Do Metrics Matter?

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Vice President, World Association of Medical Editors (WAME)
Honorary Editor, The Lancet ME
Editorial Consultant, The Lancet
Founding Editor, The IJOEM
Director, NIOC Medical Education and Research Center, Shiraz, Iran
Scientometrics (Definition)

- Scientometrics is the science of measuring and analyzing science.
- It is often done through bibliometrics.

Scientometrics

- First citation analysis by Gross & Gross (1927)
- Journal to journal cross-citation (Cason & Lubotsky, 1936)
- Journal Impact Factor (IF) by Eugene Garfield (1955)
**Journal Impact Factor**

- **Definition:**
  
  \[ IF = \frac{C}{P} \]

  \[ IF_i = \frac{\sum_{k=1}^{n} C_{k,i}}{P_i} \]

- \( IF \): IF of journal in 2006
- \( P \): number of substantive articles published in 2004-05
- \( C \): number of citations made in year 2006 to articles published in 2004-05

Garfield E. JAMA 2006;295: 90-3
### Example

**Journal Citation Reports**

**2009 JCR Evidence Edition**

**Journals: AMERICAN JOURNAL OF CARDIOLOGY**

<table>
<thead>
<tr>
<th>Week</th>
<th>Journal Title</th>
<th>JCR Index</th>
<th>Total Citations</th>
<th>Impact Factor</th>
<th>5-Year Impact Factor</th>
<th>Immediacy Index</th>
<th>Total Cites 3-Year</th>
<th>Total Cites 2-Year</th>
<th>Total Cites 1-Year</th>
<th>Total Cites 5-Year</th>
<th>Total Cites 10-Year</th>
<th>Source Date</th>
<th>JCR 2009 Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</table>

**Journal Information**

- **Full Journal Title:** AMERICAN JOURNAL OF CARDIOLOGY
- **DOI:** 10.1053/j.ajc.2008.12.024
- **ISSN:** 0002-9343
- **Online ISSN:** 1524-4636
- **Journal Country/Territory:** UNITED STATES
- **Publisher:** AMER HEART ASSOC INC GLENN E HIRSHMAN SCIENCE INC
- **Electronic Edition:** Available

**Journal Rank in Categories**

- **Source Ranks:**
  - 70% in Top Quartile

**Journal Impact Factor 2009**

- **Cites in 2009 to items published in:** 2006 to 2008
- **Number of items published in:** 2006 to 2008
- **2007 = 555**
- **2006 = 556**

**Calculation**

- **2009 Impact Factor:** 3.335
- **Number of total cites in 2009:** 1432

---

### Top Journals in Cardiology

**SI Web of Knowledge**

**Journal Citation Reports**

<table>
<thead>
<tr>
<th><strong>Mark</strong></th>
<th><strong>Abbreviated Journal Title</strong></th>
<th><strong>JCR Index</strong></th>
<th><strong>Total Citations</strong></th>
<th><strong>Team Factor</strong></th>
<th><strong>5-Year Impact Factor</strong></th>
<th><strong>Immediacy Index</strong></th>
<th><strong>Total Cites 3-Year</strong></th>
<th><strong>Total Cites 2-Year</strong></th>
<th><strong>Total Cites 1-Year</strong></th>
<th><strong>Total Cites 5-Year</strong></th>
<th><strong>Total Cites 10-Year</strong></th>
<th><strong>Source Date</strong></th>
<th><strong>JCR 2009 Class</strong></th>
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<td>7/13/2011</td>
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</tr>
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<td>2</td>
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<td>0726-0262</td>
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<td>0.860</td>
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<tr>
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<td>8.403</td>
<td>8.403</td>
<td>7/13/2011</td>
<td></td>
</tr>
</tbody>
</table>
Journal Impact Factor

- Is calculated and sold by Thomson-Reuter (formerly Thomson Scientific, before that, the Institute of Scientific Information [ISI])
- In many centers, affects
  - Decision on where to publish
  - Whom to promote or hire
  - Success of grant applications
  - Winning prize
  - Even salary bonuses
- No one has independently audited the validity of the data*


Opinion

Journal Impact Factor: Uses and Misuses

Farrokh Habilzadeh MD*

As a lecturer of biomedical writing, I have usually been asked about the impact factor of journals and how authors can publish their scientific manuscripts in journals with high impact factors. This is particularly important for faculty members since recently, many officials in Iran evaluate the scientific merit of an article based on the impact...
Journal Impact Factor

**Pros**
- A measure for journal quality
- Easy to calculate

**Cons**
- Substantive articles?
- May be used unwisely
  - “drawing conclusions about individual performance is not the proper way to interpret impact factor.”*
- Calculations behind the wall†
- Subject to manipulation‡

