
Reporting of non-communicable disease research in low- and middle-income countries: a pilot bibliometric analysis*

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Objective: The paper identifies the relative amount of research devoted to non-communicable disease in low- and middle-income countries (LMICs).

Design: A bibliometric analysis of a subset of journals published in LMICs was performed.

Measurements: Seventy-six peer-reviewed journals focused on general medicine or public health published in 46 LMICs and indexed from 1998 to 2003 in MEDLINE. A total of 24 journals were selected, 4 journals from each of 6 LMIC regions. Searches were refined using 18 non-communicable disease topics with 7,012 articles identified for analysis.

Results: More than 40% of articles in LMIC regions

focused on non-communicable disease research. The percentage was highest in Eastern Europe/Central Asia (47%) and lowest in Latin America (36%). The percentage of articles published in Sub-Saharan Africa (38%) did not differ significantly from that of Latin America or South Asia. Cardiovascular disease and cancer led the list of the top ten most-indexed published topics by region.

Conclusions: Even in regions rampant with infectious diseases, some capability exists to conduct research on non-communicable diseases. Greater attention should be paid to the conduct and support of such research in LMICs, which will benefit these countries and may yield clues to lower-cost solutions to the burden of these diseases worldwide.

INTRODUCTION

Much attention has been paid to infectious disease in low- and middle-income countries (LMICs) due to the significant morbidity and mortality arising from these diseases in endemic areas. Yet the burden of non-communicable, chronic diseases—such as cardiovascular disease (CVD), hypertension, obesity, and diabetes—is rising [1, 2], accounting for approximately 50% of deaths in high-mortality regions of the world [3].

Despite the growing burden of non-communicable disease (NCD) in LMICs, research agencies and donors have largely ignored funding this area, possibly due to a belief that these diseases affect only affluent populations. Yet global changes in lifestyle risk factors—as well as changes in work, transport, and leisure that have reduced physical activity—have led to a rise in unhealthy behaviors in these countries [2]. A recent

World Bank analysis [4] suggests that controlling CVD in LMICs would result in more gains in life expectancy than addressing the United Nations' Millennium Development Goals for these regions. Research funding agencies' focus on infectious disease and on child and maternal health is laudable. However, ignoring NCD may further compromise national or regional health care systems that are already weak [5] and contribute to increased health disparities—of particular concern because risk factors for NCDs tend to concentrate among poorer populations in LMICs. In addition, these diseases diminish worker productivity, which may have long-term negative effects on the global economy.

An examination of scientific publications can aid in determining research priorities and can provide an estimate of research taking place [6–8]. This analysis assumes that investigators usually conduct research on topics of importance to their country or region and that investigators mostly publish their research in local or regional journals. The investigators performed a preliminary bibliometric analysis to identify the general emphasis of NCD research conducted in and re-

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Highlights

- More than 40% of peer-reviewed MEDLINE journal articles published in general medical journals from low- and middle-income countries were devoted to non-communicable disease (NCD) research; a stable percentage from 1998 through 2003.
- In contrast to cancer and cardiovascular disease, the proportion of publications devoted to mental health was not commensurate with the disease burden.
- The percentage of NCD articles published in Sub-Saharan Africa and Latin America were comparable to one another, suggesting that NCD is an important research focus even in regions endemic for infectious diseases.
- International funding agencies should strongly consider placing a greater emphasis on NCD research.

Implications for practice

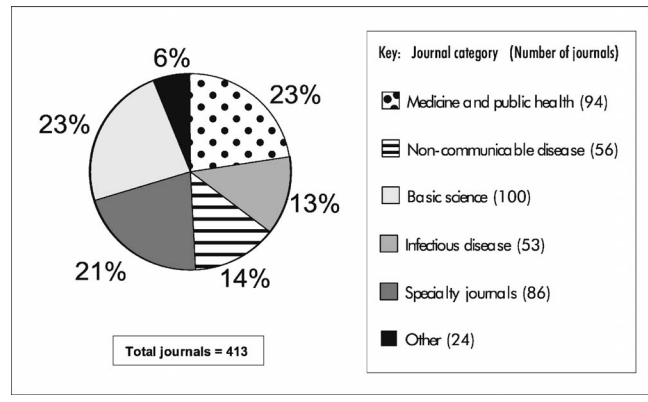
- Health information professionals can contribute to research funding decisions and policies through analysis of citation patterns in the published literature.

ported in a sample of peer-reviewed scientific journals published in LMICs.

