

Citation patterns in tropical medicine journals

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Summary

Selections of most important journals in the field of tropical medicine have previously been identified with the help of resources such as bibliographical and citation databases. This article uses ISI's Journal Citation Reports (JSR) for 2002 to analyse the citation characteristics of the Tropical Medicine category. According to these data, this small but diverse group of 12 journals bestows some 40% more citations than it receives. Its six typical core journals tend to cite one another heavily, but they also refer a lot to multidisciplinary science and general medicine journals, and to infectious diseases and parasitology journals. Looking at the sources from which JCR's tropical medicine journals derive their citations, it is clear that in this reverse direction, the specialty's literature is still more concentrated. Apart from the typical core, this JCR category also contains a number of journals with more idiosyncratic citing patterns, focused on specialties such as paediatrics, a single disease (leprosy) and a representative of Latin American and Francophone biomedical science each. Implications of concentrated citedness and language biases are discussed briefly. This paper features a selection of bibliometric parameters relating to the tropical medicine journals and lists of the 80 journals most citing and cited by them.

keywords tropical medicine, biomedical literature, journals, bibliometrics, citation analysis, Journal Citation Reports

Introduction

Which are the most important journals in the field of tropical medicine? This question has previously been tackled from various angles. Apted and Glanville (1977) gave a thorough survey of the specialty's major documentary resources, identifying the major journals, textbooks and bibliographies, but refrained from quantitative or comparative issues. Brennen and Davey (1978) offered a concise historical survey and analysed the journals indexed in four years (1972–1975) of *Tropical Diseases Bulletin* (TDB). They concluded that the literature of tropical medicine was fairly concentrated. As such it conforms to the ubiquitous journal distribution described by Bradford (1948). This allowed them to identify a group of 61 core journals producing the bulk of the tropical medicine literature. Garcia Diaz *et al.* (1980) made a comparable investigation for the year 1977. Roelants (1987) used the Journal Citation Reports (JCR) derived from the Science Citation Index (SCI), both produced by the Institute for Scientific Information (ISI), to investigate the relationship between the specialized tropical medicine journals and those beyond this group. Analysing which journals are cited most by the 10 principal journals of this core, he concluded that the general medical, multidisciplinary, infectious diseases and parasitology journals accounted for a remarkably large impact. This effort also resulted in a list

of 50 most important journals for tropical medicine. The inverse relationship, i.e. what journals were citing the tropical medicine core, has not yet been investigated.

Journal Citation Reports and journal impact factors

Almost two decades later, it seems worthwhile to take a look at the current situation. One has to bear in mind that ISI's SCI source journals selection and its allocation of journals to subject categories are prone to change. For one, there has been the merger of four tropical medicine journals of long standing into *Tropical Medicine & International Health* (TM & IH).

Other changes since the 1980s include the addition of two leprosy journals that used to be harboured in JCR's Infectious Diseases category [*International Journal of Leprosy* (*I J Leprosy*) and *Leprosy Review*]. As will be demonstrated, such highly focused journals feature rather idiosyncratic citing characteristics. Also the Latin American *Memórias do Instituto Oswaldo Cruz* (*Memórias*) and the French *Bulletin de la Société de Pathologie Exotique* (*Bulletin SPE*) have meanwhile been added to the tropical medicine core. Conversely, *Revista do Instituto de Medicina Tropical de São Paulo* and the *Papua New Guinea Medical Journal* have dropped out of the JCR selection.

One can easily think of several other tropical medicine related journals that would (partially) fit in. Some, like the

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Bulletin of the World Health Organization (Bulletin WHO), *Indian Journal of Medical Research* and the *South African Medical Journal* are listed in the JCR, but not in the tropical medicine category. Others, such as *Médecine Tropicale*, *East African Medical Journal*, *Revista Panamericana de Salud Pública*, and many other regional journals are not used as SCI source journals at all. But as ISI's selection policy is inherently restrictive and exhaustivity is clearly no aim, working with JCR data necessarily implies accepting such handicaps.

Moreover, tropical medicine as a specialty is somewhat difficult to define sharply. On a broader level, one may, for instance, wonder whether parasitology and infectious diseases journals cannot also in an appreciable proportion be considered tropical medicine journals – as is more or less implied by Roelants' (1987) conclusions. However, such journals tend to be filled only partially with tropical medicine issues, while the larger proportion covers subjects quite alien to our field.

