Refining dermatology journal impact factors using PageRank

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Background: Thomson Institute for Scientific Information's journal impact factor, the most common measure of journal status, is based on crude citation counts that do not account for the quality of the journals where the citations originate. This study examines how accounting for citation origin affects the impact factor ranking of dermatology journals.

Methods: The 2003 impact factors of dermatology journals were adjusted by a weighted PageRank algorithm that assigned greater weight to citations originating in more frequently cited journals.

Results: Adjusting for citation origin moved the rank of the *Journal of the American Academy of Dermatology* higher than that of the *Archives of Dermatology* (third to second) but did not affect the ranking of the highest impact dermatology journal, the *Journal of Investigative Dermatology*. The dermatology journals most positively affected by adjusting for citation origin were *Contact Dermatitis* (moving from 22nd to 7th in rankings) and *Burns* (21st to 10th). Dermatology journals most negatively affected were *Seminars in Cutaneous Medicine and Surgery* (5th to 14th), the *Journal of Cutaneous Medicine and Surgery* (19th to 27th), and the *Journal of Investigative Dermatology Symposium Proceedings* (26th to 34th).

Limitations: Current measures of dermatology journal status do not incorporate survey data from dermatologists regarding which journals dermatologists esteem most.

Conclusion: Adjusting for citation origin provides a more refined measure of journal status and changes relative dermatology journal rankings. (J Am Acad Dermatol 2007;57:116-9.)

Thomson Institute for Scientific Information's journal impact factor (IF) is defined as a journal's mean citation rate over 2 years, ie, the number of citations to articles published in the previous 2 years divided by the number of articles published in the same 2 years.[1] IF functions as the lingua franca of academic journal prestige and increasingly factors into academic performance assessments that influence hiring, tenure, and grant decisions.[2-7]

Because of IF's reliance on crude citation counts it sometimes yields unintuitive journal rankings—for example, the *Annual Review of Immunology* receives a higher rating than *Nature* or *Science*.[8-10] These rankings of top journals become less surprising when IF is adjusted to account for the status of the journal where the citations originate—ie, when a citation in the *New England Journal of Medicine* counts for more than a citation in *Cutis*.[8-10] We examined how objectively adjusting IF for citation origin (by using an algorithm similar to the PageRank algorithm that the search engine Google uses to rank World Wide Web pages) changes dermatology journal rankings.

METHODS

Google has achieved prominence as an Internet search engine by using the PageRank algorithm

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Supported by the National Cancer Institute grant K-07 CA92550 (Dr Dellavalle).

Dr Dellavalle serves on the editorial board of the *Journal of the American Academy of Dermatology*, the *Archives of Dermatology*, and *BMC Dermatology*. Drs Schilling, Rodriguez, Van de Sompel, and Bollen have no conflicts of interest to declare.

Accepted for publication March 11, 2007.

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Published online May 14, 2007.
0190-9622/$32.00

doi:10.1016/j.jaad.2007.03.005

Table I. Dermatology journal rankings

	Impact factor 2003	Journals ranked by impact factor	Y-factor 2003	Journals ranked by Y factor	Difference (impact factor rank minus Y-factor rank)
1	4.194	J Invest Dermatol	2.085	J Invest Dermatol	0
2	3.535	Arch Dermatol	1.294	J Am Acad Dermatol	1
3	2.971	J Am Acad Dermatol	0.954	Arch Dermatol	−1
4	2.659	Br J Dermatol	0.926	Br J Dermatol	0
5	2.204	Semin Cutan Med Surg	0.324	Dermatol Surg	4
6	2.190	Melanoma Res	0.188	Melanoma Res	0
7	2.074	Wound Repair Regen	0.144	Contact Dermatitis	15
8	2.040	Exp Dermatol	0.132	Exp Dermatol	0
9	1.806	Dermatol Surg	0.123	Wound Repair Regen	−2
10	1.654	Dermatol Clin	0.118	Burns	11
11	1.626	J Dermatol Sci	0.117	J Cutan Pathol	1
12	1.581	J Cutan Pathol	0.115	Dermatol Clin	−2
13	1.558	Acta Derm Venereol	0.113	Dermatology	5
14	1.529	Skin Pharmacol Appl	0.108	Semin Cutan Med Surg	−9
15	1.415	Arch Dermatol Res	0.106	J Dermatol Sci	−4
16	1.368	J Eur Acad Dermatol	0.0990	Acta Derm Venereol	−3
17	1.223	Clin Exp Dermatol	0.0965	Clin Exp Dermatol	0
18	1.190	Dermatology	0.0916	Skin Pharmacol Appl	−4
19	1.189	J Cutan Med Surg	0.0859	J Eur Acad Dermatol	−3
20	1.132	Am J Dermatopathol	0.0807	Arch Dermatol Res	−5
21	1.128	Burns	0.0774	Am J Dermatopathol	−1
22	1.095	Contact Dermatitis	0.0699	Eur J Dermatol	2
23	1.000	Photodermatol Photoimmunol Photomed	0.0669	Leprosy Rev	2
24	0.987	Eur J Dermatol	0.0564	Pediatr Dermatol	3
25	0.907	Leprosy Rev	0.0535	Int J Dermatol	5
26	0.867	J Investig Dermatol Symp Proc	0.0442	Mycoses	3
27	0.837	Pediatr Dermatol	0.0436	J Cutan Med Surg	−8
28	0.790	Skin Res Technol	0.0412	Photodermatol Photoimmunol Photomed	−5
29	0.755	Mycoses	0.0397	Cutis	2
30	0.736	Int J Dermatol	0.0360	Ann Dermatol Venereol	4
31	0.695	Cutis	0.0326	Skin Res Technol	−3
32	0.647	Clin Dermatol	0.0308	J Dermatol	1
33	0.633	J Dermatol	0.0306	Clin Dermatol	−1
34	0.624	Ann Dermatol Venereol	0.0270	J Investig Dermatol Symp Proc	−8
35	0.521	Hautarzt	0.0268	Hautarzt	0
36	0.400	Wounds	0.0124	Wounds	0
37	0.195	J Cosmet Sci	0.0051	J Cosmet Sci	0
38	0.176	Curr Probl Dermatol	0.0050	Curr Probl Dermatol	0