MATERIALS

The investigators identified LMICs by using the World Bank classification of economies [9], which is based on gross national income per capita (GNC). For the purpose of this study, the team focused only on countries classified as low-income, lower-middle income, or upper-middle income. The World Bank classification of economies also classifies a high-income group (e.g., Canada, United States, United Kingdom), which was excluded from this analysis as the researchers' interest was in the publishing practices of developing nations. The World Bank classification further grouped the LMICs into six regions: East Asia/Pacific, Eastern Europe/Central Asia, Latin America/Caribbean, Middle East/North Africa, South Asia, and Sub-Saharan Africa. The researchers used this regional framework to organize and report the results of this study. The decision to use MEDLINE, the US National Library of Medicine's citation database, was based on the assumption that health researchers were partial to publishing in journals indexed by this service. Inclusion in MEDLINE requires journals to have satisfied certain scope and quality requirements, including reliance on peer review. Indexed publications are also afforded a high level of visibility in the global biomedical and scientific community. This analysis focused on journals that were published in LMICs and indexed in MEDLINE for the study period of 1998 through 2003, referred to as the "journal subset" or "subset" below.

Figure 1
Subject classification of journals published by developing countries included in MEDLINE



METHODS

The journal subset was separated into categories based on their assigned Medical Subject Headings (MeSH) classification: medicine, public health, non-communicable disease, basic science, specialty, or other (Figure 1). The researchers' specific interest was in the publishing nature of general health journals, therefore, this analysis focused on medicine or public health journals (23% of total subset) and excluded publications focused on specialized NCD topics (13% of total subset) such as cancer, CVD, or infectious disease (14% of total subset). To include the specialty journals in the analysis would, the investigators believed, distort the reality of the publishing environment of general health and medical journals. The search strategy was constructed using MeSH and included several elements: one of eighteen non-communicable, chronic disease topics (Table 1); the specific journal title; and the year published. To improve the validity and reliability of retrieval, the team also incorporated the "NOT" operator to eliminate specific items: news, letters, and general infectious disease topics (HIV infections, tuberculosis, malaria, leishmaniasis, and respiratory tract infections) (Figure 2). These infectious disease topics were not intended to completely eliminate the retrieval of articles on all communicable disease; rather, these general topics were introduced to ensure that the retrieval of some of the most commonly referenced

Table 1
Non-communicable, chronic diseases and disorders topics

Alcohol related disorders	Hypertension
Cardiovascular diseases	Mental disorders
Cerebrovascular disorders	Neoplasms
Diabetes mellitus	Pain
Diet, nutrition, and obesity	Respiratory-tract diseases
Disasters	Substance abuse
Environmental pollution	Tobacco and smoking
Exercise and physical fitness	Violence
Hyperlipidemia	Wounds and injuries

Figure 2
Framework for MEDLINE search strategies

NCD topic [mh] NOT (HIV infections [mh] OR Tuberculosis [mh] OR Malaria [mh] OR Leishmaniasis [mh] OR Respiratory tract infections [mh] OR letter [pt] OR news [pt]) AND *Journal* [ta] AND *Year* [dp]*

*Italicized items were substituted depending on non-communicable disease topic, journal, and date.

communicable disease topics in developing countries would not distort the results.

Searching the journal subset in MEDLINE was facilitated by the Office of Computer and Communication Systems at the National Library of Medicine. An automated Perl script was created to systematically search the database and retrieve the number of citations per search. This automated method allowed a large amount of searching to be completed in a relatively short time. The results were imported into spreadsheets for further analysis.

RESULTS

In 2004, MEDLINE indexed 413 journals published in 46 LMICs. Of the 94 journals focused on general medicine or public health, 76 were indexed in MEDLINE from 1998 through 2003. Of these 76 eligible journals, 24 were selected for final analysis: 4 journals per World Bank region to generate a sample with equal representation. The selected journals represented content with a regional or national focus (e.g., *Journal of the Indian Medical Association* or *Central European Journal of Public Health*) (Table 2). After eliminating news items and letters, the investigators identified 16,524 articles among these journals between 1998 and 2003. Seven

thousand twelve (42.4%) of these articles were indexed with 1 or more of 18 non-communicable, chronic disease MeSH terms.