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*http://scientific.thomsonreuters.com/citationimpactforum/8424440/

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Does Journal Impact Factor a Good Metric for Assessing Researchers/Articles?
Citations to *Am J Cardiol*

- Impact Factor 2009: 3.575
- SEARCH STRATEGY
  - Database: *Web of Knowledge® (ISI)*
  - Publication Name=(American Journal of Cardiology) AND Year Published=(2009)
  - Refined by: Document Type=(ARTICLE OR REVIEW)
- RESULTS
  - 1889 records → 946 articles and reviews
  - Minimum: 0; Maximum: 60
  - Mean (SD): 3.3 (5.1); Median (IQR): 2 (5)
  - Skewness: 3.7

Distribution of Citations
Citations to Articles in 2009

- SEARCH STRATEGY
  - Database: Web of Knowledge® (ISI)
  - Address=(Shiraz) AND Address=(Iran) AND Year Published=(2009)
  - Refined by: Subject Areas=(CARDIOVASCULAR SYSTEM & CARDIOLOGY) AND Document Type=(ARTICLE)

- RESULTS
  - Total 1414 → 78 Cardiovascular → 56 Articles

Distribution of Citations
A scientist has index $h$, if $h$ of his/her $N_p$ papers have at least $h$ citations each, and the other $(N_p - h)$ papers have no more than $h$ citations each.

H-index = 5

H-index = 3
Brief communication

The problem of "Who"

Farrokh Habibzadeh*, Mahboobeh Yadollahie

Summary: Several metrics were proposed to measure the contribution of a person to scientific enterprise. However, the very first step in the calculation of all of these metrics correctly, is to figure out who did what. For several reasons, like scarcity of many common names, different spelling out of some names, variable presentation of certain names, etc., it is not always possible to identify what record really belongs to "who". Hence, we proceed to establish an identification system through which a unique identification number is assigned to each author (or by an international service). The author should use his/her AID in all his/her contributions to science. In this way, the key for search of digital databases would be the researcher's AID rather than name. In our digital world, this AID would be a great aid in figuring out "who" did what.

*Corresponding author.

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Keywords: Authority control; Digital identity; Scientometrics
H-index = 6

H-index
- **Pros**
  - Two-dimensional

- **Cons**
  - Who?
  - Different databases!
  - Contribution through one or two influential papers
    - Nikolai Korotkoff
    - Wilhelm Conrad Röntgen
  - Subject to manipulation
    - Self-citation
    - Member of a prolific research group
H-index and its variants

<table>
<thead>
<tr>
<th>Index</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>$h$ index</td>
<td>“A scientist has index $h$ if $h$ of his or her $N_h$ papers have at least $h$ citations each and the other $(N_h - h)$ papers have fewer than $h$ citations each” (Hirsch, 2005, p. 1106)</td>
</tr>
<tr>
<td>$r$ quotient</td>
<td>$h = N_h / t$ where $h = h$ index, $t = \text{number of years since publishing the first paper}$</td>
</tr>
<tr>
<td>$g$ index</td>
<td>“The highest number $g$ of papers that together received $g^2$ or more citations” (Egghe, 2006)</td>
</tr>
<tr>
<td>$h2$ index</td>
<td>“A scientist’s $h2$ index is defined as the highest natural number such that his $h2$ most-cited papers received each at least $(h2)^2$ citations” (Kosinski, 2006, p. 4)</td>
</tr>
<tr>
<td>$e$ index</td>
<td>$\sum_{i=1}^{h} c_i$, where $h = h$ index, $c_i = \text{citation counts}$</td>
</tr>
<tr>
<td>$m$ index</td>
<td>The median number of citations received by papers in the Hirsch core (this is the papers ranking smaller than or equal to $h$)</td>
</tr>
<tr>
<td>$r$ index</td>
<td>$\sqrt{\sum_{i=1}^{h} c_i}$, where $h = h$ index, $c_i = \text{citation counts}$</td>
</tr>
<tr>
<td>$ar$ index</td>
<td>$\sqrt{\sum_{i=1}^{h} c_i / a}$, where $h = h$ index, $c_i = \text{citation counts}, a = \text{number of years since publishing}$</td>
</tr>
<tr>
<td>$k_e$ index</td>
<td>$\sum_{i=1}^{h} c_i$ where $c_i = \text{citation counts}, k_e =$ the largest row index $j$ such that $c_{i,j} = c_j$</td>
</tr>
</tbody>
</table>


