicago, SPSS inc.] statistical analysis program, we applied one-way ANOVA for multiple comparisons, Tukey's tests for post hoc analysis and Spearman's test for correlation analysis. P=<0.05 was accepted as significant.

RESULTS

We screened 1403 faculty members on different academic ranks from 29 different departments through the website of the UTHealth McGovern Medical School, Houston, TX, during November 2016. The ranks included assistant professors (N= 772), associate professors (N= 233) and professor (N= 282). We excluded faculty members who are not of the above categories (n=116).

Based on the data we collected, male faculty members had significantly higher *h* and *m* indices than female faculty members (Table 1). According to the post-hoc analysis, both *h* and *m* indices had significant difference between all three academic ranks (Table 1). Table 2 described the included departments and related medical branches. Basic science fields showed significant higher *h* and *m* indices compared to internal and surgical fields, although there were no statistical differences between the latter two fields (Table 3). *h*-index showed gradual increase with advancing in academic ranks in all internal fields. *m*-index also showed gradual increase with the academic ranks, except in Basic Science Assistant Professor rank. *m*-index exceeded 1 in Basic Science Assistant Professors and Surgical Professor ranks (Table 4). Correlation analysis showed positive correlation between grants amounts and *h* and *m* indices, but a stronger correlation with *h*-index (Rho = 0.470, P = 0.024; *Rho* = 0.625, *P* = 0.001, consecutively) (Figure 1 and 2).

DISCUSSION

This is a descriptive study evaluating the efficacy of *h* and *m* indices in measuring the academic performance of the UTHealth McGovern Medical School faculty members. The present of female physician in the UTHealth McGovern Medical School was higher (41.2%) compared to the national average (34%) according to the 2016 Association of American Medical College report.[8] Higher *h* and *m* indices in male

Table 1: Comparing *h* and *m* Indices According to Academic Ranks and Faculty Gender.

Category	*N* (%)	*h*-index	SD	*m*-index	SD
Assistant	772 (60%)	3.76[π]	±5.62	0.36[¥]	±0.49
Associate	233 (18%)	11.51[π]	±8.65	0.68[¥]	±0.48
Professor	282 (22%)	25.99[π]	±15.67	1.07[π]	±3.20
Females	578 (41.2%)	6.18[π]	±9.34	0.39[¥]	±0.46
Males	825 (58.8%)	11.75[π]	±14.11	0.65[¥]	±1.94

Both *m* and *h* indices were significantly different among academic ranks, however, *h*-index showed higher significant value.

[¥] P value <0.05. [π] P value < 0.0001

SD: Standard Deviation

Table 2: *h* and *m* Indices According to Departments.

Department	N	h-index	SD	m-index	SD
Basic Science Branches					
Biochemistry and Molecular Biology	32	23.16	13.164	0.98	0.433
Integrative Biology and Pharmacology	55	20.55	11.539	1.07	0.590
Microbiology and Molecular Biology	17	20.35	9.893	1.00	0.268
Neurobiology and Anatomy	26	23.00	12.869	0.77	0.316
Surgical Branches					
Acute Care Surgery	14	12.86	12.340	0.87	0.621
Anesthesiology	77	2.81	5.508	0.16	0.266
Cardiothoracic and Vascular Surgery	22	12.77	16.739	0.78	0.710
Diagnostic and Interventional Imaging	68	6.54	9.981	0.38	0.432
Elective General Surgery	32	6.44	9.179	0.35	0.488
General Surgery	11	9.36	8.406	0.54	0.497
Head and Neck Surgery	14	6.86	7.594	0.51	0.276
Neurosurgery	44	9.11	10.176	0.64	0.602
OB/GYN	80	6.71	13.442	0.40	0.511
Ophthalmology	26	11.08	11.537	0.45	0.349
Oral and Maxillofacial Surgery	6	4.00	4.885	0.34	0.212
Orthopedic Surgery	95	5.23	11.969	0.85	5.530
Pediatric Surgery	37	14.00	11.008	0.75	0.504
Plastic Surgery	4	3.25	5.852	0.12	0.171
Urology	5	7.80	9.960	0.42	0.372
Internal Branches					
Dermatology	14	13.79	17.542	0.63	0.496
Emergency Medicine	81	1.44	2.669	0.14	0.269
Family Medicine	78	0.67	2.795	0.04	0.165
Immunology and Organ Transplant	4	5.00	4.243	0.35	0.308
Internal Medicine	182	13.20	15.649	0.62	0.539
Neurology	56	12.23	13.880	0.86	0.670
Pathology	59	14.44	13.004	0.65	0.410
Pediatrics	166	8.95	10.719	0.48	0.441
Physical Medicine and Rehabilitation	27	3.44	5.793	0.26	0.360
Psychiatry	71	9.97	12.342	0.68	0.741