Close to 50% of articles in every region focused on NCD research (Table 3). For the period 1998 to 2003, the percentage was highest for Eastern Europe/Central Asia and lowest for Latin America. A 2-sided z-test for proportions was used to determine if the proportion of articles on NCDs differed between regions. The number of NCD articles and the total number of articles from each region was used to evaluate significant differences between regions to the 95% level in pair-wise comparisons. The results from the 2-sided z-tests indicated that the percentage of chronic disease articles in Eastern Europe/Central Asia differed significantly from all other regions except for Middle East/North Africa ($P = 0.002$ to $P < 0.0003$). The percentage of NCD articles published in Sub-Saharan Africa did not differ significantly from that of Latin America or South Asia but did differ significantly from Eastern Europe/Central Asia, Middle East/North Africa, and East Asia/Pacific. Among the topics indexed in these articles, CVD and cancer consistently ranked at the top of the list for every region, although respiratory tract conditions superseded neoplasms in Eastern Europe/Central Asia (Table 4).

DISCUSSION

Principal findings

The record of published articles suggested considerable interest in NCD research even in LMICs with endemic infectious diseases and in regions displaying a variety of economic profiles. More than 40% of peer-reviewed journal articles published in the examined LMIC journals were devoted to NCD research, and

Table 2
Study sample: region, journal title, and country of publication

World Bank Region (number selected/total number indexed in MEDLINE)	Journal title	Country of publication
Middle East/North Africa	<i>Eastern Mediterranean Health Journal</i>	Egypt
	<i>Lebanese Medical Journal</i>	Lebanon
	<i>Saudi Medical Journal</i>	Saudi Arabia
	<i>Tunisian Medical Journal</i>	Tunisia
South Asia	<i>Journal of the Indian Medical Association</i>	India
	<i>National Medical Journal of India</i>	India
	<i>Journal of the Pakistan Medical Association</i>	Pakistan
	<i>Ceylon Medical Journal</i>	Sri Lanka
Sub-Saharan Africa	<i>East African Medical Journal</i>	Kenya
	<i>West African Medical Journal</i>	Nigeria
	<i>African Journal of Medicine and Medical Sciences</i>	Nigeria
	<i>South African Medical Journal</i>	South Africa
Latin America/Caribbean	<i>Medicina</i>	Argentina
	<i>Revista de Saude Publica</i>	Brazil
	<i>Salud Publica de Mexico</i>	Mexico
	<i>Investigacion Clinica</i>	Venezuela
East Asia/Pacific	<i>Asia Pacific Journal of Public Health</i>	China
	<i>Chinese Medical Journal</i>	China
	<i>Medical Journal of Malaysia</i>	Malaysia
	<i>Journal of the Medical Association of Thailand</i>	Thailand
Eastern Europe/Central Asia	<i>Medicinski Arhiv</i>	Bosnia and Herzegovina
	<i>Central European Journal of Public Health</i>	Czech Republic
	<i>Croatian Medical Journal</i>	Croatia
	<i>Klinicheskaia Meditsina (Mosk)</i>	Russia

Table 3
Percentage of journal articles found on non-communicable, chronic disease, by region

Region	1998	1999	2000	2001	2002	2003	1998–2003
Eastern Europe/Central Asia	46.3	40.2	48.0	50.4	54.1	46.7	47.8
Middle East/North Africa	47.6	42.9	41.9	41.4	50.1	58.9	45.1
East Asia/Pacific	51.3	41.7	48.4	43.1	42.1	42.4	44.4
South Asia	44.5	43.8	37.3	39.7	41.9	29.8	39.4
Sub-Saharan Africa	41.4	37.9	39.4	38.0	41.1	35.2	38.9
Latin America	36.7	31.2	36.0	39.2	39.1	37.2	36.4
Total	44.9	39.8	42.7	42.3	44.6	40.4	42.4

this percentage appeared stable from 1998 through 2003 (Figure 3). CVD, cancer, and respiratory conditions dominated the list of top-ranked NCD topics. Diabetes, hypertension, diet, nutrition, and obesity were consistently represented in the top 10 list for every region. In contrast to what was observed for cancer and CVD, the proportion of publications devoted to mental health did not appear to be commensurate with its disease burden. According to the 2001 World Health Report, depression alone was the 4th leading cause of disability adjusted life years (DALY) worldwide [10]. The low volume of articles on mental health might reflect the low priority given to mental health research in LMICs [7, 11].

