

Trends in the core literature on tropical medicine: A bibliometric analysis from 1952–2002

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The medical specialty of “tropical medicine” only dates back a little more than 100 years and, in the meantime, has gone through several quite distinctive eras. The aim of our study was to investigate trends that occurred in the leading literature on tropical medicine over the past 50 years. We analysed 2,802 original articles published in 1952, 1962, 1972, 1982, 1992 and 2002 in five of the high impact factor journals, namely (i) *Acta Tropica*, (ii) *American Journal of Tropical Medicine and Hygiene*, (iii) *Annals of Tropical Medicine and Parasitology*, (iv) *Leprosy Review*, and (v) *Transactions of the Royal Society of Tropical Medicine and Hygiene*. Authors’ country affiliations were categorized according to the human development index 2003 (HDI), with stratification into low, medium and high HDI. We observed the following trends: First, there was a strong increase in the number of articles published from 250 in 1952 to 726 in 2002. Second, over the same time span, the median number of authors per article increased from 1 (four journals) or 2 (*American Journal of Tropical Medicine and Hygiene*) to 2.5 (*Leprosy Review*) up to 6 (*Acta Tropica* and *American Journal of Tropical Medicine and Hygiene*). Third, research collaborations between countries of different HDI ranks increased concomitantly – in 2002, 19.4–43.7% of all manuscripts comprised authors from different HDI countries – indicating that tropical medicine has become a global endeavour. However, in four of the five journals investigated, the overall percentage of researchers affiliated with low HDI countries decreased over the past 50 years and only a slight positive trend can be observed over the last decade. Concluding, current roadblocks should be identified and programmes designed and implemented to enhance equity of publishing in tropical medicine. This in turn might be an important step forward to substantially reduce the current burden of tropical diseases, so that social and economic development in the tropics and subtropics can be advanced and poverty alleviated.

Introduction

Only one century ago the medical specialty of “tropical medicine” officially emerged. It came after many decades of European activities overseas and numerous reports of the loss of whole crews from trading expeditions to the tropics (VAN DER BRUG, 1997). The colonialization of the tropics and an increase of international trade were key factors that triggered the establishment of this medical sub-discipline

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(WARREN, 1990; KORTE, 1997). Strong economic interest was a constant driver of tropical medicine research, since the developing world provides a huge market for exports and supplies the US and Europe with imports of natural resources, e.g. petroleum (MACY, 1954; UTZINGER et al., 2005). Devastating epidemics occurred among the new settlers of overseas territories, the army and the colonial servants, since they were highly susceptible to infectious disease agents. Hence, there was a need to enhance fundamental knowledge on the epidemiology of these diseases. At the beginning, emphasis was placed to meet the medical needs of colonial officers, troops and immigrant settlers, to protect their lives while serving and living abroad. Laborers were another group receiving special attention, as they were responsible for economic development (MANDERSON, 1999).

Patrick Manson, Louis Pasteur, Alphonse Laveran, Robert Koch and Ronald Ross were among the pioneers who made major advances and helped to provide further rationale for tropical disease research and laid the foundation for prevention and control (GILLES & LUCAS, 1998). Several research institutes in the colonies were established, and the opening of many European tropical medicine schools facilitated training of personnel for services overseas. The first two journals in the field of tropical medicine were launched in the year 1907, namely *Annals of Tropical Medicine and Parasitology* and *Transactions of the Royal Society of Tropical Medicine and Hygiene* (MULLIGAN, 1981). In contrast to the extensive European colonization, the American involvement in the tropics was mostly focused on the Caribbean and the Philippines. In the US the early history of tropical medicine was closely related to the armed forces and military activities, commencing with the Spanish-American War, and had a strong focus on malaria and yellow fever (MOSTOFI, 1968; WARREN, 1990). Major contributions in the field of military medicine were made by Walter Reed, William Gorgas and Josiah Nott among others (MOSTOFI, 1968).

In the first decades of the 20th century, the etiology of several infectious diseases pervasive in the tropics was discovered and described. Sound research on disease reservoirs and vectors, increasingly taking place also in developing countries, alongside the development of novel tools and vector control strategies were key factors for a better understanding of tropical diseases (LUMSDEN, 1975; MULLIGAN, 1981; WARREN, 1990; GREENWOOD, 1998).

