# **Brief Communication**

Survey of h-index for neurosurgeons in Saudi Arabia

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## ABSTRACT

**Objectives:** To calculate the h-index for neurosurgeons in the Kingdom of Saudi Arabia (KSA), and to assess its association with a number of features relating to neurosurgical practice in KSA.

**Methods:** The h-index for 84 neurosurgeons that worked in KSA during 1990-2013 was evaluated using Google Scholar during the period September to October 2014. The correlation between the h-index and a number of neurosurgeon and neurosurgical center characteristics was determined and examined statistically.

**Results:** The median h-index was 2.5 (range 0-33) and the mean was 5.04. The h-index was significantly higher for neurosurgeons who obtained their certification before 2001 and those working at the King Faisal Specialist Hospital, Riyadh, KSA. The h-index was also higher, but without reaching significance, for non-Saudi neurosurgeons, those with international certification and those working at the university hospitals. Additionally, the h-index was significantly lower for neurosurgeons working in the Ministry of Health hospitals.

**Conclusion:** Application of the h-index to KSA neurosurgeons revealed a significant correlation with the duration after certification and with certain centers. Evaluation of the h-index should be included in the consideration for academic positions in KSA. Saudi neurosurgeons should be encouraged to publish in journals with high impact factor.

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The h-index is a bibliometric measure that was introduced by Hirsch in 2005.<sup>1,2</sup> It combines the number of publications and the citation count in a single number, that signifies the scientific yield of a researcher. In recent years, it gained extensive interest and became accepted for practices, such as evaluating grant allocation, employment, promotion, prizes, and fellowship in societies.<sup>2</sup> Assessment of h-index for academic neurosurgeons has been the subject of recent publications from the United States of America (USA) and Great Britain (GB).<sup>1-6</sup> The objectives of the study are to calculate the h-index for neurosurgeons working in Kingdom of Saudi Arabia (KSA), and to determine its correlation with a number of neurosurgeon and neurosurgical center characteristics in KSA.

Methods. This study was carried out at King Khalid National Guard Hospital (KKNGH), Jeddah, KSA during the period September 2014 to October 2014. It was a review based on routinely available data with open access; hence, it did not require an ethical approval by KKNGH. The author compiled a list of all neurosurgeons that worked in KSA during 1990-2013 by means of records from the Saudi Association of Neurological Surgery (SANS) membership lists, from previous SANS scientific meetings programs and from the Saudi Board in Neurosurgery training records. The inclusion criteria were: neurosurgeons that worked as a consultants in any neurosurgical center in KSA during the 24 year period irrespective of their nationality; and duration of employment. The h-index was defined as the number of papers h, by a researcher with citation counts of h or above for each paper.<sup>1</sup> Google Scholar was used to calculate manually the h-index for every neurosurgeon using the surname and initials. An additional PubMed search was carried out when there was doubt for neurosurgeons with name duplication, and for those with a few or no publications. Neurosurgeons were considered to be affiliated to their last employing KSA neurosurgical center, whether, at the time of study, they were working inside or outside KSA, or had retired.

The following data were collected for each neurosurgeon: nationality, origin, and year of neurosurgical certification, as well as the KSA neurosurgical center and its region. The distribution of the h-index within the selected groups of neurosurgeons was evaluated and compared with respect to; the neurosurgeon's nationality, whether Saudi or non-Saudi, the origin of the neurosurgeon's specialty certification whether international or Saudi, the year of the neurosurgeon's specialty certification whether before or on, and after 2001, the KSA region of the neurosurgical center whether central, western or eastern, and the KSA neurosurgical center itself, whether university hospital, King Faisal Specialist Hospital and Research Center (KFSHRC), Armed Forces Hospital (AFH), National Guard Hospital (NGH), Ministry of Health (MOH)

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Hospital, or others. The latter included Security Forces Hospital, ARAMCO Hospital, and 5 private hospitals (Erfan, Fageeh, Bakhsh, Saad, and AlHabib). GraphPad Quickcalcs (GraphPad Software, LaJolla, California, USA) was used for the statistical analysis. The h-index for each selected group was compared with that for other neurosurgeons in the study population. The various pairs of h-index were examined statistically by comparing their mean; standard deviation (SD), and number using unpaired t test. A p<0.05 was considered statistically significant.

**Results.** Data pertaining to 84 KSA neurosurgeons were analyzed. Table 1 summarizes the h-index for

the various selected groups of neurosurgeons. Most neurosurgeons in this study were males (97.6%), Saudi nationals (53.6%), with international neurosurgical certification (82.1%), with neurosurgical certification before 2001 (71.4%), working in the central region of KSA (52.4%), and working in MOH (31%), and university hospitals (25%). Of the 45 Saudi neurosurgeons, 15 (33.3%) had Saudi neurosurgical certification, and 23 (51.1%) had their neurosurgical certification before 2001. The median h-index for the 84 neurosurgeons was 2.5 (range 0-33), and the mean $\pm$ SD was 5.04 $\pm$ 6.10. The median h-index for the 12 neurosurgeons who reached the level of professor at KSA university hospitals was 9 (mean 11.2, range 7-20).

