

h-index: Assessing a researcher's impact

2015 Scholar's Cooperative Brown Bag Series

Katherine Akers

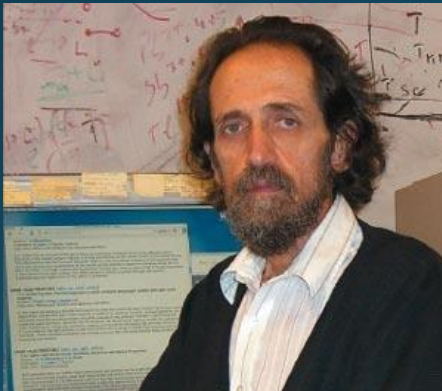
Biomedical Research & Data Specialist

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What is the h -index?

A combined measure of researcher productivity (# of publications) and impact (# of citations)

Created in 2005 by physicist Jorge E. Hirsch (UCSD)



An index to quantify an individual's scientific research output

J. E. Hirsch*

Department of Physics, University of California at San Diego, La Jolla, CA 92093-0319

Communicated by Manuel Cardona, Max Planck Institute for Solid State Research, Stuttgart, Germany, September 1, 2005 (received for review August 15, 2005)

I propose the index h , defined as the number of papers with citation number $\geq h$, as a useful index to characterize the scientific output of a researcher.

citations | impact | unbiased

For the few scientists who earn a Nobel prize, the impact and relevance of their research is unquestionable. Among the rest of us, how does one quantify the cumulative impact and relevance of an individual's scientific research output? In a world of limited resources, such quantification (even if potentially distasteful) is often needed for evaluation and comparison purposes (e.g., for university faculty recruitment and advancement, award of grants, etc.).

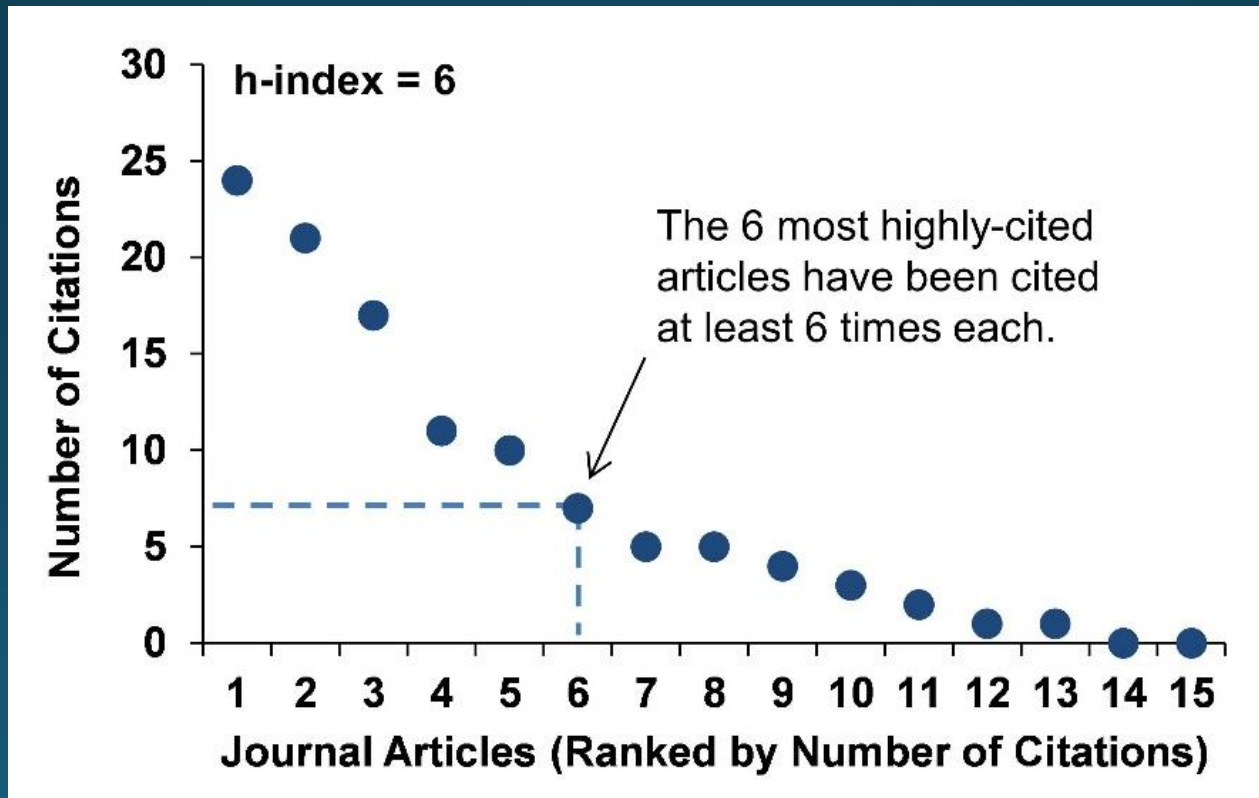
The publication record of an individual and the citation record clearly are data that contain useful information. That information includes the number (N_p) of papers published over n years, the number of citations (N_c) for each paper (j), the journals where the papers were published, their impact parameter, etc. This large amount of information will be evaluated with different criteria by different people. Here, I would like to propose a single number, the " h index," as a particularly simple and useful way to characterize the scientific output of a researcher.