The independence of the colonies commencing in the late 1950s/early 1960s, characterized on the one hand by the process of local appointments and self-governance, and on the other hand by political instabilities and the decline of research expenditures, led to a gradual deterioration of the science infrastructure in the former colonies. Institutional capacity building at the primary, secondary and tertiary level weakened, which in turn resulted in a decline of high-level national scientists in low human development index (HDI) countries. In the developed world the medical discipline of tropical medicine expanded rapidly, as not only parasitic disease research

flourished, but also the major importance of bacterial and viral infections were revealed and public health programmes expanded. Due to its broad interdisciplinary nature, tropical medicine transformed into influential specialties of tropical, public, environmental, global or international health (WARREN, 1990).

To our knowledge, a trend analysis of the authors' share from different HDI ranked countries over the past half century, which might reflect historical and contemporary developments that took place, has yet to be done in the tropical medicine literature. An attempt is made here to fill this gap by carrying forward a bibliometric analysis of selected tropical medicine journals with the highest impact factors that have been launched at least 50 years ago. We have counted both the number of articles and contributing authors at 10-year intervals from 1952–2002, and computed the percentages of authors stratified by their affiliations of different HDI countries. Finally, we examine the extent of research collaborations and discuss our findings.

Materials and methods

In the year 2003, the Institute of Scientific Information (ISI; Philadelphia, USA) listed 12 tropical medicine journals on their *Journal Citation Reports*. Out of these we have chosen the five leading journals according to (i) their latest available impact factor (IF) for the year 2003, (ii) their launch dating back at least 50 years, and (iii) publication language English. In chronological order of the first issues ever published, these journals are: (i) *Annals of Tropical Medicine and Parasitology* (*Ann Trop Med Parasitol*; 1907; IF = 1.010); (ii) *Transactions of the Royal Society of Tropical Medicine and Hygiene* (*Trans R Soc Trop Med Hyg*; 1907; IF = 2.114), (iii) *Leprosy Review* (*Lepr Rev*; 1923; IF = 0.907), (iv) *Acta Tropica* (*Acta Trop*; 1944; IF = 1.336) and (v) *American Journal of Tropical Medicine and Hygiene* (*Am J Trop Med Hyg*; 1952; IF = 2.105).

In a first step we have collected contemporary information from these selected journals, number of issues published per year, current estimated circulations, publisher, society affiliation, aims and scope, and subscription prices. Next, we conducted a 50-year temporal analysis with a yearly snapshot per decade, commencing in 1952. Emphasis was placed on the country of affiliation of all contributing authors (hereafter referred to as author countries). We obtained hardcopies of all volumes of the selected journals and studied all full articles that were published at these cross-sectional time points. Editorials, letters or correspondence, conference proceedings or reports, special reports, teaching materials, book and CD reviews, and news announcements were not considered. Authors' country affiliations were categorised into low, medium and high HDI countries according to the human development report 2003 (UNDP, 2003). The HDI is a cumulative measure of the achievement of an individual country in terms of

their residents' life expectancy, educational attainment and adjusted real income (<http://hdr.undp.org>). Because the HDI is only available since 1975 we applied a single value (the HDI 2003) for all years analysed.

Those articles that lacked address details of contributing authors, or in case addresses could not be readily linked to each individual author, were omitted. This affected less than 0.5% of all articles. Authors with double or triple addresses, consisting of different HDI ranks, were accounted for as half or a third, respectively, under each HDI category.

Results

Table 1 summarises key publishing characteristics of *Ann Trop Med Parasitol*, *Trans R Soc Trop Med Hyg*, *Lep Rev*, *Acta Trop* and *Am J Trop Med Hyg* as of January 2004. While *Lep Rev* publishes quarterly, *Ann Trop Med Parasitol* publishes 8 regular issues (plus 1-2 supplements) per year, the remaining three journals are published monthly. *Am J Trop Med Hyg* publishes additional supplements to the 12 yearly issues. Current circulations range from 1,800 to 4,400. Two out of the five journals are published by their societies. *Acta Trop* and, since 2004, *Trans R Soc Trop Med Hyg* are published by Elsevier, while *Ann Trop Med Parasitol* is published by Maney Publishing. The vast majority of personal subscription is held by people affiliated with high HDI countries.