Strengths and limitations of the analysis

The extent to which NCD research is reported in this analysis may be underestimated, because the topic list (Table 1) was not exhaustive. Furthermore, MEDLINE is not a bibliometric study tool and does not equally represent all countries, journals, or topics. In three of the World Bank regions, three countries are represented twice (India, China, and Nigeria) for several reasons—either the journals from other countries in their regions did not fit the scope of this study, they were not indexed by MEDLINE, or they were not indexed from 1998 through 2003. Another limitation could be the reliance on indexing to adequately describe the article: indexing of articles and items in MEDLINE is a human endeavor, open to differences of opinion and human error. Additionally, the selection of journals for this analysis might have introduced a bias—selecting four journals per region may have weighted the sample in favor of Middle East/North Africa, which had only five eligible publications, compared to Eastern Europe/Central Asia, which had thirty. MEDLINE does not include surveillance, grant, or technical reports required by the United Nations, the World Health Organization, or local ministries of health, and these reports could have yielded additional important information about research priorities in LMICs. Likewise, this pilot study focused on a five-year period, which might be too brief to identify consistent trends.

Despite the potential biases in journal selection however, the relatively consistent proportion of NCD publications between highly disparate regions suggests good evidence for the validity of data. Finally, this study does not provide a point of comparison with high-income countries; however, the purpose of

the study was to quantify the amount of publication, if any, on NCD topics relative to infectious disease topics in each region.

Implications

The high percentage of NCD articles published in Eastern Europe/Central Asia may reflect the region's proximity to Western Europe, where NCD has been a focus for some time. Likewise, the Eastern Europe/Central Asia region, which encompasses more middle-income countries, may be farther along the epidemiological transition from communicable diseases to non-communicable ones. Surprisingly, the percentage of articles published in Sub-Saharan Africa is comparable to the percentage in Latin America. Although some countries in the Sub-Saharan Africa region, such as South Africa, may exhibit economic profiles close to that of countries in Latin America, other countries, such as Kenya and Nigeria, do not. The comparable percentages of NCD articles published in Sub-Saharan Africa and Latin America suggest that NCD is an important research focus even in regions endemic for infectious diseases.

Research funding decisions should consider the burden of disease, as well as the health priorities of the targeted population. The high morbidity and mortality stemming from infectious diseases in LMICs has led to increased research funding from external agencies and donors. Although this increase in funding is laudable, the percentage of articles devoted to NCD topics, in general medicine and public health journals as well as the equal numbers of LMIC journals devoted exclusively to either non-communicable or communicable diseases, suggest that infectious disease should not be the sole focus of research funding in LMICs. Expertise is already in place to conduct NCD research; thus, international funding agencies will not need to build expertise and research in this area from scratch. Furthermore, medical research councils in middle-income countries such as India, Mexico, and South Africa are already committed to this agenda [12–14] (Table 5).

In light of increasing evidence that infections, inflammatory stimuli, and nutrition affect many aspects of aging, including NCDs [15], LMICs, which face dual burdens from both communicable and non-communicable disease, may offer unique scientific research opportunities. LMIC researchers may also potentially identify and establish lower-cost interventions that can offset the burgeoning costs of health care worldwide.

Table 4

Top ranked non-communicable, chronic condition topics published in subset of journals by World Bank Region

Middle East/North Africa	South Asia	East Asia/Pacific	Eastern Europe/ Central Asia	Sub-Saharan Africa	Latin America
1. Cardiovascular diseases	1. Neoplasms	1. Neoplasms	1. Cardiovascular diseases	1. Cardiovascular diseases	1. Neoplasms
2. Neoplasms	2. Cardiovascular diseases	2. Cardiovascular diseases	2. Respiratory tract diseases	2. Neoplasms	2. Cardiovascular diseases
3. Respiratory tract diseases	3. Diabetes mellitus	3. Respiratory tract diseases	3. Neoplasms	3. Wounds and injuries	3. Environmental pollution
4. Wounds and injuries	4. Respiratory tract diseases	4. Wounds and injuries	4. Hypertension	4. Diet, nutrition, obesity	4. Diet, nutrition, obesity
5. Diabetes mellitus	5. Wounds and injuries	5. Mental disorders	5. Environmental pollution	5. Respiratory tract diseases	5. Respiratory tract diseases
6. Hypertension	6. Diet, nutrition, obesity	6. Cerebrovascular disorders	6. Wounds and injuries	6. Mental disorders	6. Diabetes mellitus
7. Mental disorders	7. Mental disorders	7. Environmental pollution	7. Mental disorders	7. Hypertension	7. Hypertension
8. Diet, nutrition, obesity	8. Hypertension	8. Diabetes mellitus	8. Pain	8. Pain	8. Tobacco and smoking
9. Pain	9. Pain	9. Hypertension	9. Diabetes mellitus	9. Diabetes mellitus	9. Mental disorders
10. Cerebrovascular disorders	10. Violence	10. Pain	10. Cerebrovascular disorders	10. Environmental pollution	10. Wounds and injuries

