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BRIEF ARTICLE

Cardiovascular disease research in Latin America: A comparative bibliometric analysis

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Abstract

AIM: To investigate the number of publications in cardiovascular disease (CVD) in Latin America and the Caribbean over the last decade.

METHODS: We performed a bibliometric analysis in PubMed from 2001 to 2010 for Latin America and the Caribbean, the United States, Canada, Europe, China, and India.

RESULTS: Latin America published 4% of articles compared with 26% from the United States/Canada and 42% from Europe. In CVD, Latin America published 4% of articles *vs* 23% from the United States/Canada and 40% from Europe. The number of publications in CVD in Latin America increased from 41 in 2001 to 726 in 2010.

CONCLUSION: Latin America, while publishing more articles than previously, lags behind developed countries. Further advances in research infrastructure are necessary to develop prevention strategies for this region.

INTRODUCTION

Over the last half century chronic diseases have steadily increased, accounting for 60% of the estimated 58 million people who died globally in 2005[1]. By 2030 this number is expected to increase to 69% of all deaths, partially due to a combination of increased life spans and improvement in infectious disease control[2-6]. With the majority of these deaths expected to occur in low-income and middle-income countries, chronic diseases are changing from being a problem in rich countries to the main crisis in poor countries[6]. This shift is also due to the steady decrease in certain chronic disease deaths, such as cardiovascular disease (CVD), in developed countries[7-9]. Despite this projection, it has been proposed that by decreasing the death rates from chronic diseases by 2% a year, 36 million deaths could be prevented by 2015[10].

Latin America remains one of the regions with high CV mortality rates despite advances in overall development[11]. Out of all Latin American countries only Argentina, which had high mortality rates in the 1970s, has

seen a decline similar to those reported in North America (-63% between 1970-1972 and 1998-2000 in Argentina, Canada, and the United States)[11]. Despite this decline, the absolute mortality rates remain higher in Argentina compared to the United States and Canada[12]. Declines have been smaller in other countries in the region such as Brazil, Chile, and Cuba (-18%, -33% and -2%, respectively)[11]. While in recent years the rates have varied less in countries in the region, it is estimated that mortality due to CVD and stroke in Latin America will increase by 145% among men and women from 1990 to 2020 as compared to only a 28% increase for women and a 50% increase for men over the same period in developed countries[11,13].

Taking into account this increasing CVD burden, we tried to ascertain the current level of CVD research in Latin America and the Caribbean (LA&C) and whether it reflected the magnitude and extent of this epidemic, through a bibliometric analysis in PubMed. We then further evaluated the number of publications in LA&C compared to the United States, Canada, and all European countries including Russia, Western Europe, China and India.

MATERIALS AND METHODS

We performed a bibliometric analysis of the National Library of Medicine and the National Institute of Health PubMed database (Bethesda, MD, United States) to describe the number of publications from LA&C during 2001-2010 on May 23, 2011. Limiting our search criteria to the years 2001-2010, we searched PubMed using MeSH terms for: (1) LA&C; (2) United States and Canada; (3) all Europe including Russia; (Table 1); (4) Western Europe; (5) China; (6) India; (7) Argentina; (8) Brazil; (9) Chile; (10) Colombia; (11) Mexico; (12) CVD, including hypertension and cerebrovascular disease; and (13) clinical, epidemiological, and public health studies articles (Appendix A available online). We then searched for studies in CVD by region and specific countries by combining MeSH terms for each region and CVDs (individually combining strategies #1-11 + #12). We assessed the total number of articles on clinical, epidemiological, and public health studies by region and country (individually combining strategies #1-11 + #13), and clinical, epidemiological, and public health studies on CVDs by region and country (individually combining strategies #1-11 + #12 + #13) (Appendix A). Finally, we evaluated the number of publications in 2001 *vs* 2010 by region, for total publications (strategies #1-6) and in CVDs (individually combining strategies #1-6 + #12).

Table 1 European countries included in the PubMed database analysis performed February 2011

Western Europe	Eastern Europe and Russia
Andorra	Albania
Austria	Armenia
Belgium	Azerbaijan
Cyprus	Bosnia-Herzegovina
Denmark	Bulgaria
Finland	Croatia
France	Czech Republic
Germany	Estonia
Gibraltar	Hungary
Great Britain	Latvia
Greece	Lithuania
Iceland	Moldova
Ireland	Montenegro
Italy	Poland
Liechtenstein	Republic of Belarus
Luxembourg	Republic of Georgia
Malta	Republic of Macedonia
Monaco	Romania
Netherlands	Russia
Norway	Serbia
Portugal	Slovakia
San Marino	Slovenia
Scotland	Ukraine
Spain	Yugoslavia
Sweden	
Switzerland	
Wales	

RESULTS

From January 2001 through December 2010 approximately 6.7 million articles were published in PubMed worldwide. Articles from LA&C accounted for 3.63% of the total publications (243 983 publications), and of these almost 80% came from three countries: Argentina, Brazil and Mexico (Table 2). This compared with 41.56% from Europe and 26.28% from the United States and Canada. Of the articles published from Europe, the majority came from Western Europe (2 771 953 articles of the 2 798 988 total articles). China and Indian subcontinents produced 5.73% and 2.54% of the total articles, respectively. When adjusting the number of publications by population, Western Europe produced the most articles (6679 publications/1 million persons) while India produced the least (144 publications/1 million persons). The top four Latin American countries, Argentina, Brazil, Mexico, and Chile, individually produced more articles when adjusted for population than China or India (600, 574, 414 and 728 *vs* 287 and 144, respectively, per million population). Interestingly Chile, which produced little more than 5% of the total publications in LA&C, had the highest population-adjusted publication rate of the region (728 publications/million persons).