Overall, we have examined 2,802 articles published in these five journals: 250 in 1952, 298 in 1962, 333 in 1972, 515 in 1982, 680 in 1992, and 726 in 2002. Thus, within the past 50 years there was almost a 3-fold increase of published articles. Within the same time span the number of contributing authors has grown more than 9-fold from 443 in 1952 to 4,068 in 2002. Figure 1 depicts the increase in the number of authors for each of the five journals individually.

Single authored publications were the norm in 1952 (53.0%), but they have become the exception 50 years later (6.0%). Concurrently, the median number of authors per article published in the selected journals grew from 1 (four journals) or 2 (*Am J Trop Med Hyg*) in 1952 to 2.5 (*Lep Rev*) up to 6 (*Acta Trop* and *Am J Trop Med Hyg*) in 2002. Publications among authors affiliated with countries of different HDI ranks have increased substantially over the past 50 years as shown in Figure 2. While none (*Acta Trop*, *Ann Trop Med Parasitol* and *Lep Rev*) or only very few (maximum 2.5% in *Am J Trop Med Hyg*) of papers published in 1952 were joint contributions between authors from low/medium and high HDI countries, this percentage has increased to at least 19.4% (*Lep Rev*), up to 43.7% (*Am J Trop Med Hyg*) 50 years later.

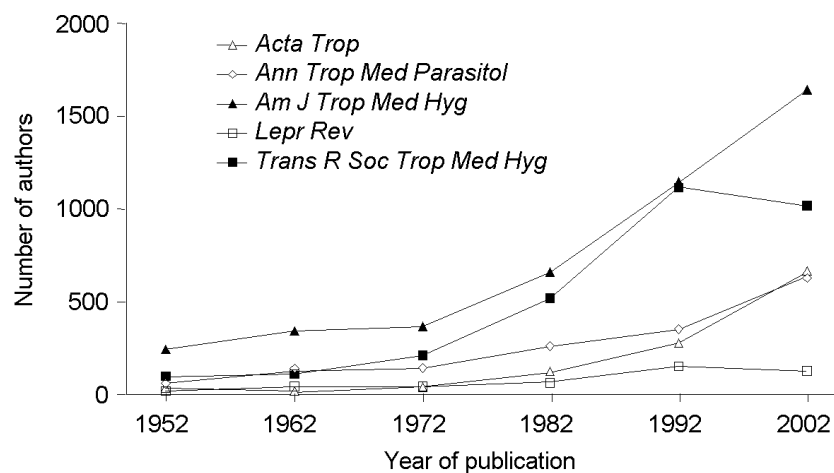


Figure 1. Number of authors in five leading journals of tropical medicine between 1952 and 2002

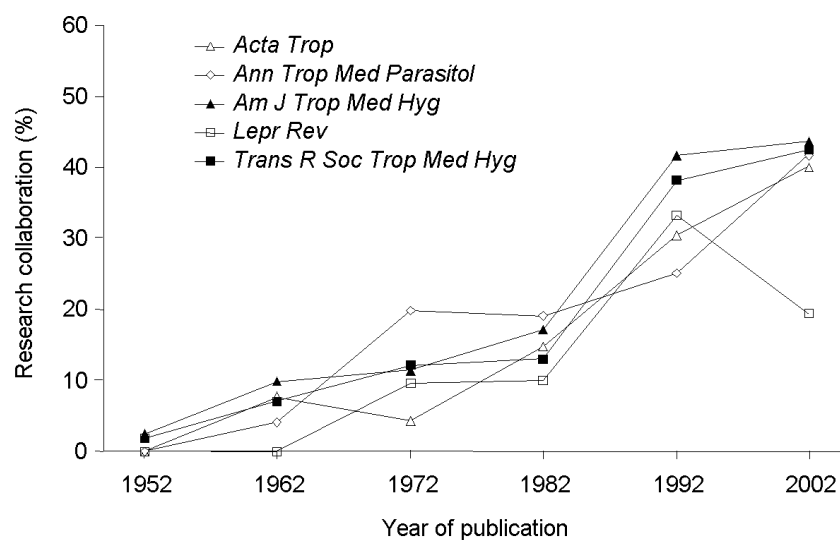


Figure 2. Research collaborations (%) among authors affiliated with countries of different HDI ranks in five leading journals of tropical medicine between 1952 and 2002