For our current analysis, we make use of the most recently published JCR, i.e. relating to the year 2002. Inevitably, these awesome data powerhouses feature a number of logistic limitations and minor inaccuracies, but in as far as is practically possible the present calculations try to remedy such shortcomings.

The impact factor (IF) is basically the ratio between the number of articles published in recent years, and the number of citations these articles have received during the current year. Ample conceptual and technical objections have been raised against the IF – especially when used as a research assessment tool. Such methodological discussions have been dealt with extensively in earlier papers (Schoonbaert, Roelants 1996 and dozens of others). The current contribution focuses on more practical issues.

Table 1 shows a survey of the current JCR tropical medicine journals, with a selection of bibliometric parameters and the available data for a number of previously indexed journals. The first column lists the number of articles published during 2002 and thus allows for a rough comparison of sheer size. The second column indicates how often each journal has been cited during 2002 by JCR's source journals. This is obviously an indicator of a journal's overall influence. According to this parameter, the *American Journal of Tropical Medicine and Hygiene (AJTMH)* and the *Transactions of the Royal Society of Tropical Medicine and Hygiene (Transactions)* leave *TM & IH* far behind them. Also the *Memórias* received slightly more citations than *TM & IH*. To be fair, the citations gathered by *TM & IH*'s various predecessors should be added here. This amount cannot readily be derived without analysing the citing behaviour of all 7000 JCR source journals, but already over 300 citations can be identified

starting from the 12 core journals only, moving *TM & IH* well into the top four most cited tropical medicine journals.

Obviously, older journals are at an advantage here as they have many more citable items. This imbalance is partially mitigated in the next column, where only citations to articles published during 2000 and 2001 are counted. Next to self-citations/citedness percentages, IFs from 2002 going back to 1995 are listed. On average, the tropical medicine IFs rise during this 8-year period, but this may reflect a general trend, partially due to increased database coverage and evolving citation habits. Also, some of the weaker titles have meanwhile vanished from this category.

During the review process of this paper the 2003 JCR's were published. With IFs over 2.1, the top three tropical medicine journals are now closer together than ever. As every year, there are some fluctuations in the IF values for the 12 journals, but the relative positions do not change spectacularly. For both the *Transactions* and *TM & IH*, which now finds itself in pole position, there's a significant IF improvement of more than 20%. Also *Annals of Tropical Paediatrics* gets a relatively steep IF rise, while the *I J Leprosy* IF declines to 2001-like values. For the first time, the average of the 12 IFs exceeds 1. The 2003 IFs have been added to Table 1, but the citation data could obviously not be included in this paper, without redoing the entire study.

Tropical medicine core journals as citers

In 2002, the reference lists of the 12 core journals featured 32 514 citations. Table 2 lists the top 80 journals receiving these citations. Eight of our core journals belong to the first 13 items in this ranking, and together they received 6089 citations (18.7%). Conforming with Roelants' (1987) findings, the upper part of this list is completed by predominantly parasitology, infectious diseases, general medicine and multidisciplinary science journals. Once more, *The Lancet* features a remarkably high score. It outshines all but two of our own core journals and has moved up from fifth place in 1985 to third place in 2002. Broad spectrum journals in this list include *Proceedings of the National Academy of Sciences of the USA*, *New England Journal of Medicine (NEJM)*, *British Medical Journal (BMJ)*, *Science*, *Nature* and *Journal of the American Medical Association (JAMA)*. Other important non-core journals are *Journal of Infectious Diseases*, *Journal of Clinical Microbiology*, *Bulletin WHO* and *Parasitology Today* (including *Trends in Parasitology*). Some of the more prominent journals making it into this list do not themselves belong to the JCR source journals but are nevertheless highly cited by the tropical medicine core: *Southeast Asian Journal of Tropical Medicine and Public*

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Table 1 Selected parameters of JCR tropical medicine journals