Regarding clinical, epidemiological, and public health publications worldwide, out of 283 900 articles, the United States/Canada produced 24.6% (69 844 articles) of the total, while China produced 9.63% (27 337 articles). Europe, LA&C and India published roughly the same number of articles (15 141, 12 104 and 12 469 articles, respectively).

Worldwide, in 2001-2010 there were 32 833 publications that focused on CVD. Of these, 4.08% (1338 publications) were performed in LA&C, with Argentina, Brazil and Mexico again being the largest producers (Table 2). China produced 10.65% (3499 publications) and India

Table 2 Publications in Medline and Pubmed, 2001-2010[1]

All publications	Population[2]	Publications	Publications/million persons	World total (%)
Worldwide	6920	6734804	973	100.00
China	1344	385614	287	5.73
India	1189	171083	144	2.54
All Europe + Russia	857	2798988	3266	41.56
All of LA&C	597	243983	408	3.63
Western Europe	415	2771953	6679	41.15
United States and Canada	347	1770046	5100	26.28
Brazil	203	116535	574	1.73
Mexico	114	47180	414	0.70
Colombia	45	5943	132	0.09
Argentina	42	25180	600	0.37
Chile	17	12370	728	0.18
Cardiovascular diseases				
Worldwide	6920	32833	4.8	100.00
China	1344	3499	2.6	10.65
India	1189	1294	1.1	3.94
All Europe + Russia	857	12985	15.2	39.55
All of LA&C	597	1338	2.2	4.08
Western Europe	415	12655	30.5	38.54
United States and Canada	347	7613	21.9	23.19
Brazil	203	815	4.0	2.48
Mexico	114	164	1.4	0.50
Colombia	45	29	0.7	0.09
Argentina	42	105	2.5	0.32
Chile	17	69	4.1	0.21

LA&C: Latin America and the Caribbean. [1]Accessed February 2011; [2]2011 estimates in millions[31].

3.94% (1294 publications), while the United States/Canada produced 23.19% (7613 publications) and Europe 39.55% (12985 publications of which 12655 were from Western Europe). The number of articles varied markedly by country with Brazil producing approximately five times as many articles on CVDs than Mexico, the country with the second highest publication rate (815 and 164 articles, respectively). However, when adjusted for population, Brazil and Chile produced the highest number of publications (4 and 4.1, respectively, per 1 million population) in LA&C. Brazil and Chile also produced more publications per million people than China or India (2.6 and 1.1, respectively) but far less than the United States/Canada and Western Europe (21.9 and 30.5, respectively). Finally, approximately half of the articles published about CVDs were clinical, epidemiological, and public health papers regardless of the region (1338 articles in LA&C; 3436 articles in the United States and Canada; 6320 articles in Europe, 1211 articles in China, and 691 articles in India).

When evaluating the trend of total publications produced in 2001 *vs* 2010 in LA&C, the number has doubled (15939 in 2001 to 36978 in 2010). CVD publications also increased substantially from 2001 compared with 2010 (41 *vs* 726) in LA&C. This increase in total publications was also seen in the other regions, with the United States/Canada increasing publications from 150705 to 229911, in Europe from 215401 to 409258 (Western Europe 213024 to 405898), in China from 15888 to 74613, and in India from 10976 to 28635.

DISCUSSION

This bibliometric analysis describes the trend in scientific publications in LA&C, highlighting the increase in articles published over the last 10 years, particularly in CVD research. Although the number of publications remain less than 5% of all articles, there is a reassuring trend which may be due to various factors including global attention on the impact of non-communicable diseases in developing countries, increased support from national public funding agencies resulting from a local shift in the political agenda of Latin American countries, and improvement in support from other international agencies[10,11,14-18]. Furthermore, we did not take into account the impact factor of the publications, which may have widened the gap of CVD publications between developing and developed countries and regions.

Some of the recent increase may be due to the establishment of research centers such as the Collaborating Centers of Excellence which have been established with support from the National Heart, Lung, and Blood Institute with the goal of conducting research to improve the prevention and management of chronic CVDs[18]. Four of these sites are in Latin America and have already begun epidemiological research investigations such as the Centro de Excelencia en Salud Cardiovascular para el Cono Sur[19]. These centers allow for further infrastructure development and planning, furthering the research needs of Latin America.