**Table 1** - The h-indices for selected groups of neurosurgeons from Saudi Arabia.

Feature	n (%)	Median	Range	Mean±SD	<i>P</i> -value*
Neurosurgeon's nationality					
Saudi	45 (53.6)	1	0-20	4.00±5.39	0.0949 (NS)
Non-Saudi	39 (46.4)	4	0-33	6.23±6.70	
Neurosurgical certification origin	!				
International	69 (82.1)	3	0-33	5.57±6.42	0.0871 (NS)
Saudi	15 (17.9)	1	0-12	2.60±3.48	
Neurosurgical certification year					
<2001	60 (71.4)	5	0-33	6.57±6.54	0.0002 (Sig)
≥2001	24 (28.6)	0.5	0-6	1.21±1.72	
Neurosurgical center region					
Central region	44 (52.4)	4	0-20	5.64±5.95	0.3475 (NS)
Other 2 regions	40 (47.6)	2	0-33	4.38±6.27	
Western region	23 (27.4)	2	0-33	4.96±7.69	0.9417 (NS)
Other 2 regions	61 (72.6)	3	0-20	5.07±5.45	
Eastern region	17 (20.2)	2	0-10	3.59±3.64	0.2772 (NS)
Other 2 regions	67 (79.8)	3	0-33	5.40±6.55	
Neurosurgical center					
KFSHRC Hospitals	12 (14.3)	10.5	0-33	10.75±9.27	0.0003 (Sig)
All other hospitals	72 (85.7)	2	0-20	4.08±4.87	
University hospitals	21 (25)	7	0-20	6.67±5.29	0.1573 (NS)
All other hospitals	63 (75)	2	0-33	4.49±6.29	
National Guard Hospitals	9 (10.7)	4	0-19	6.33±6.18	0.5035 (NS)
All other hospitals	75 (89.3)	2	0-33	4.88±6.11	
Armed Forces Hospitals	8 (9.5)	1	0-16	4.13±6.22	0.6618 (NS)
All other hospitals	76 (90.5)	3	0-33	5.13±6.12	
Ministry of Health Hospitals	26 (31)	1	0-9	1.69±2.33	0.0005 (Sig)
All other hospitals	58 (69)	4	0-33	6.53±6.66	
Remaining hospitals	8 (9.5)	1	0-7	2.50±2.78	0.2189 (NS)
All other hospitals	76 (90.5)	3	0-33	5.30±6.30	
NS - not significant, Sig - significant, KFSHRC - King Faisal Specialist Hospital and Research center,					

Rezmaining hospitals - Security Forces Hospital, ARAMCO, and 5 private hospitals

The h-index was significantly higher for neurosurgeons who obtained their neurosurgical certification before 2001 (median 5 versus 0.5) (p=0.0002) and those working at the KFSHRC (median 10.5 versus 2) (p=0.0003). The h-index was also higher, but without reaching significance for neurosurgeons that were non-Saudi nationals (median 4 versus 1) (p=0.0949), those with international neurosurgical certification (median 3 versus 1) (p=0.0871), and those working at university hospitals (median 7 versus 2) (p=0.1573). In addition, the h-index was significantly lower for neurosurgeons working in the MOH hospitals (median 1 versus 4) (p=0.0005).

Discussion. Modern neurosurgery has been practiced in KSA for more than 30 years, mainly in tertiary care hospitals. The KSA neurosurgeons are relatively small in numbers, and they have contributed to the local and international literature. Hence, KSA neurosurgeons are a suitable group for a first attempt at calculating the h-index for practitioners in a medical specialty in KSA. The h-index is a robust statistic, but it has certain inadequacies. It cannot be used to compare scientists belonging to different fields, even closely related specialties.<sup>3</sup> Its use in contrasting departments academic output may be considered unreliable.<sup>4,6</sup> It undervalues the importance of high scientific impact work, which has citation numbers well above h.5,6 The h-index discriminates against those who work alone or in a small team, and underestimates the contribution of women who had a marital change in surname.<sup>5</sup> In addition, the accuracy of its measurement is dependent on the reliability of the available databases, which are known to be influenced by authors name repetition and articles publication date.<sup>5,6</sup> In an effort to compensate for these deficiencies many variants of the h-index were introduced,<sup>2,5,6</sup> and some of them, such as the m-quotient<sup>5</sup> and the g-index<sup>3</sup> correlate well with the h-index. Nevertheless, at present, the h-index is a widely accepted measure that is useful in evaluating the academic performance of a researcher objectively.<sup>1-6</sup>