A scientist has index h if h of his or her N_p papers have at least h citations each and the other ($N_p - h$) papers have $\leq h$ citations each.

- (i) Total number of papers (N_p). Advantage: measures productivity. Disadvantage: does not measure importance or impact of papers.
- (ii) Total number of citations ($N_{c,tot}$). Advantage: measures total impact. Disadvantage: hard to find and may be inflated by a small number of "big hits," which may not be representative of the individual if he or she is a coauthor with many others on those papers. In such cases, the relation in Eq. 1 will imply a very atypical value of a , > 5 . Another disadvantage is that $N_{c,tot}$ gives undue weight to highly cited review articles versus original research contributions.
- (iii) Citations per paper (i.e., ratio of $N_{c,tot}$ to N_p). Advantage: allows comparison of scientists of different ages. Disadvantage: hard to find, rewards low productivity, and penalizes high productivity.
- (iv) Number of "significant papers," defined as the number of papers with $> y$ citations (for example, $y = 50$). Advantage: eliminates the disadvantages of criteria i , ii , and iii and gives an idea of broad and sustained impact. Disadvantage: y is arbitrary and will randomly favor or disfavor individuals, and y needs to be adjusted for different levels of seniority.
- (v) Number of citations to each of the q most-cited papers (for example, $q = 5$). Advantage: overcomes many of the disadvantages of the criteria above. Disadvantage: It is not a single number, making it more difficult to obtain and compare. Also, q is arbitrary and will randomly favor and disfavor individuals.

What is the h -index?

An h -index of h means that an author's h most highly cited articles have at least h citations each.



The *h*-index assesses *researchers*

ITEM

METRIC

journal article

citations
(and altmetrics)

journal

impact factor

researcher

h-index

Advantages of *h*-index

- **Informative:** more informative than # of publications or # of citations
- **Simple:** easy to calculate and understand
- **Robust:** insensitive to “one-hit wonders” or an excess of uncited papers--rewards researchers who consistently publish influential work

Disadvantages of *h*-index

- **Simple:** ignores other aspects of research impact
- **Cannot decrease:** researchers can maintain a good *h*-index even if they cease to be productive
- **Gameable:** can be inflated by self-citation (5-25%)
- **Relative:** depends on discipline, length of research career, number of co-authors, etc.