SD: Standard Deviation

Table 3: Comparing *h* and *m* Indices According to Department Types[£].

Medical Branches	N (%)	h-index	m-index
Basic science	130 (9.3%)	21.65 [π]	0.98[¥]
Surgical	535 (38%)	8.07	0.55
Internal	738 (53%)	8.32	0.46

No statistical differences in indices between surgical and internal branches. Both *h* and *m* indices differentiated between basic science and other medical branches.

[£] Statistical analysis by Tukey HSD

[¥] P value <0.05. π P value < 0.0001

Table 4: Comparing h and m Indices Between Academic Ranks According to Department Types.

Medical Branches	N	h-index	SD	m-index	SD
Basic Science Branches					
Assistant	47	14.70	±5.53	1.13	±0.49
Associate	28	19.73	±6.04	0.85	±0.35
Professor	55	30.49	±12.35	0.98	±0.50
Surgical Branches					
Assistant	318	3.36	±5.17	0.30	±0.43
Associate	85	9.53	±7.12	0.64	±0.45
Professor	99	24.42	±16.25	1.40	±5.42
Internal Branches					
Assistant	415	2.89	±4.68	0.32	±0.65
Associate	126	11.10	±9.10	0.67	±0.52
Professor	134	25.33	±16.20	0.87	±0.55

SD: Standard Deviation

faculty members might be related to continuity of the academic career, as females may need to take more breaks such as maternity leave or disparities between the two genders.[9,10]

h-index was a strong measure to distinguish between all academic branches in general, which is consistent with our prior findings.[11,12] Opposite to expectations, *m*-index also showed a gradual increase with academic ranks, except in Basic Science Assistant Professor Rank (Table 1). This result could be explained by the steady increase in citations and academic productivity with advancing in academic ranks that may eliminate the effect of time lapse. A recent study compared the *m*-index and contemporary *h*-index (which account for the publication age, authorship value and journal impact factor) in 188 neurosurgeons found a steady increase in both measures with advancing academic ranks.[4]

Our findings support the importance of evaluating academic productivity according to medical branches.[13] Basic science branches showed obvious higher *h* and *m* indices compared to Surgical and Internal Branches (Table 3). By the same token, *h* and *m* indices are markedly different when comparing each academic rank separately (Table 4). Moreover, *m*-index presented unique pattern in each medical branch which could be explained by the nature of research and clinical work throughout academic career. *m*-index showed linear increase with advancing in academic rank in Internal Branches, however, it showed a positively skewed curve in Basic Science Branches and a negatively skewed curve in Surgical Branches (Table 4). Studies supported our finding of markedly high academic

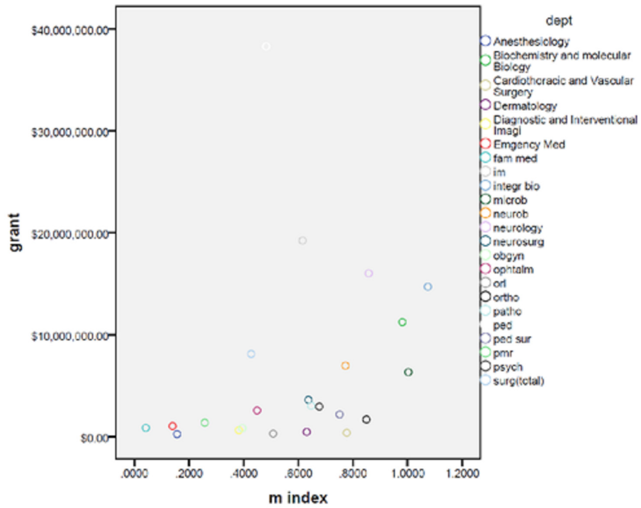

Figure 1: Correlation of m-index and grand amounts according to departments.