Abbreviation	2002 Articles	Total cites	Recent cites*	Self-citing (%)	Self-cited (%)	JIF 2003†	JIF 2002	JIF 2001	JIF 2000	JIF 1999	JIF 1998	JIF 1997	JIF 1996	JIF 1995
Acta Trop	118	1473	309	4.10	8.48	1.336	1.332	1.045	0.799	1.000	0.953	0.891	1.076	1.240
Am J Trop Med Hyg	252	8664	852	12.07	9.91	2.105	2.063	2.126	1.765	1.932	2.086	1.964	1.910	1.822
Ann Soc Belg Med Trop												0.676	0.313	0.500
Ann Trop Med Parasitol	93	1875	178	6.45	6.40	1.010	0.978	1.049	0.988	0.989	0.928	0.901	0.819	0.835
Ann Trop Paediatr	55	456	45	3.45	8.99	0.704	0.429	0.243	0.413	0.383	0.423	0.411	0.349	0.296
Bull Soc Pathol Exot	73	505	38	5.33	12.48	0.183	0.236	0.368	0.151	0.290	0.220	0.198		
Int J Lepr	18	610	52	17.92	33.77	0.674	0.963	0.648	1.114	0.824	0.714	0.784	0.538	0.547
J Trop Med Hyg												0.916	0.683	0.523
J Trop Pediatr	75	571	64	2.65	7.18	0.514	0.413	0.425	0.447	0.297	0.375	0.288	0.297	0.342
Lepr Rev	44	563	123	20.98	41.56	0.907	1.017	0.720	1.343	0.954	0.746	0.607	0.477	0.464
Mem Inst Oswaldo Cruz	254	1714	257	7.41	28.06	0.688	0.635	0.643	0.542	0.636	0.474	0.440	0.314	
P N G Med J												0.054	0.054	0.014
Trans R Soc Trop Med Hyg	97	5145	569	10.22	4.72	2.114	1.724	1.693	1.485	1.781	1.676	1.535	1.631	1.149
Trop Doct	83	293	59	3.41	11.95	0.347	0.330	0.302	0.282	0.198	0.275	0.234	0.217	0.122
Trop Geogr Med												0.363	0.320	0.309
Trop Med Int Health	132	1457	483	4.70	12.36	2.156	1.796	1.500	1.350	1.560	0.997	0.980	0.976	0.748
Trop Med Parasitol												0.895	0.976	0.748
Average	107.8	1943.8	252.4	8.22	15.49	1.062	0.993	0.897	0.890	0.904	0.822	0.755	0.665	0.637

* 2000 + 2001 articles.

† The 2003 JIFs were added afterwards (see text).

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D. Schoonbaert **Citation patterns in tropical medicine journals****Table 2** Journals cited by the tropical medicine core journals numbers 1–80

Number of citations received	Cited journal	Rank citing the core journals*	Rank cited by the core journals* see Table 3	Rank in Roelants (1987)*	Rank in Brennen & Davey (1978)*
1846	The American Journal of Tropical Medicine and Hygiene	1	1	1	2
1433	Transactions of the Royal Society of Tropical Medicine and Hygiene	2	5	2	1
811	Lancet	3	31	5	16
659	Memórias do Instituto Oswaldo Cruz	4	2		
619	The Journal of Infectious Diseases	5	13	13	24
554	Annals of Tropical Medicine and Parasitology	6	6	3	7
540	Journal of Clinical Microbiology	7	11	31	
470	Bulletin of the World Health Organization	8	32	4	4
426	Tropical Medicine & International Health	9	3		
410	Leprosy Review	10	8		28
402	Parasitology Today [including Trends in Parasitology]	11	9		
383	International Journal of Leprosy	12	10		25
378	Acta Tropica	13	4	20	42
363	Parasitology	14	17	14	28
293	Infection and Immunity	15	21	11	26
293	Molecular and Biochemical Parasitology	15	33	25	
276	Journal of Immunology	17	51	9	52
270	Proceedings of the National Academy of Sciences of the USA	18	63	29	
246	New England Journal of Medicine	19	35	24	54
222	British Medical Journal	20	56	16	23
221	Journal of Medical Entomology	21	12	21	14
217	Journal of Parasitology	22	16	6	3
210	Experimental Parasitology	23	27	10	5
202	Revista do Instituto de Medicina Tropical de São Paulo	24		12	12
194	Clinical Infectious Diseases	25	14		
192	Science	26		15	
165	AIDS	27			
165	Nature	27	56	8	20
161	The Southeast Asian Journal of Tropical Medicine and Public Health	29		37	6
138	International Journal of Parasitology	30	7	40	18
137	Indian Journal of Leprosy	31			
135	Revista da Sociedade Brasileira de Medicina Tropical	32			36
132	Parasite Immunology	33	56	45	
130	Bulletin de la Société de Pathologie Exotique	34	36	17	10
127	World Health Organization Technical Report Series	35		35	
126	JAMA	36	79	43	47
124	Social Science and Medicine	37	70		
121	The Pediatric Infectious Disease Journal	38	65		
112	Antimicrobial Agents and Chemotherapy	39			
110	The Journal of Experimental Medicine	40		19	
110	Pediatrics	40			
106	Medical and Veterinary Entomology	42	25		
105	The American Journal of Clinical Nutrition	43		48	22
105	Morbidity and Mortality Weekly Report	44			
97	Emerging Infectious Diseases	45			