Table 1. Publishing characteristics of five leading journals of tropical medicine

Journal (abbr.)	Launched (year)	Frequency (issues/year)	Publisher	Society affiliation	Subscription price (North America)	Current circulation	Subscription number*
<i>Ann Trop Med Parasitol</i>	1907	8	Maney Publishing	None	Print + online: US\$ 358 (personal), US\$ 688 (institutions)	Not known	500 subscribers (85% high HDI, 12% medium HDI, 3% low HDI)
<i>Trans R Soc Trop Med Hyg</i>	1907	12	Elsevier	Royal Society of Tropical Medicine and Hygiene	Print + online: US\$ 168 (personal), US\$ 406 (institutions)	3,300 unspecified	Not known
<i>Lepr Rev</i>	1927	4	British Leprosy Relief Association	British Leprosy Relief Association	Print + online: £ 34	1,800 unspecified	Not known
<i>Acta Trop</i>	1944	12	Elsevier	None	Print + online: US\$ 1569 (institutions)	Not known	1,557 institutional subscribers. Only 4 print subscribers in Africa (2002)
<i>Am J Trop Med Hyg</i>	1952	12	American Society of Tropical Medicine and Hygiene	American Society of Tropical Medicine and Hygiene	Print + online: US\$ 625 (institutions)	4,400 paid	Less than 10% of readers in low and medium HDI countries

* Data obtained from editors of the individual journals

Table 1. continued

Journal (abbr.)	Aims and scope
<i>Ann Trop Med Parasitol</i>	"To make the results of the relevant research more widely known; to encourage those who feel discouraged; and to strengthen the links between the many scientific communities involved in tropical medicine, global parasitology and medical entomology."
<i>Trans R Soc Trop Med Hyg</i>	"To promote and advance the study, control and prevention of disease in man and other animals in warm climates; and to facilitate discussion and the exchange of information."
<i>Lepr Rev</i>	"To contribute to a better understanding of leprosy and its control; to publish information of educational value which is of direct benefit to the control of leprosy under field conditions; and to interpret what is being done in other disciplines."
<i>Acta Trop</i>	"To detail every aspect of biomedical sciences relevant to humans, including veterinary medicine and biology in the tropics."
<i>Am J Trop Med Hyg</i>	"To publish work throughout the field of tropical medicine, including parasitic and viral diseases of the tropics, as well as other infectious diseases, such as enteric and mycobacterial infections."

Source: journals' homepages and <http://www.ulrichsweb.com/ulrichsweb/>

Key findings of the authors' representation according to different HDI ranks are summarised in Table 2. Clearly, authors from high HDI countries have dominated and continue to dominate publication outputs in the five investigated journals. The lowest percentages of authors from high HDI countries were found in *Lep Rev* (19.5–46.7%) and the highest in *Acta Trop* and *Am J Trop Med Hyg*. For example, in 1972, nine of ten authors publishing in *Acta Trop* were affiliated with high HDI countries. In 2002 the share of all authors affiliated with high HDI countries ranged between 37.8% (*Lep Rev*) and 59.4% (*Am J Trop Med Hyg*).

Authors from high HDI countries were even more prominent on the first and last author positions, which are normally considered as the most prestigious positions in the tropical medicine literature. The lowest percentage of first authors affiliated with high HDI was 26.7% (*Lep Rev*), and the highest one was 80.9% (*Am J Trop Med Hyg*) in 1952. Fifty years later, the corresponding percentages were 40.3% and 62.5%, respectively. Even slightly higher percentages were noted for last authors affiliated with high HDI countries.

The proportion of authors affiliated with medium HDI countries has increased over the past decades. While in 1952 the percentages ranged from 18.7–31.3%, the corresponding percentages 50 years later had increased to 28.5–54.5%. Interestingly, in 1962 and 1972 not a single author from a medium HDI country had published in *Acta Trop*. First and last author positions from medium HDI ranked countries have also increased steadily.