Insufficient research funding and infrastructure are some of the largest limitations in performing and publishing research in Latin America. While agencies such as the National Institutes of Health are allocating more resources for research, the reality for local and national governments in most Latin American countries involves issues such as healthcare access and coverage, not mentioning education and housing, which are higher national priorities than health research. This is a major difference compared with developed countries such as the United States, that has a human development index of 0.902 (compared with 0.775, 0.750 and 0.699 for Argentina, Brazil, and Mexico, respectively) and is able to focus more resources towards research[20]. For instance, when comparing gross domestic product (GDP) per capita, the United States ($47284 in international dollars) has a higher GDP per capita than Argentina ($15854), Brazil ($11239), or Mexico ($14430), and the percentage of the GDP devoted to research is much higher in the United States (2.67% *vs* 0.51%, 1.02% and 0.5%, respectively)[21,22]. Funding is not the only issue. Another limitation is the poorly developed research network and capacity with few mentors available for training young investigators as well as no established academic career structure. These limitations are slowly being overcome with institutions such as some Centers of Excellence that have set training and infrastructure building as priorities[23]. Finally, Latin American authors may be limited in publishing in

English language journals because of both a language barrier and an element of bias from journals for research that has been generated in developing countries[23].

Unlike medical teaching and skills which can help serve a small community, research leads to programs that can influence populations on a wide level, influence change at a policy level, and be applied to entire populations. Therefore, data management and research are needed as part of a multi-factorial approach to effectively control chronic diseases by improving local data acquisition, and defining resource needs in resource-limited areas, and to assess what programs work in different settings. Thus, evidence-based approaches should be the basis of all actions to ensure that the resources being devoted to a program are effectively working in the community to impact on chronic diseases[24]. There are certain steps that Latin America should take to continue improving its research capability. Initially, development of the research infrastructure and capacity needs to occur as it has been argued that strengthening research capacity is one of the most powerful, cost-effective, and sustainable means of advancing health and development[25]. Infrastructure building can be facilitated by financial, political, and resource support from both local governments, regional health agencies such as the Pan American Health Organization, and local and foreign agencies such as the Global Alliance for Chronic Disease, which combines six of the world's foremost public health research funders (United States, United Kingdom, Canada, Australia, China and India) to fund implementation research on non-communicable diseases in developing countries[26]. Furthermore, institutions should focus on developing a career track for researchers and building mentor-mentee relationships to train young investigators. Institutional mission statements need to be developed with a focus on research and training goals as well as a strong focus on national healthcare priorities. By allocating their resources towards national health priorities, Latin American institutions can improve funding while applying research-based evidence that optimizes health benefits for their community. The success of this strategy is based on a belief that, with increased local political will, further investments can be obtained, and both of these are needed to establish an effective, sustainable, and productive research community.

Local and national support can be gained by tailoring research to the needs of the particular population as well as the priorities set in the policy agenda. These agendas should be long-term plans with sustained and reliable investment[25]. This tailored research plan is important as the habits and prevalence of risk factors can differ not only between countries within a region, but also within cities or social classes[27-30]. Therefore, epidemiologic research focusing on area-specific needs to assess the burden of disease and to identify potential prevention strategies, such as community-based interventions or lifestyle changes can lead to the support of local and national organizations. Once this has been identified, research can be focused on translating the research into the best practices and disseminating the knowledge amongst governments, universities, and agencies. While it is unclear how teaching and research impacts the prognosis of CVD, by focusing on research, infrastructure building, and disease prevention we will hopefully begin to measure and see improvements in the future of Latin America's health and put a stop to the predicted epidemic.

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COMMENTS

Background

Over the last half century, chronic diseases have steadily increased and cardiovascular disease (CVD) now accounts for 17.7 million annual deaths worldwide, constituting 11% of estimates for the global burden of disease. With increasing life spans and improved infectious disease control, the impact of chronic diseases are estimated to grow to 69% of deaths by 2030, with 80% expected in low-middle income countries. In Latin America the mortality due to CVD and stroke is estimated to increase 145% from 1990 to 2020. Understanding the prevalence of CVD and associated risk factors is key to developing policies to combat these conditions.

Research frontiers

To ensure that measures are taken to improve the future of CVD in Latin America an expansion of research and network building needs to be initiated. Studies focusing on defining the problems and designing cost-effective, high impact strategies are necessary.

Innovations and breakthroughs

Few studies have demonstrated the level of research being produced in Latin America despite the increasing burden of CVD in this area. This study outlines the level of research being produced and provides a comparison amongst highly developed and developing countries.

Applications

By understanding the type and level of research being produced from Latin America, the authors explain how further advances in research infrastructure are necessary to develop prevention strategies for this region.

Terminology

A bibliometric anaylsis is the analysis of a body of literature to reveal the pattern of publications in a field.

Peer review

The authors performed a bibliometric analysis in PubMed from 2001 to 2010 for Latin America and the Caribbean, the United States, Canada, Europe, China, and India. Through this search they discovered that, while interest in chronic diseases have improved, Latin America only produced 4% of chronic disease publications worldwide. While the number of publications in CVD in Latin America has increased significantly over the last 10 years, the studies published have not been population based prospective follow up studies and typically do not

represent countrywide prevalence of disease. These results are interesting and represent areas for potential research focus.

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