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Number of citations received	Cited journal	Rank citing the core journals*	Rank cited by the core journals* see Table 3	Rank in Roelants (1987)*	Rank in Brennen & Davey (1978)*
95	American Journal of Epidemiology	46		23	
92	Clinical Experimental Immunology	47		28	
88	Annals of Tropical Paediatrics	48	49		
87	Journal of Pediatrics	49			55
86	Journal of Tropical Medicine and Hygiene	50		25	13
82	East African Medical Journal	51		27	17
81	International Journal of Epidemiology	52	75		
80	Vaccine	53	44		
79	Journal of the American Mosquito Control Association	54	69		
79	Tropical Medicine and Parasitology	54		7	11
78	Medical Tropics	56		50	34
78	Weekly Epidemiological Record	56			
76	Journal of Tropical Pediatrics	58	45		37
76	Virology	58	65		
75	Archives of Disease in Childhood	60			
75	Indian Pediatrics	60			
74	Journal of Medical Virology	62			
74	Tropical Doctor	62	59		
72	The Journal of Biological Chemistry	64	52	33	
72	Parasitology Research [+ Zeitschrift für Parasitenkunde]	64		34	32
71	Annals of Internal Medicine	66		40	
71	Clinical Microbiology Reviews	66	29		
68	Advances in Parasitology	68	34	48	
66	South African Medical Journal	69			19
66	Veterinary Parasitology	69	18		
64	Journal of Virology	71	43		
64	Tropical and Geographical Medicine	71		30	15
62	Annales de la Societe belge de medecine tropicale	73		17	40
62	Epidemiology and Infection	73	52		
58	Bulletin of Entomological Research	75		31	35
58	K-Cell	75			
56	Revista de Saude Publica	77			
54	Health Policy and Planning	78			
53	Nucleic Acids Research	79			
52	The Journal of General Virology	80			

*As the different rankings comprise 25 years, several titles are relatively new or have ceased publication.

Health, Revista da Sociedade Brasileira de Medicina Tropical and *WHO Technical Report Series*.

The number of different journals cited by our core journals during 2002 ranges from 336 for *I J Leprosy* to 1903 for *Memórias*. Because of obvious overlap, the total number cited by the tropical medicine category cannot be determined accurately, but it must clearly be over 2000. Yet with just the first 71 journals (3.5%) in this list over 50% of the 32 514 citations are captured. The first 11 journals (0.5%) together receive over 25% of all citations. This clearly illustrates a fair degree of concentration.

Within the group of 12 core journals different types of citing behaviour can be observed: half of them may be called

typical in that they feature significantly more references than the other six and tend to cite one another highly: *Acta Tropica*, *AJTMH*, *Annals of Tropical Medicine and Parasitology*, *Transactions* and *TM & IH*. Up to a point, *Memórias* can also be considered part of this group, but it has somewhat peculiar citing customs, as will be discussed below. *AJTMH* and *Transactions* invariably end up in the top three of journals most cited by members of this subgroup, and the remaining four are generally well within the top 20 (Table 4). Together these six journals receive 5296 citations (16.3%). Self-citing ranges from 4.1% to 12.1%, which can hardly be called excessive. Moreover, for the stronger journals a certain degree of self-citing seems quite natural.