No obvious trend can be detected regarding the proportion of authors affiliated with low HDI countries over the past 50 years, and we noted considerable variation between the individual journals (Table 2). In *Am J Trop Med Hyg* few but a gradually increasing number of articles were published with authors affiliated with low HDI countries over the investigated 50-year period (0.8% in 1952; 9.3% in 2002). In 1952 and 1962, a large amount of articles published in *Ann Trop Med Parasitol* and *Trans R Soc Trop Med Hyg* stemmed from authors affiliated with low HDI countries (e.g. 43.0% in 1962 in *Trans R Soc Trop Med Hyg*). This was followed by low percentages between 1972 and 1992 (for example only 12.4% in *Ann Trop Med Parasitol* in 1992), but increasing shares in 2002 (20.3% and 20.9% in *Trans R Soc Trop Med Hyg* and *Ann Trop Med Parasitol*, respectively). In *Act Trop* authors affiliated with low HDI countries showed strong variations between the individual years with 6.6–31.3% of all contributions. *Lep Rev* is characterized by high percentages of low HDI affiliated authors in 1952 and 1962 (43.7% and 36.6%, respectively), which then decreased gradually to 8.1% in 2002. First and last positions of low HDI authors also show considerable variations, and are summarised in Table 2.

Table 2. Percentage of all, first and last authors according to HDI in five leading journals of tropical medicine between 1952 and 2002

Journal (abbreviation)		HDI rank	1952	1962	1972	1982	1992	2002
<i>Ann Trop Med Parasitol</i>	All authors	High	50.0	54.5	50.0	63.3	49.9	41.2
		Medium	22.9	17.4	27.1	24.3	37.7	37.9
		Low	27.1	28.1	22.9	12.4	12.4	20.9
	First authors	High	46.3	50.7	43.9	55.8	56.5	41.5
		Medium	22.5	16.4	28.8	31.6	30.0	39.5
		Low	31.2	32.9	27.3	12.6	13.5	19.0
	Last authors	High	46.3	50.7	48.5	58.9	54.0	45.2
		Medium	22.5	19.2	22.7	26.3	34.0	38.3
		Low	31.2	31.5	28.8	14.8	12.0	16.5
<i>Trans R Soc Trop Med Hyg</i>	All authors	High	48.9	38.3	39.6	49.7	45.2	51.1
		Medium	28.7	18.7	35.9	32.4	37.2	28.6
		Low	22.4	43.0	24.5	17.9	17.6	20.3
	First authors	High	46.3	38.3	45.8	55.9	45.2	54.9
		Medium	27.8	18.7	28.9	26.2	37.2	30.7
		Low	25.9	43.0	25.3	17.9	17.6	14.4
	Last authors	High	44.5	35.7	44.6	54.1	53.6	62.6
		Medium	25.9	23.2	31.3	31.3	29.9	25.9
		Low	29.6	41.1	24.1	14.6	16.5	11.5
<i>Lep Rev</i>	All authors	High	25.0	19.5	27.9	29.0	46.7	37.8
		Medium	31.3	43.9	58.1	55.0	40.8	54.1
		Low	43.7	36.6	14.0	16.0	12.5	8.1
	First authors	High	26.7	20.8	33.3	33.3	56.4	40.3
		Medium	33.3	41.7	47.6	43.3	35.9	43.0
		Low	40.0	37.5	19.1	23.4	7.7	16.7
	Last authors	High	26.7	20.8	28.6	33.4	41.0	50.0
		Medium	33.3	41.7	52.4	50.0	38.5	36.1
		Low	40.0	37.5	19.0	16.6	20.5	13.9
<i>Acta Trop</i>	All authors	High	68.8	77.8	90.2	54.3	51.1	38.9
		Medium	18.7	0	0	19.0	17.6	54.5
		Low	12.5	22.2	9.8	26.7	31.3	6.6
	First authors	High	65.2	76.9	95.6	48.8	47.8	42.5
		Medium	17.4	0	0	19.5	21.8	51.4
		Low	17.4	23.1	4.4	31.7	30.4	6.1
	Last authors	High	65.2	69.2	91.3	51.2	52.2	54.6
		Medium	17.4	0	0	17.1	20.3	41.2
		Low	17.4	30.8	8.7	31.7	27.5	4.2
<i>Am J Trop Med Hyg</i>	All authors	High	82.7	70.1	72.5	73.3	65.4	59.4
		Medium	16.5	25.5	18.3	24.0	29.3	31.3
		Low	0.8	4.4	9.2	2.7	5.3	9.3
	First authors	High	80.9	72.7	75.7	74.6	74.7	62.5
		Medium	18.2	22.7	17.9	22.6	21.5	29.6
		Low	0.9	4.6	6.4	2.8	3.8	7.9
	Last authors	High	80.1	69.7	74.3	75.1	75.8	68.5
		Medium	19.1	25.0	21.4	23.2	22.9	24.6
		Low	0.8	5.3	4.3	1.7	1.3	6.9