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Alternatives

Journal Network
Weighted Impact Factor

- Counting a reference from a more prestigious journal more heavily
  - Kochen, 1974
  - Pinski & Narin, 1976
  - PageRank of Google™
  - SCImago SJR ([www.scimagojr.com](http://www.scimagojr.com), 2007)

- Prestige: “the standing or estimation in the eyes of other people” / journals ([Merriam-Webster Dictionary](http://www.merriam-webster.com))
SJR vs JIF


Weighted IF
Journal weighted impact factor: A proposal

Farrokh Habibzadeh*, Mahboobeh Yadollahie

Article Info
Article history:
Received 27 March 2007
Revised in revised form 25 January 2006
Accepted 21 February 2008

Abstract
The impact factor of a journal reflects the frequency with which the journal's articles are cited. It is the best available measure of journal quality. For calculation of impact factor, we just count the number of citations, no matter how prestigious the citing journal is. We think that impact factor as a measure of journal quality, may be improved if in our calculation, we not only take into account the number of citations, but also incorporate a factor reflecting the prestige of the citing journal in relation to the cited journal. In calculation of this proposed "weighted impact factor," each citation has a coefficient (weight) the value of which is 1 if the citing journal is as prestigious as the cited journal; is > 1 if the citing journal is more prestigious than the cited journal; and is < 1 if the citing journal is less prestigious than the cited journal. In this way, journals receiving many citations from prestigious journals are considered prestigious themselves and those cited by low-status journals receive little credit. By considering both the number of citations and the prestige of the citing journals, we expect the weighted impact factor to be a better scientometrics measure of journal quality.

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Journal Impact Factor

- Definition:

\[ IF = \frac{C}{P} \]

\[ IF_i = \sum_{k=1}^{n} \frac{C_{k,i}}{P_i} \]

- \( IF \): IF of journal in 2006
- \( P \): number of substantive articles published in 2004-05
- \( C \): number of citations made in year 2006 to articles published in 2004-05

Garfield E. JAMA 2006;295:909-3
Weighted Impact Factor

\[ WIF_i = \frac{\sum_{k=1}^{n} w_{k,i} \cdot C_{k,i}}{P_i} \]

Calculation of Weights

- Popularity of the cited journal
- Prestige of the citing relative to the cited journal
Calculation of Weights

\[ q \rightarrow w \]

\[ [0, +\infty) \rightarrow (0.1, 10) \]

\( w_{k,j} = 10 \times 0.828 \cdot e^{-q_{k,j}} \)

\( q_{k,j} = \frac{PYIF_j}{PYIF_i} \)

\( PYIF: \) Previous year IF

How Journals Are Cited
## Parameters of 70 Medical Journals

<table>
<thead>
<tr>
<th>Rank</th>
<th>IF WIF</th>
<th>Abbreviated Journal Title</th>
<th>Articles Published in 2004-05</th>
<th>Total Cites Received in 2006</th>
<th>Year 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>NEW ENGL J MED</td>
<td>644</td>
<td>52,209</td>
<td>52,196</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>LANCET</td>
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<td>20,021</td>
<td>25,800</td>
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<td>3</td>
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<td>19,800</td>
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<tr>
<td>5</td>
<td>1</td>
<td>PLOS MED</td>
<td>108</td>
<td>1,485</td>
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<tr>
<td>6</td>
<td>3</td>
<td>ANNU REV MED</td>
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<tr>
<td>14</td>
<td>69</td>
<td>CAN FAM PHYSICIAN</td>
<td>107</td>
<td>82</td>
<td>0.794</td>
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</tbody>
</table>

WIF = 0.28 IF + 3.03

Spearman's ρ = 0.78, n = 70
Other Metrics

- Eigenfactor™ score
- Article Influence™ score
  - Per article citation influence

Top Journals in Cardiology

Journals listed below are specializations CARDIOVASCULAR SYSTEMS

Page 1 of 5

<table>
<thead>
<tr>
<th>Rank</th>
<th>Title</th>
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<th>Eigenfactor Score</th>
<th>Article Influence Score</th>
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None of these metrics are adequate compared with what should be the gold standard

PEER REVIEW

Opinion

Read the Articles; Don’t Count Them

Farrokh Habibzadeh MD*, Mahboobeh Yadollahie MD*

For many years journal impact factor has been used for the evaluation of researchers and research centers. After the proposal of h-index by Hirsch, this metric has been found in place and currently many authorities use it as a substitute for the journal impact factor for assessing the researchers and research centers or even journals. The Ministry of Health has recently decided to evaluate the frontiers of Iranian Universities of Medical Sciences by comparing their h-index. However, the appropriateness of this index is questioned by some researchers. But, before continuing our discussion, let us examine what h-index is.

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http://f1000medicine.com