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The two leprosy journals, with a highly specific nature, evidently show an atypical citing pattern. *I J Leprosy* and *Leprosy Review* predominantly cite themselves and one another. To a lesser degree they are oriented towards a number of other leprosy and dermatology journals, which are relatively less popular targets for the other core journals. If only citations to the remaining tropical medicine core journals are counted, it is clear the two leprosy journals have only the slightest attention for our specialty.

The two paediatric journals (*Annals of Tropical Paediatrics* and *Journal of Tropical Pediatrics*) present an atypical citing profile, too. Understandably, they rely heavily on other paediatric journals, but in contrast to the leprosy journals they do not feature excessive self-citing. *Tropical Doctor*, more practice than research oriented, is the smallest citer of the 12 core journals. It grants 1025 citations, less than 4% of which point to the other core journals (i.e. excluding self-citations).

Memórias, with 6489 citations markedly the second biggest citer of the 12 core journals, almost singlehandedly puts the Latin American biomedical literature on the international tropical medicine map. Yet apart from the obvious regional bias, most of the journals it cites are familiar from the citation lists of the other core journals. The French literature finds itself in a similar position. The *Bulletin SPE* is its only representative in this category, and its top 10 most cited journals features titles not frequently cited by the other (Anglophone) core journals: *Médecine Tropicale*, *Médecine d'Afrique Noire*, and *Médecine et Maladies Infectieuses*.

Tropical medicine core journals receiving citations

The 12 tropical medicine core journals were cited 23 326 times by the JCR source journals during 2002. Generally speaking, they are being cited roughly 30% less than they themselves cite publications. Table 3 is the counterpart of Table 2 in that it lists the top 80 journals citing the 12 core journals. The same eight journals are now all within the top 10 of most cited journals and together they receive 6101 citations (26.2%).

While more or less the same citing behaviour issues are at stake here, it is clear that from the citedness perspective the tropical medicine literature is even more strongly concentrated. The number of different citing journals now ranges from 86 (*Leprosy Review*) to 830 (AJTMH). Hence for the 12 core journals taken together there are probably over 1000 citing journals. This time only 29 journals or less than 3% are needed to gather half of the 23 326 citations received, and a mere seven journals (<1%) capture almost a quarter of this total.

The citations received from non-core journals again come predominantly from parasitology (*International*

Table 3 Journals citing the tropical medicine core journals: 1–80

Rank	Citations given to the tropical medicine core	Citing journal
1	1544	American Journal of Tropical Medicine and Hygiene
2	967	Memórias do Instituto Oswaldo Cruz
3	873	Tropical Medicine & International Health
4	722	Acta Tropica
5	647	Transactions of the Royal Society of Tropical Medicine and Hygiene
6	552	Annals of Tropical Medicine and Parasitology
7	440	International Journal of Parasitology
8	414	Leprosy Review
9	400	Trends in Parasitology
10	382	International Journal of Leprosy
11	367	Journal of Clinical Microbiology
12	363	Journal of Medical Entomology
13	297	Journal of Infectious Diseases
14	293	Clinical Infectious Diseases
15	281	Current Topics in Microbiology and Immunology
16	270	The Journal of Parasitology
17	267	Parasitology
18	257	Veterinary Parasitology
19	254	Antimicrobial Agents and Chemotherapy
20	248	Emerging Infectious Diseases
21	240	Infection and Immunity
22	219	Parasitology Research
23	218	The Lancet Infectious Diseases
24	211	Microbes and Infection
25	195	Medical and Veterinary Entomology
25	195	NATO Sc Sc SS I L
27	194	Experimental Parasitology
28	190	Chemical Immunology
29	181	Clinical Microbiology Reviews
30	179	Clinical and diagnostic laboratory immunology
31	174	Lancet
32	158	Bulletin of the World Health Organization
33	142	Molecular and Biochemical Parasitology
34	129	Advances in Parasitology
35	126	The New England Journal of Medicine
36	125	Bulletin de la Société de Pathologie Exotique
37	115	Parasite
38	110	Current Opinion in Infectious Diseases
39	109	Journal of Medical Virology
40	101	Current Pharmaceutical Design
41	98	Annals of the New York Academy of Sciences
42	96	Clinics in Chest Medicine
43	95	Journal of Virology
44	93	Vaccine
45	87	International Journal of Dermatology
45	87	Journal of Tropical Pediatrics
47	83	Clinical and Experimental Immunology
48	75	Archives of Medical Research
49	74	Annals of Tropical Paediatrics
49	74	Health Policy and Planning
51	73	Journal of Immunology
52	71	Epidemiology and Infection
52	71	The Journal of Biological Chemistry
54	68	Journal of Travel Medicine
55	67	Saudi Medical Journal
56	66	British Medical Journal
56	66	Nature