to rank World Wide Web pages according to both hyperlink frequency and quality.[11,12] Google's application of PageRank is proprietary; our computations instead used a modified algorithm, weighted PageRank (PRw) (Fig 1).[9,10] Furthermore, although our calculations were based on an algorithm similar to Google's PageRank, they did not involve results from the Google search engine itself nor any World Wide Web–derived data.

In short, a network of journal-to-journal citations was extracted from the 2003 Journal Citation Report published by Thomson Institute for Scientific Information. The resulting Journal Citation Network comprised 5709 journals whose citation relations were encoded in a citation matrix. The cells of this matrix represented the number of citations originating from the row journal in 2003 to articles in the column journal that were published in 2001 and 2002. The matrix contained citation counts only for journals with non-zero IF values. PRw values were calculated for all 5709 journals on the basis of the resulting citation matrix.[9,10]

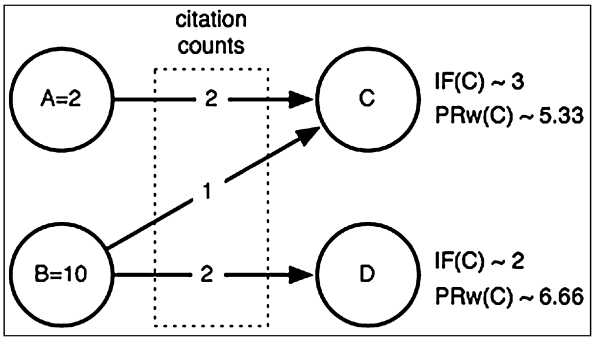

Fig 1. Weighted PageRank (*PRw*) algorithm used to calculate Y-factor modulates propagation of prestige values according to number of citations that point from one journal to another. A simple example of how PRw takes into account citation origin appears below. Assume initial prestige values (eg, provided by impact factor [*IF*]) for journal A = 2 and journal B = 10, that journal C is cited twice in journal A and once in journal B, that journal D is cited twice in journal B, and that journals C and D publish same number of articles. Given this scenario, journal C would be ranked higher than journal D by IF (3 vs 2). In PRw calculation, journal C receives 2 citations from journal A with prestige value of 2. Because journal A only cites journal C, journal C receives 100% of its prestige. Journal C furthermore receives one citation from journal B with prestige value of 10. However, journal B connects to both journal C and journal D, and taking into account distribution of citations emerging from journal B, journal C receives a third of journal B's prestige. Journal D on the other hand receives two thirds of journal B's prestige. Total PRw for journals C and D, labeled PRw(C) and PRw(D), respectively, are calculated as follows:

$$\mathrm{PRw(C)} = 2 \times 100\% + 10 \times 33.3\% = 5.33$$

$$\mathrm{PRw(D)} = 10 \times 66.66\% = 6.66$$

In this example, PRw reverses ranking of journals C and D determined by IF because journal D receives its citations from more prestigious sources than journal C does.

An example of how PRw takes into account citation origin is provided (Fig 1). To acknowledge the importance of IF, the Y-factor of dermatology journals was defined as the product of the PRw and IF values, ie, Y-factor = PRw × IF.[9,10]

All journals assigned to the dermatology subject category by Thomson Institute for Scientific Information were then ranked according to their Y-factor values.