Unanswered questions

It would be useful to determine whether the research reported in this sample of articles was funded by outside organizations to begin to distinguish between individual initiatives and directed, sponsored research. The pharmaceutical industry continues to fund clinical trials testing new products that address NCD worldwide. In 2003, the Fogarty International Center at the US National Institutes of Health (NIH) allocated approximately one-third of its budget to NCD focused in LMICs. These allocations include funds for research and training programs on tobacco, neurosciences, mental health, stigma, genetics, population health, and occupational or environmental health. However, tracking global health resources for research is a major challenge [16], and funding information for individual diseases is currently lacking [17].

Knowledge of the percentage of articles that represent outside collaborations with LMIC investigators

and an inventory of expertise in these research communities could be advantageous. In addition, this preliminary examination focused on only the past five years. A larger study spanning ten to fifteen years may be useful in determining whether publishing trends echo the epidemiological disease trends in a particular region. A broader analysis might also examine regional databases such as those maintained by the World Health Organization [18], as well as databases for individual nations. Further examination of the specific nature of NCD research conducted in these regions is needed. Such data may determine whether this research mirrors the Western focus on research and development and pharmacological solutions, as opposed to identifying lower-cost alternatives.

CONCLUSIONS

Sustained research on neglected and, especially, very neglected diseases is clearly essential in LMICs, but international funding agencies should strongly consider placing a greater emphasis on NCD research as well. Some expertise to conduct this research currently exists and is most likely funded by local governments (Table 5). To ensure that research funding agencies make informed decisions, bibliographic data gathered by health information professionals will be required. Furthermore, greater effort is needed to develop a focused and robust research agenda that is responsive to the continued growth of NCDs, especially in middle-income nations. Increasing the focus on NCD research will likely be more responsive to local priorities and may yield unexpected benefits for people around the world.

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Figure 3
Trends in percentage of non-communicable disease articles published per year, 1998–2003

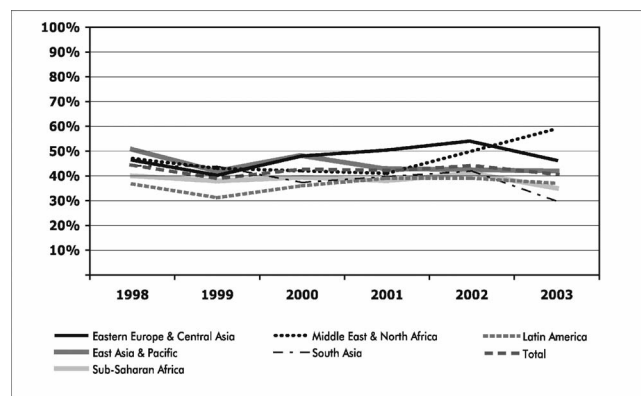


Table 5
Non-communicable disease research funded by middle-income country research councils

Indian Council of Medical Research	Mexican National Institute of Public Health	South African Medical Research Council
Cardiovascular disease Diabetes mellitus Disaster management Mental health Non-communicable disease surveillance Oncology Ophthalmology Pancreatic disorders Physical disability in children	Population health research <ul style="list-style-type: none"> ■ Chronic diseases <ul style="list-style-type: none"> – Cancer – Epidemiology of cancer – Ethics and health – Risk factors for the development of chronic diseases in children and young adults – Tobacco and health ■ Environmental and occupational health ■ Nutrition and health ■ Reproductive health <ul style="list-style-type: none"> – Demographics and health – Women's health 	Anxiety and stress disorders Cancer epidemiology Cardiovascular disease Chronic diseases of lifestyle Crime, violence, and injury Dental Diabetes Human genetics Medical imaging

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