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Table 3 Continued

Rank	Citations given to the tropical medicine core	Citing journal
56	66	Parasite Immunology
59	65	Tropical Doctor
60	64	The International Journal of Tuberculosis and Lung Disease
60	64	Parasitology International
62	63	Diagnostic microbiology and infectious disease
63	62	Proceedings of the National Academy of Sciences of the USA
64	60	Nestle Nutrition Workshop Series
65	54	Journal of Helminthology
65	54	Pediatric Infectious Disease
65	54	Virology
68	52	European Journal of Clinical Microbiology
69	51	Journal of the American Mosquito Control Association
70	49	Insect Biochemistry and Molecular Biology
70	49	Social Science & Medicine
72	48	Medecine et Maladies Infectieuses
72	48	Scandinavian Journal of Infectious Diseases
74	47	Primary Care
75	44	International Journal of Epidemiology
75	44	Public Health Nutrition
77	42	Cellular and Molecular Life Sciences
77	42	The Journal of Infection
79	41	JAMA
80	39	Drug News & Perspectives
80	39	Insect Molecular Biology

Journal for Parasitology, Trends in Parasitology, Journal of Medical Entomology, Journal of Parasitology, Parasitology, Veterinary Parasitology) and infectious diseases journals (*Journal of Clinical Microbiology, Journal of Infectious Diseases, Clinical Infectious Diseases, Current Topics in Microbiology*).

The impact of multidisciplinary and general medicine journals, however, is far less outspoken. The striking ranking difference for *The Lancet* (31 instead of three) speaks for itself. Of the other major representatives *NEJM* still grants well over 100 citations to our core journals, but *Nature, BMJ, JAMA* and *Science* give them appreciatively less. A major medical journal like *Annals of Internal Medicine* cites the tropical medicine core journals a mere three times. So the relationship is fundamentally unbalanced – which is not that surprising. For certain topics it is even self-evident that the citing influence is mainly uni-directional (e.g. for journals like *AIDS, Bulletin of Entomological Research*). It is remarkable though, that the *Bulletin WHO*, with rank eight in Table 2, does not figure in the top 30 of Table 3. In the other direction, *The Lancet Infectious Diseases*, which as a newcomer necessarily is still missing from Table 2, clearly displays keen attention for the tropical medicine journals. As such, it partially makes up for

the lower interest its parent *The Lancet* shows, and holds a promise for growing overall visibility of our specialty.

As from the citing perspective, the 12 core journals feature a number of different citedness patterns: the same six heavily rely upon one another for collecting citations. As they generally feature within each other's citer top eight, and together constitute the complete top six of this list, their central position is markedly stronger here than where their citing behaviour is at stake (Table 4). Together they receive 5305 citations (22.7%). Self-citedness ranges from 4.7% to 12.4% – excepting the *Memórias*, with a steep 28.1% – which again is quite acceptable.

Citations to the journals that merged into *TM & IH* should also be added to this core: *Annales de la Société Belge de Médecine Tropicale, Journal of Tropical Medicine and Hygiene, Tropical and Geographical Medicine, Tropical Medicine and Parasitology*, and their former names like *Tropenmedizin und Parasitologie* and *Zeitschrift für Tropenmedizin und Parasitologie*. These essentially older publications still receive 320 citations from the core group (not counting references from other journals). This may conform to only 1.4% of references received by the core, but can be seen as an indication that the much older literature is not yet fully obsolete. It would be interesting to investigate the nature of this influence more closely.

For receiving citations, the two leprosy journals depend even more strongly upon themselves. Discounting self- and mutual citations, they would virtually be obliterated from the list of journals cited by the tropical medicine core journals. Also the paediatric journals present a somewhat different profile. Both groups receive relatively few citations. *Tropical Doctor* got 293 citations during 2002, a mere 30 of which are coming from its category peers.