Alternatives to h -index

g -index: accounts for highly cited articles

contemporary h -index: accounts for recency of articles

individual h -index: accounts for co-authors

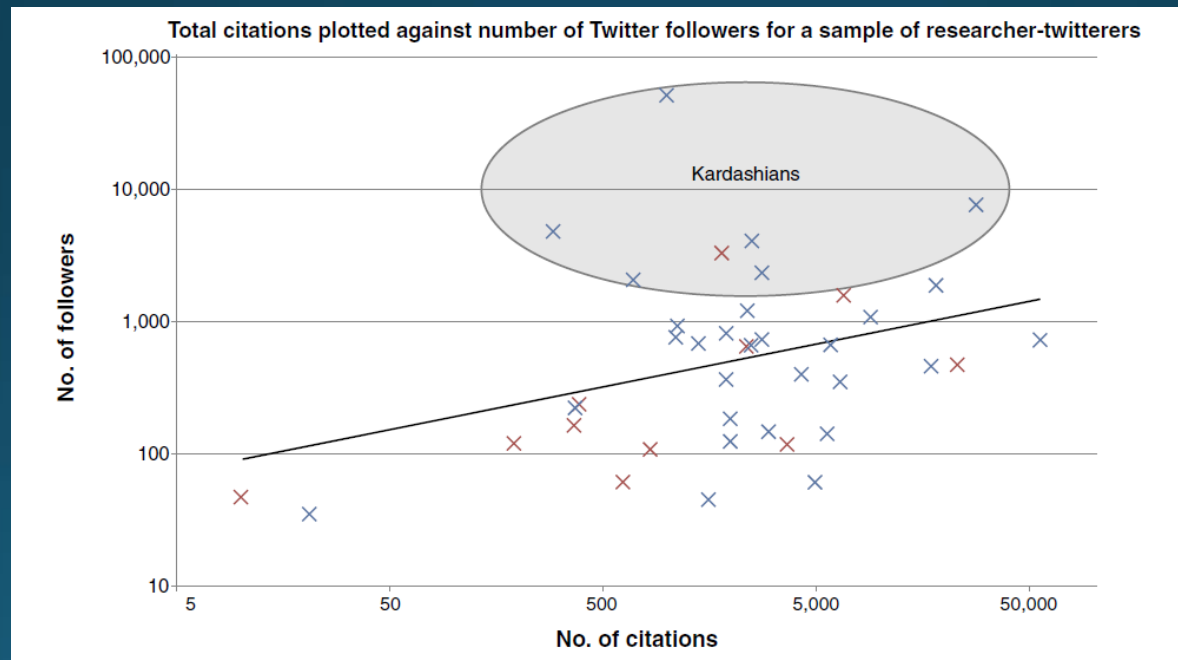
m -quotient: accounts for career length

a -index, ar -index, e -index, c -index, h' -index, $h(2)$ -index, h_f -index, h_T -index, h_w -index, HCP indicator, $i10$ -index, IQp -index, maxprod index, p -index, π -index, r -index, s -index, success-index, t -index, w -index

k -index

Ratio of Twitter followers (“celebrity”) to citations (“scientific value”)

k -index ≥ 5 : overblown public profile



Tools for calculating h -index

Web of Science

Scopus

Google Scholar

Publish or Perish software

(<http://www.harzing.com/pop.htm>)

h -index prediction tool

(<http://klab.smpp.northwestern.edu/h-index.html>)