In Figure 3 we present the temporal trend of the authors' share from low, medium and high HDI countries with pooled data from all five journals. Overall, the percentage of high HDI authors decreased from 68.0% in 1952 to 50.5% in 2002. This was paralleled by an increase of the share of authors affiliated with medium HDI countries from 20.6% in 1952 to 36.1% in 2002. The presence of low HDI authors remained fairly constant at low percentages (11.4% in 1952 and 13.4% in 2002).

Figure 4 depicts the percentages of authors affiliated with low, medium and high HDI countries for each of the five journals pooled for all six snapshots in time. With the exception of *Lep Rev*, which had a high share of medium HDI authors throughout, the dominance of authors affiliated with high HDI countries is clearly shown. For example, 66.2% of all authors publishing in *Am J Trop Med Hyg* in the selected years were affiliated with high HDI countries.

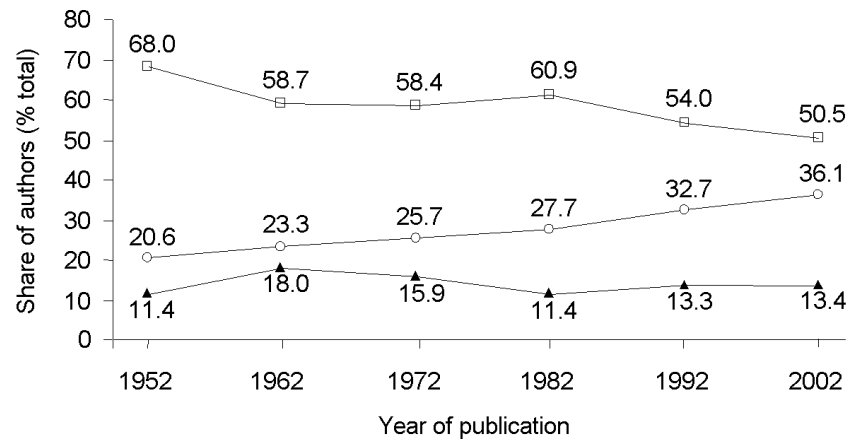


Figure 3. Share of authors (% total) from low (▲), medium (○) and high HDI countries (□) in five leading journals of tropical medicine between 1952 and 2002

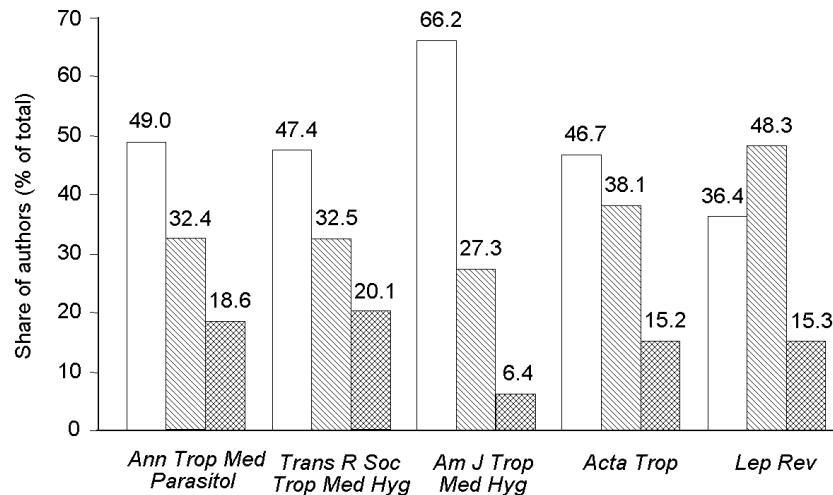


Figure 4. Share of authors from low (white bars), medium (single-hatched) and high HDI countries (cross-hatched) in the five leading journals of tropical medicine combined for the years 1952, 1962, 1972, 1982, 1992 and 2002