The Latin American journals strongly depend on their sole representative *Memórias*. If this journal were disregarded, not only itself, but also several other Latin American journals like *Revista do Instituto de Medicina Tropical de São Paulo* and *Revista da Sociedade Brasileira de Medicina Tropical* would fall back to far lower places in the rankings – the latter two evidently also being disadvantaged in not or no longer being JCR source journals.

French language journals are also disadvantaged, partly by JCR's language bias, partly by harsh international realities. The journals citing the *Bulletin SPE* do not differ much from those citing its Anglophone peers, but this may be a side-effect of the limited number of French language journals within JCR's source collection. Adding journals like *Cahiers Santé* and *Médecine Tropicale* to the core might somewhat alter this picture. But then again, such journals are apparently hardly being cited by the English language core journals. Journals such as *Parasite* and *Microbes AND Infection* both are JCR source journals and

D. Schoonbaert **Citation patterns in tropical medicine journals****Table 4** Relative ranking of journals citing and cited by the 12 core journals

Citing/cited journal	AT	AJTMH	ATMP	ATP	BSPE	IJL	JTP	LR	MIOC	TRSTMH	TD	TMIH
Acta Tropica	3 (1)	1 (3)	7 (7)	* (*)	49 (29)	* (*)	* (*)	* (*)	4 (2)	2 (4)	* (*)	15 (6)
The American Journal of Tropical Medicine and Hygiene	22 (6)	1 (1)	6 (13)	* (*)	* (*)	* (*)	* (*)	* (*)	19 (3)	2 (6)	* (*)	17 (2)
Annals of Tropical Medicine and Parasitology	8 (5)	3 (2)	2 (1)	* (*)	32 (49)	* (*)	* (*)	* (*)	39 (6)	1 (3)	28 (*)	5 (4)
Annals of Tropical Paediatrics	* (12)	41 (6)	* (37)	4 (1)	* (37)	* (*)	* (2)	* (*)	* (*)	* (16)	* (16)	* (8)
Bulletin de la Société de Pathologie Exotique	14 (11)	10 (2)	23 (8)	* (*)	1 (1)	* (*)	* (*)	* (*)	* (11)	* (11)	6 (11)	* (2)
International Journal of Leprosy	* (*)	46 (8)	* (*)	* (*)	* (*)	1 (1)	* (*)	2 (2)	* (*)	24 (*)	* (*)	* (8)
Journal of Tropical Pediatrics	* (*)	34 (22)	* (*)	* (4)	14 (*)	* (*)	3 (1)	* (32)	* (*)	22 (*)	* (*)	40 (7)
Leprosy Review	* (*)	23 (20)	39 (*)	* (*)	* (*)	2 (2)	* (*)	1 (1)	* (*)	13 (5)	* (5)	20 (20)
Memórias do Instituto Oswaldo Cruz	17 (2)	2 (3)	18 (34)	* (*)	* (*)	* (*)	* (*)	* (*)	1 (1)	5 (13)	* (*)	* (*)
Transactions of the Royal Society of Tropical Medicine and Hygiene	7 (4)	2 (1)	4 (5)	* (*)	40 (37)	* (*)	* (*)	* (*)	22 (8)	1 (3)	* (*)	10 (2)
Tropical Doctor	* (*)	26 (9)	36 (3)	36 (11)	* (24)	* (*)	* (*)	* (*)	18 (*)	* (8)	2 (1)	* (4)
Tropical Medicine & International Health	13 (6)	2 (2)	6 (3)	* (*)	29 (*)	* (*)	41 (49)	* (39)	* (25)	1 (5)	47 (*)	3 (1)

Numbers: rank in list of journals most cited by the (horizontal) citing journal.

Numbers between brackets: rank in list of journals most citing the (horizontal) cited journal.

* Not among the first 50 items in the active citation list.

recent title changers, and, although originally French, they now publish most of their articles in English. They are fairly heavy citers of the tropical medicine core, yet are virtually absent as targets in Table 2. Regional or local journals are in a predicament comparable with the Francophone and Latin American journals, as is pointed out by some of the examples listed earlier.