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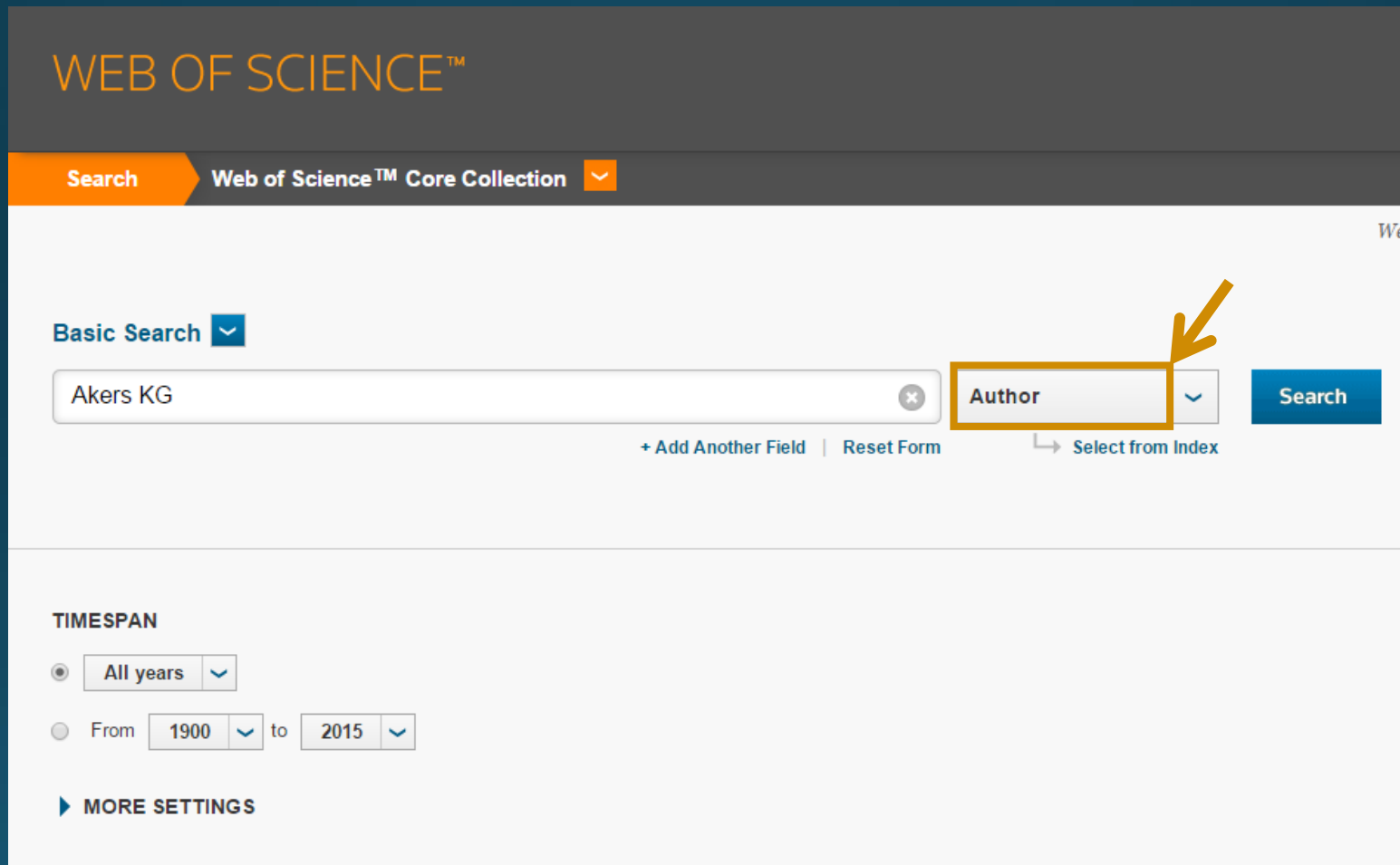
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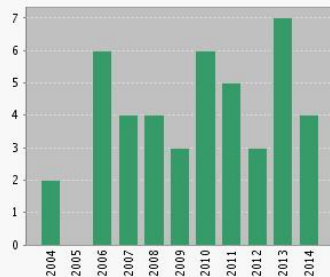
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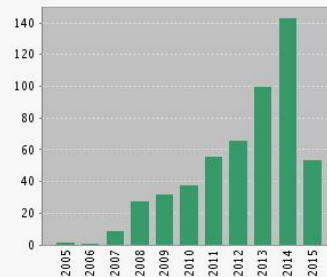
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h-index	16	15
i10-index	22	22