In this study, the median h-index for the KSA neurosurgeons was 2.5, and the mean h-index was 5.04. Khan et al<sup>4</sup> reported an h-index median of 16, and a mean of 19.7 for 188 neurosurgeons working in 10 highly ranked USA institutions. Spearman et al<sup>1</sup> calculated a median h-index of 9 for 1120 academic neurosurgeons working at al<sup>1</sup> USA Electronic Residency Application Service-listed neurosurgery training programs. Wilkes et al<sup>5</sup> stated a median h-index of 6 for 315 neurosurgeons in GB and Ireland. We observed a significant correlation between the h-index for KSA neurosurgeons and the duration after their neurosurgical

certification (before or on, and after 2001), which is in agreement with other reports.<sup>3,4</sup> We also noted that h-index for Saudi neurosurgeons and for those holding Saudi neurosurgical certification was lower than others but without significance. This is probably linked to the fact that the Saudi group compared to the non-Saudis, included a larger proportion of neurosurgeons who were newly qualified and holding a Saudi neurosurgical certification. It is agreed that the h-index is influenced significantly not only by the duration of the academic career, and but also by the academic rank,<sup>1-5</sup> and by the holding of an additional high research degree, such as MD or PhD.<sup>5</sup> The mean h-index for the 12 KSA neurosurgeons that reached the level of professor in our universities was 11.2, which is probably reasonable when compared to a mean h-index range of 10.1-28.1 for professors in major academic institutes in USA and GB and Ireland.<sup>3-5</sup> It is also recognized that the h-index may be affected by the neurosurgical subspecialty with vascular neurosurgery<sup>4</sup> and functional/epilepsy<sup>5</sup> surgery being highest, while general neurosurgery being lowest.4 The h-index however, is not affected by the researchers'gender<sup>4</sup> or their position in the articles' authorship.<sup>3</sup>

We observed some correlation between the h-index for KSA neurosurgeons and their neurosurgical center. The h-index for neurosurgeons working in KSA central region compared with other regions was higher but without significance. This is related to the presence of most of the well-established neurosurgical centers in Riyadh. The h-index was significantly higher for neurosurgeons working at KFSHRC, and it was significantly lower for those working at MOH hospitals. In addition, the h-index was higher but without significance for neurosurgeons working at the university hospitals. Reasons for the disparity in the h-index between neurosurgeons in various KSA neurosurgical centers are multifactorial. They include staff selection policy with regard to qualification, training, and academic background. In addition, the academic productivity is influenced by workload, experience, and logistic support, the level of which vary between different KSA hospitals. The MOH hospitals compared with others had the largest number of neurosurgeons in this study (31%), and their neurosurgical centers were probably more heterogeneous with regard to staff qualification, seniority, and facilities. This is likely to change in the future with the establishment in 2011 of the Saudi National Neuroscience Institute at the MOH King Fahad Medical City, Riyadh, KSA.

This study is an evaluation the h-index for 84 neurosurgeons that worked in KSA over a 24 year period. There may be limitations to the research.

The study group is relatively small, and limits the generalizability of the findings. It is possible that a few neurosurgeons from the smaller hospitals in KSA may have been overlooked, but this is unlikely to influence the study results. Google Scholar was used because it is free and easy to use, and it correlates well with other subscription databases search engines; such as Scopus.<sup>3</sup> There may have been errors, and omissions in the calculating the h-index due to name duplication and missed publications. Furthermore, the h-index was calculated manually rather than automated. This is known to influence the findings, particularly for the more senior neurosurgeons.<sup>4</sup> Nevertheless, it is felt that the inaccuracies were minimized by the countercheck with a PubMed search, when there was doubt. In addition, using the mean h-index to compare groups of neurosurgeons implies that slight imprecisions in the individual h-index are unlikely to influence the conclusions.

In conclusion, the h-index is a useful measure that reflects the cumulative impact and relevance of an individual's academic productivity. Its application to KSA neurosurgeons revealed a significant correlation with the duration after neurosurgical certification and with certain neurosurgical centers. Evaluation of the h-index should be included during the application process for academic positions in KSA. Saudi neurosurgeons should be encouraged not only to continue publishing papers, but to publish papers that will have an impact on the field reflected by a high citation count. However, there is a need for standardizing the current method of calculating the h-index. **Acknowledgement.** The author is grateful to Dr. Aimun A. Jamjoom for his help with the literature search and his comments on the manuscript, and for Ms. Sophia M. Almoro for her secretarial assistance with the manuscript.

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