Discussion

The literature of tropical medicine is clearly being noticed and actively used by its researchers. The journals of the core group display a fair amount of interest in each other's papers, yet eyes are not closed for pertinent literature published in general medical and multidisciplinary journals or in those of related specialties such as parasitology. The imbalance between citations given and citations received may suggest that publishing tropical medicine research outside of the specialty's journals may benefit the visibility of individual articles. The tropical medicine researchers, undoubtedly helped by a.o. modern current awareness services, are not likely to miss such papers and – at least if the target journal has the necessary status and database coverage – it has a better chance of being noticed by an additional audience. This may then result in higher citedness (i.e. if picked up by others), or accrue collateral assessment advantages (e.g. higher IFs). Publishing in tropical medicine journals of lower status and/or non-English language may have the unpleasant contrary effect – at least for the authors. As such, this seems like another illustration of the somewhat perverse Matthew effect (Merton 1968), stating that most is given to those

who already have. This is strengthened further by the fact that high impact journals, by their visibility and their impact, can attract worthwhile papers relatively easily, so they can permit themselves to be highly selective.

But this phenomenon is unlikely to be unique for the tropical medicine literature. Many specialties will experience a redirection of part of the ground-breaking results to more general or multidisciplinary journals. Elucidation of this point is not within the scope of this somewhat speculative section – but if this were not the case, how would journals like *Nature* and *Science* manage to have IFs far beyond the averages of any specialty? From a practical – and even strategic – point of view, one can wonder whether such a concentration of top papers published in high-impact journals is not a blessing rather than a curse for both readers and authors. On the other hand, publishing outside the specialty in order to consciously search for bibliometric glory may not seem like an honourable thing to do. But, as stated before, selectivity forms a built-in check on this transition and the internal cohesion of the (typical) core journals suggests a true sense of scientific community. A more serious problem would be the abandonment of certain subjects because of their low bibliometric potential. If smaller, modestly or slowly citing research areas need to enter into open competition with the larger, highly citing ones, this may result in neglected and unviable journal categories, and the impoverishment of the scientific ecosystem.

Authors from developing countries regularly complain they experience difficulties in publishing their research findings in Western top journals. Language bias or stylistic issues may often lie at the basis of this apparent

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discrimination (Horton 2003; Maisonneuve *et al.* 2003; Obuaya 2003). The loss is bidirectional (Gibbs 1995). The citation patterns of French and Latin American core journals endorse this point. Such problems are especially relevant for a discipline such as tropical medicine, both because of its core subject and its intensive international scientific collaboration. Does this not imply a special role for the tropical medicine journals as a haven for sound research difficult to publish in Western-centered high impact journals? It might be interesting to compare the distribution of author addresses in the tropical medicine journals to that of some top medical or multidisciplinary journals.

It would also be interesting to view the trends identified here in a broader context. Most of our core journals now also belong to another, far broader JCR category called 'Public, environmental and occupational health'. With 90 journals instead of 12, this would logistically be a massive task. Moreover, while only 12 source journals to characterize the field's literature may seem overly selective, many of the 90 journals of the broader category may not be relevant choices for this purpose.

Finally, the analysis of citation patterns at best reflects the explicit use of published results in subsequent research, not the overall impact of a journal. The substantial influence on clinical care, for instance, may not be duly captured by citation studies. Equally, the impact of local and regional journals, largely responsible for the wide dissemination (including translation) of medical knowledge, is ignored.

Conclusions

- The core journals of the JCR tropical medicine category are cited some 30% less than they cite.
- Although they feature different types of citing behaviour, the typical core journals heavily cite one another.
- They also refer a lot to parasitology, infectious diseases, multidisciplinary science and general internal medicine journals.
- This relation is not bidirectional: the citations the tropical medicine core journals receive are far more concentrated upon themselves. Broad science and medicine journals are far less interested in the tropical medicine journals than vice versa. Therefore, it makes sense strategically to publish results in non-specialist journals with high visibility.
- Apart from the typical core, the JCR's tropical medicine category contains a number of journals with divergent citing patterns, focused on specialties such

as paediatrics, single diseases, like leprosy, and a representative of both Latin American and Franco-phone biomedical science.

- Citation analysis can provide meaningful insights in both internal and external influences on this research area. It cannot, in its present format, take account of all the relations of a specialty's published literature, especially one as geographically encompassing as tropical medicine.

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