Add co-authors

- Paul Frankland + x
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- Tsuyoshi Miyakawa + x
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- Blake Richards + x
- Jonathan R Epp + x
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- Ruth Guinsburg + x
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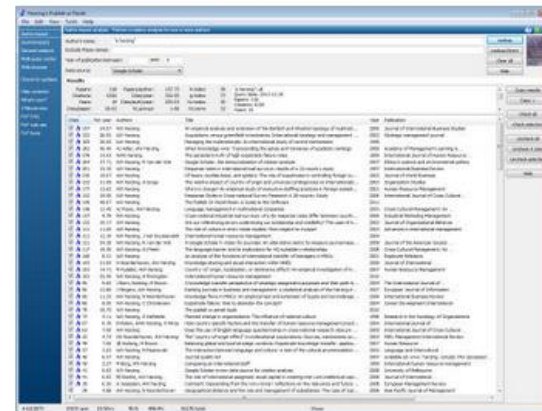
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h-index prediction tool

H-index prediction

Read details in [Acuna, Allesina, Kording, Nature, 489, 201-202 \(2012\)](#)

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H-index calculator uses BitmapExporter by Mario Klingemann

H-index

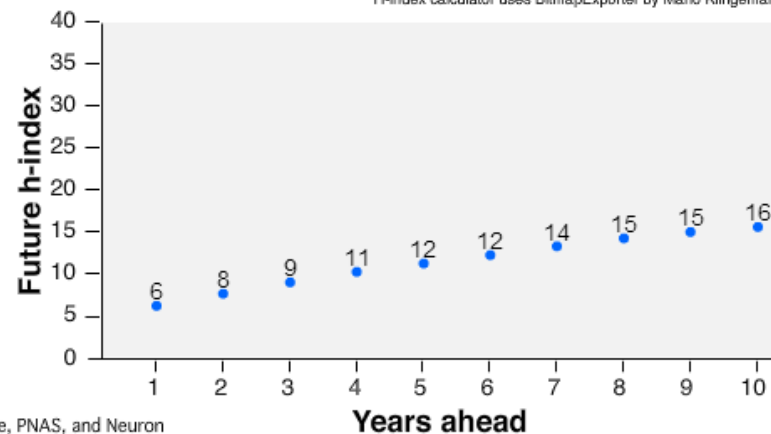
articles

Years since first article

distinct journals

articles in 'top' journals*

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* Nature, Science, Nature Neuroscience, PNAS, and Neuron

distinct journals: number of different journals where you have published in.

Note: The equations and the calculator model people that are in [Neurotree](#), have an h-index 5 or more, and are between 5 to 12 years after publishing first article.

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What is a good h -index?

For physicists:

Successful \rightarrow h -index of 20 after 20 years of activity

Outstanding \rightarrow h -index of 40 after 20 years of activity

Truly unique \rightarrow h -index of 60 after 20 years of activity

h -index = 12 \rightarrow tenure

h -index = 18 \rightarrow full professorship

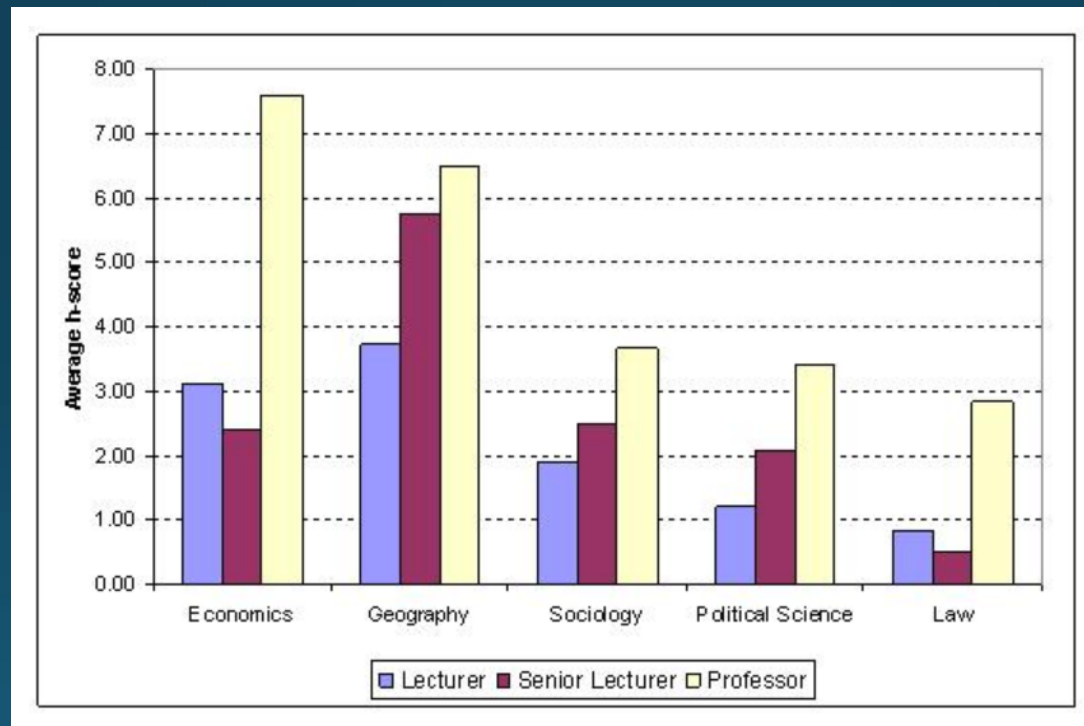
h -index = 15-20 \rightarrow fellowship in American Physical Society

h -index \geq 45 \rightarrow membership in National Academy of Sciences

84% of physicists who won Nobel prizes had an h -index of at least 30

What is a good *h*-index?

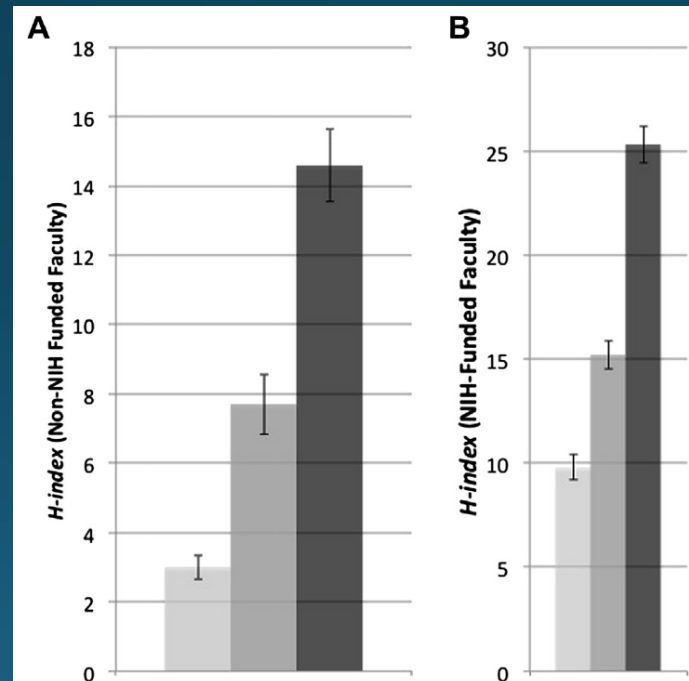
For social scientists:



Validity of h -index

NIH-funded researchers have higher h -indices than non-
NIH-funded researchers.

Ophthalmologists:



PF Svider et al (2014). The association between scholarly impact and National Institutes of Health funding in ophthalmology. *Ophthalmol* 121:423-428.

Validity of *h*-index

NIH-funded researchers have higher *h*-indices than non-
NIH-funded researchers.

Radiologists:

Variable	NIH Funding (<i>n</i> = 48 [23%])	No NIH Funding (<i>n</i> = 162 [77%])
<i>h</i> -index		
Mean ± SD	19.1 ± 12.6	10.4 ± 9.0
Median (IQR)	19.5 (9–28.5)	7.5 (4–16)

Questions?

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