Discussion

Bibliometrics has been recognised as an objective tool to assess, quantify and interpret the state of science in developing countries (ARVANITIS et al., 2000). Our bibliometric analysis of the country affiliations of authors in the leading literature on tropical medicine contained one American-based journal (*Am J Trop Med Hyg*), launched in 1952, three journals from the UK (*Ann Trop Med Parasitol*, *Lepr Rev* and *Trans R Soc Trop Med Hyg*), which were founded in the first decades of the last century, and one journal with its editorial office currently at Stockholm, Sweden (*Acta Trop*), which published its first issue in 1944. We conducted a temporal analysis of all original articles published in these five journals with yearly cross-sectional snapshot per decade over 50 years, commencing in 1952. Clearly, there are variations between the percentages of authors affiliated with different HDI ranks between individual years, but our recent analysis on the current representation of authors from different HDI ranks in the same five journals between 2000 and 2002 showed that these were only marginal and mainly due to special issues or supplements (KEISER et al., 2004). We decided to employ the HDI (year 2003) because in contrast to the gross domestic product (GDP) it is a measure of the average achievements in a country in three basic dimensions. It is

commonly applied, e.g. in a recent examination of the geographical composition of editorial boards in the general medicine literature (HORTON, 2003). However, one uncertainty of applying the HDI 2003 for the selected time points covering 50 years is that it does not take into account the dynamics, i.e. setbacks of countries in the HDI on the one hand and increases in their average achievements over time. For example, Kenya and Zimbabwe were classified as low HDI countries in 2003, but the year before both countries were ranked with a medium HDI.

Our temporal analysis with an emphasis on author's country affiliations according to HDI in leading tropical medicine journals covering half a century shows several interesting trends. First, we found a strong increase of the median number of authors per article published. This phenomenon, which has been labelled "author inflation" is common in most scientific fields (POWERS, 1988; MANSOUR & LAWRENCE, 1992). It has been explained with an increasing complexity of research and thus the need of more subspecialties and research groups involved. Others have argued that it is also related to the excessive pressure to publish (MUSSURAKIS, 1993).

Second, developments and a progression from colonial tropical medicine into an international research discipline are clearly recognisable. For example, in the European journals the share of authors from low HDI countries was relatively high in 1952 and 1962, which was probably the result of expatriate scientists and medical doctors residing in the developing world and disseminating their observations through these journals. For example, 43.0% of all authors contributing to original articles that were published in *Trans R Soc Trop Med Hyg* in 1962 were affiliated with low HDI countries. Before independence of many African countries, research in tropical medicine was either conducted in European schools or in a variety of research institutes in the colonies, usually by expatriates working there. After independence expatriates were gradually replaced by African scientists. The new independent countries and territories struggled with transitional difficulties and the establishment of research and training of scientists was complicated by manifold political and developmental issues (LUMSDEN, 1975). Political instabilities and the decline of research expenditures caused a further deterioration of the science infrastructure in developing countries. For example, the proportion of authors affiliated with low HDI countries was only 17.9% in *Trans R Soc Trop Med Hyg* in 1982.

Interestingly, the vast majority of publications in the US-based journal *Am J Trop Med Hyg* originated from authors affiliated with high HDI countries (82.7% in 1952). This journal revealed a constant low, but slowly increasing percentage of authors from low HDI countries over the past half century from 0.8% in 1952 to 9.3% in 2002. A possible explanation is that in the journal's beginnings the Americans were not significantly involved in research conducted in colonial states. A considerably stronger research relationship existed with the geographically closer Central and South Americas (most of these countries are middle HDI) when compared to Africa (most of these

countries are low HDI). In fact, the number of authors from middle HDI in *Am J Trop Med Hyg* has been expanded steadily over the years, from 16.5% in 1952 to 31.3% in 2002.