RESULTS

Dermatology journals were separated into 3 groups: high impact (*Journal of Investigative Dermatology*, *Journal of the American Academy of Dermatology*, *Archives of Dermatology*, *British Journal of Dermatology*); middle impact (most journals); and low impact (*Journal of Cosmetic Science* and *Current Problems in Dermatology*, which has ceased publication) (Fig 2). Specific rankings are listed in Table I. Adjusting for citation origin moved the rank of the *Journal of the American Academy of Dermatology* higher than that of the *Archives of Dermatology* (third to second) but did not change the ranking of the highest impact dermatology journal, the *Journal of Investigative Dermatology*. Among all 38 dermatology journals, those with IFs most positively affected by adjusting for PageRank were *Contact Dermatitis* (moving from 22nd to 7th in rankings) and *Burns* (21st to 10th). The most negatively affected were *Seminars in Cutaneous Medicine and Surgery* (5th to 14th), the *Journal of Cutaneous Medicine and Surgery* (19th to 27th), and the *Journal of Investigative Dermatology Symposium Proceedings* (26th to 34th).

DISCUSSION

Dermatology journals segregated into 3 impact groupings with *Dermatologic Surgery* and *Wounds* respectively at the higher and lower border of the middle group (Fig 2). Among the 4 highest impact journals, accounting for citation location increased the ranking of the *Journal of the American Academy of Dermatology* from third to second—corroborating assertions that IF does not accurately reflect the *Journal of the American Academy of Dermatology*'s clinical impact.[13]

The study is limited in that journals without an IF in 2003, eg *BioMed Central Dermatology*, were not studied. Because open access increases journal impact[14,15] it is of interest how open access dermatology journals will rank according to their Y-factor values.

Small changes in the Y-factor might produce large changes in the rankings of clustered journals. Conversely, large changes in the Y-factor in uncrowded areas of the distribution could lead to small changes in rank order. Absolute y-factor values in addition to changes in rank order should thus be considered to avoid misrepresenting journal status.

Future research could investigate domain-specific, longitudinal deviations between IF and Y-factor rankings. These could illuminate particular trends in a fast-moving medical field, but were outside the scope of this report. Future research that surveys dermatologists regarding dermatology journals could provide independent validation for ranking measurements. Such information is not currently incorporated into either IFs or Y-factors.

In summary: (1) many dermatology journals exist (Table I); (2) these journals are commonly ranked by

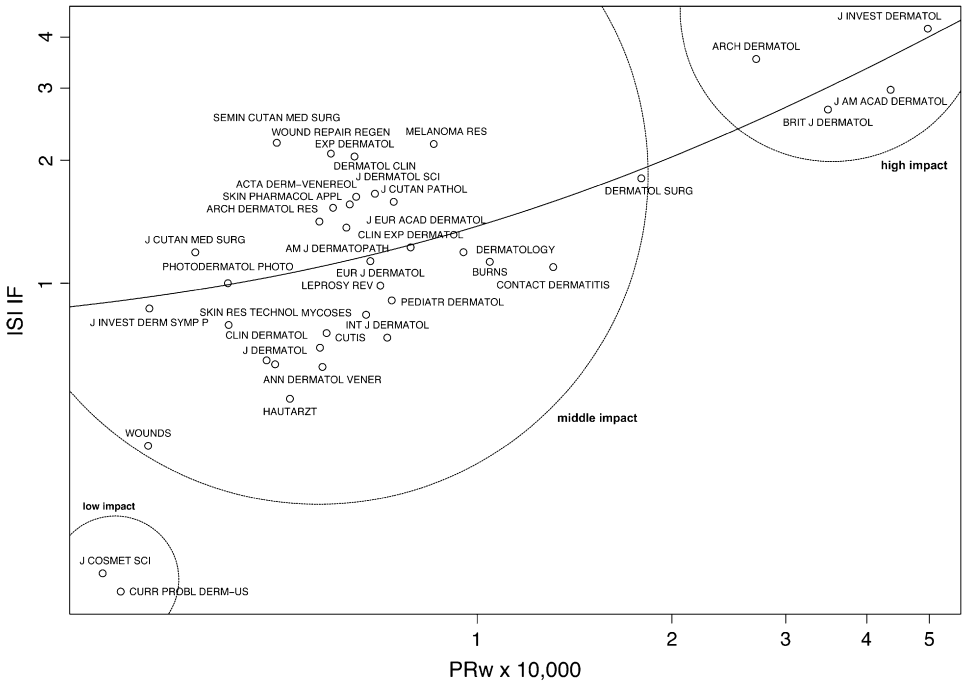

Fig 2. Journal impact factor (*IF*) and weighted PageRank (*PRw*). Scatter plot displays journal PRw (x-axis) and IF (y-axis). Diagonal line predicts relationship between IF and PRw. Journals below line have lower IF than would be statistically predicted by PRw, and journals above line have higher IF than would be statistically predicted by PRw. Spearman rank order correlation between PRw and IF was +0.65 (+1 is maximal) a sample highly significant, positive relationship; ie, high IF generally corresponds with high PRw.

IF, which measures how often journal articles are cited; (3) IF increasingly is used in objective surrogate performance measures that affect the hiring, promotion, funding, and publication decisions of academics (including academic dermatologists) and editors (including dermatology editors); and (4) IF rankings may be improved by the same technology that improved Internet search engines (PageRank).

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