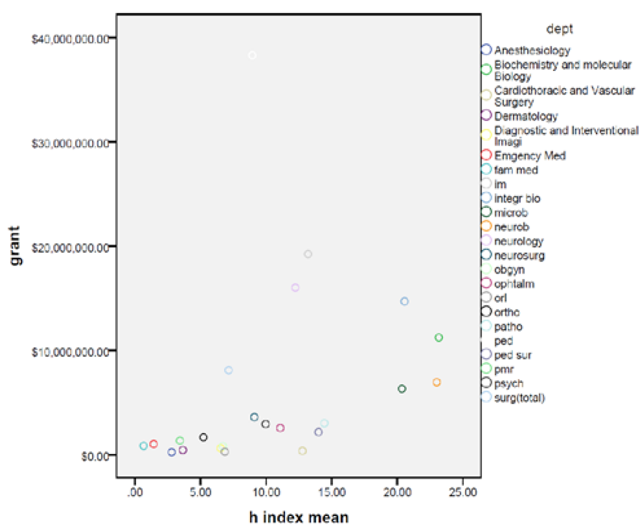

Figure 2: Correlation between *h*-index and grand amounts according to departments.

productivity (*m*-index=1.4) of Surgical Branches Professor, who apparently were able to maintain an increase of 1 point of *h*-index each academic year.[1,4,5] In the light of these findings, we developed a percentile of academic growth according to medical branches (Table 5), which could be a useful measure to determine promotion of individuals.

Supporting to prior literature, we found a positive strong positive correlation between *h*-index and received amounts of NIH research grands.[11,12,14] *h*-index seems to have better predictability and correlation with the received grant amount compared to *m*-index. However, the correlation between *m*-index and grant amount shows a curve shape,

Table 5: h and m Indices Academic Growth Percentiles According to Academic Ranks.

		25th	50th	75th	95th
		Basic Science Branches			
Assistant	*h*	10.00	15.00	17.75	25.75
	m	0.81	1.08	1.36	2.33
Associate	*h*	14.50	21.50	25.00	30.25
	m	0.53	0.77	1.10	1.55
Professor	*h*	23.00	31.00	39.50	51.90
	m	0.68	0.91	1.25	2.11
		Surgical Branches			
Assistant	*h*	0.00	1.00	4.75	13.15
	m	0.00	0.11	0.46	1.23
Associate	*h*	4.00	7.00	15.00	22.60
	m	0.333	0.55	0.92	1.48
Professor	*h*	13.50	22.00	33.00	57.00
	m	0.48	0.88	1.13	2.31
		Internal Branches			
Assistant	*h*	0.00	0.50	4.00	14.00
	m	0.00	0.00	0.50	1.33
Associate	*h*	4.00	9.00	16.00	29.50
	m	0.27	0.57	0.95	1.62
Professor	*h*	12.25	21.00	38.00	57.00
	m	0.42	0.78	1.24	1.81

with a sharp increase in the grant amount when *m*-index is close to 1 (Figure 1). In addition, *h*-index has been shown to be a strong measure for institutional quality and academic productivity. Turaga *et al*. showed a correlation between United States top 10 medical schools and the mean of faculty *h*-index.[14] The general gradual increase in *h*-index throughout academic ranks in all medical branches (Table 4) may also reflect the factual academic forecast and institutional success in supporting faculty members and academic productivity.

Despite the detailed description, the study also has weaknesses. This include limiting our sample to one medical school, however, the goal of this study is to evaluate the UTHealth McGovern Medical School Center in Houston, TX. Also, the comparative groups contain unequal numbers of departments and faculty members, which may affect the final results. One of the most common critical topic about the use of *h* and *m* indices in evaluating academic productivity, is the assumption that citations and higher indices are surrogate for quality in publishing.[5] Also, *h* and *m* indices do not differentiate between types of articles and all citations counted as equal as original research contributions. Moreover, publications of established researches may be more recognized due to prominence instead of article content, a phenomenon known as the "Mathew effect".[15] We wonder if the Mathew effect impacted the result of Surgical Branches Professors *m*–index. In summary, *h* and *m* indices are a single factors that should be considered in evaluating the academic productivity of individuals or departments.[1]

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