Third, during the past decades inequities in health became a major political issue (GLOBAL FORUM FOR HEALTH RESEARCH, 2002) and initiatives promoting equity in health research, e.g. the Council on Health Research for Development, have been launched. In addition, research partnerships between North and South have been strongly endorsed. Contemporary research partnerships are important in the field of tropical medicine, as they provide a platform for exchange of expertise and experience, as well as capacity building of local scientists and technology transfer (HARRIS & TANNER, 2000; KEISER et al. 2004). Here, we document that publications stemming from authors affiliated with low/medium and high HDI ranks increased strongly from as low as 0–2.5% in 1952 up to 43.7% in 2002. To some extent this increase is influenced by the observed “author inflation”. In addition, not every paper authored by scientists affiliated with different HDI countries indicates true research collaboration. For example, scientists from the developing world might be added as co-authors simply because international health papers with joint authorships from both developing and developed countries are perceived to have a better chance to be accepted for publication. In fact, a higher acceptance rate for papers including US/Canadian and foreign authors was found for the *American Journal of Public Health* in 1989 (KOCH-WESER & YANKAUER, 1993).

Fourth, despite efforts to promote health equity, the overall percentages of authors affiliated with low HDI countries decreased over the past 50 years in four of the five journals examined. Since the relatively high percentages of low HDI affiliated authors in the 1950s and 1960s may be explained by expatriates living there, focussing on the past 2-3 decades might be more interesting. Our data facilitate this kind of evaluation, however, no overall difference can be detected in the percentage of authors affiliated with low HDI countries in 1972 (9.2-24.5%) when compared with 2002 (6.6-20.9%). Only a slightly positive trend can be detected over the last decade with an increase of authors from low HDI countries in three of five journals. It is important to note that the decline in low HDI authors has not been compensated by their publishing in other ISI-referenced journals of tropical medicine. Although two additional journals, i.e. *Tropical Doctor* and *Annals of Tropical Paediatrics*, currently included in ISI's *Journal Citation Reports*, were founded in 1970 and 1981, respectively, *Tropical Medicine and International Health* was launched in 1996 as a merger of four tropical medicine journals. Hence, *Annales de la Société Belge de Médecine Tropicale*, *Journal of Tropical Medicine and Hygiene*, *Tropical and Geographical Medicine* (incorporating *Acta Leidensia*) and *Tropical Medicine and Parasitology* disappeared in 1996.

Fifth, authors affiliated with high HDI countries figure prominently on the most prestigious author position in the leading literature on tropical medicine, namely on the

first and last positions. While in 1952 the percentages of all, first and last authors affiliated with high HDI countries were similar, our analysis revealed particularly high percentages of high HDI last authors in 2002 (e.g. *Acta Trop* 38.9% of all authors, but 54.6% of last authors were affiliated with high HDI countries). Our results are in agreement with recent findings from the life sciences, social sciences and applied sciences, since authors from low income countries rarely occupied key positions in the respective literature (DAHDOUH-GUEBAS et al., 2003). It has been argued that senior scientists, in our case predominately affiliated with high HDI countries, are better able to influence the decision on authorship, that authorship is granted to chairpersons of departments as a matter of convention, or that senior authors are listed just to boost a paper (DRENTH, 1998). It should also be noted that there is a great pressure to publish among scientists based at Northern Universities, which in turn will be decisive for future funding.

Conclusion

Tropical medicine research has gone through several phases before it has evolved from colonial medicine to an international research field with a global scope. This scientific discipline is advancing rapidly and sustained efforts should be made that scientist from low and medium HDI countries can contribute in major ways. The current under-representation of authors from low HDI, which does not appear to have improved over the past decades, underscores that much remains to be done to further enhance sound and influential research in the developing world.

There is a necessity that the developed countries continue to support developing countries by means of financial assistance, technology transfer, training and capacity building of local scientists, including the promotion of North-South and South-South partnerships. Ongoing efforts and debate to correct the 10/90 gap, indicating the huge discrepancy between the magnitude of disease burden in the world, and the allocation of research funding might provide leverage to move forward research and control of tropical diseases in developing countries. Recently, it has also been proposed to found a research and development committee in every low income country, responsible for the identification of prioritized research sectors, manpower development, resource mobilization and allocation, quality control and the dissemination and utilization of research findings (RAHMAN & FUKUI, 2003). Another strategy proposed was to tap productive research centres in the South to jointly engage in global health research (KEUSCH & MEDLIN, 2003). Sustained efforts are required to further support these initiatives to reduce the gap between developing and developed countries within tropical medicine and international research, so that some of the grand challenges in global health can be addressed and solved.

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