

Growth and trends in scientific production in epidemiology in Brazil

ABSTRACT

OBJECTIVES: To analyze the growth of epidemiological research in Brazil in comparison to the total number of indexed publications worldwide and from several Latin American and Caribbean countries.

METHODS: A Boolean combination of epidemiological key words was used to search the MEDLINE/PubMed database for articles published between 1985 and 2004. These articles were divided into 4 time periods: 1985-9, 1990-4, 1995-9, and 2000-4.

RESULTS: Of the total 211,727 articles identified in the MEDLINE/PubMed database, 1,952 (0.9%) were related to Brazil. The number of articles increased 12-fold throughout the period (from 91 to 1,096), and more than doubled (0.54% to 1.1%) if considered in relation to the total number of indexed articles. This growth was accompanied by diversification of the subjects addressed. The fields of infectious diseases and mother-child health, which predominated during the first period (74%), represented only a minority of articles in the last period. There was a noteworthy increase in the Brazilian output when compared to that of other Latin American and Caribbean countries.

CONCLUSIONS: Our results corroborate previous evidence of the intense growth of epidemiological research in Brazil in the last two decades. This growth was more intense than mean growth worldwide, and much greater than that found in other Latin American countries. Therefore, Brazilian scientific output in the epidemiology field is showing a growth pattern similar to that of other scientific areas in the country.

KEYWORDS: Journal article. Publications. Epidemiology, trends. Research, trends. Research, statistics & numeral data.

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Recebido: 26/6/2006

INTRODUCTION

Scientometric studies have been showing significant growth in Brazilian scientific production in recent decades. The main source for such measurements has been the bibliographical database compiled by the Institute for Scientific Information/Thomson Scientific (ISI/Thomson), under the Web of Science interface. According to this source, the production of scientific articles in Brazil in the last two decades has increased at twice the mean global rate. The proportion of articles coming from Brazil indexed in the Web of Science database, which two decades ago was approximately 0.5%, now approaches 1.5% of global output. A similar growth pattern has been observed other analyses of research in the health area.⁹

Some of these studies report that, generally speaking, the growth of Brazilian scientific production in recent decades has been greater than that of other Latin American countries.* A bibliometric study¹² that divided publications in the health field into biomedicine, clinical practice, and collective health showed intense growth in scientific production between 1973 and 1992. In relation to other Latin American countries, Brazil ranked first in production in the field of biomedicine, with 38.7% of all published articles (followed by Argentina, with 29.6%); in the field of clinical practice, production in Brazil, Argentina, and Mexico was similar (26.6%, 27.5%, and 22.7%, respectively); however, in the field of collective health, Brazilian production accounted for 60.7% of published articles, with a substantial lead over Argentina (13.5%) and Mexico (11.2%), in second and third places, respectively.¹² This study also showed that epidemiological production was centered on infectious diseases and mother-infant health; this is in contrast with worldwide production, in which chronic diseases were already the foremost topic of investigation.

Regarding epidemiology specifically, the description and analysis of its growth and trends in Brazil were the subject of a few but important studies.^{5,10,13} Teixeira¹³ analyzed the abstracts of studies presented at the first three Brazilian epidemiology congresses, and identified some important characteristics: significant participation of health care professionals, collaboration between academics and such professionals, and the existence of a small core of epidemiologists that presented abstracts at the three congresses investigated. Guimarães et al,¹⁰ using the 2000 Research Directory of *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (CNPq - National Council for Scientific and Technological

Development), showed that epidemiological research topics were quite well structured, and were present in at least 176 research groups, most of which were in the field of collective health. However, their most interesting finding was that part of these groups did not belong to the health field, indicating the multidisciplinary trend typical of Brazilian epidemiological research. Barreto⁵ analyzed the foundations of the intense growth of epidemiology in Brazil, highlighting the strong interaction between academic research and health care service practice.

The aim of the present study was to analyze the growth of scientific production in epidemiology in Brazil and to discuss qualitative aspects of this growth, as well as its implications and trends.

METHODS

We carried out a survey of epidemiological articles produced in Brazil and published in journals indexed in the MEDLINE/PubMed database between 1985 and 2004. Even though it favors North-American publications, the MEDLINE/PubMed database is the greatest available bibliographical database for the health area with global coverage. A number of relevant Brazilian health science journals are indexed in this database, whereas others, just as relevant, are not. Specifically in the field of collective health, two important journals – *Revista de Saúde Pública* and *Cadernos de Saúde Pública* – are indexed, while other journals of growing importance in this area, such as *Ciência e Saúde Coletiva* are still not in the database. At the international level, important epidemiological journals are indexed in MEDLINE/PubMed (American Journal of Epidemiology, International Journal of Epidemiology, Epidemiology, Annals of Epidemiology, Journal of Epidemiology and Community Health, Journal of Clinical Epidemiology, Paediatric and Perinatal Epidemiology, Epidemiology and Infection, Social Psychiatry and Psychiatric Epidemiology, European Journal of Epidemiology, Journal of Epidemiology, Community Dentistry and Oral Epidemiology).

The present study covered a period of two decades, divided into four subperiods: 1985-1989, 1990-1994, 1995-1999, and 2000-2004. In order to characterize an article as “epidemiological”, the following keywords were used, in Boolean combination: (*epidemiology OR risk*) AND (*ecological OR geographical OR aggregate OR time-series OR trend OR cohort OR transversal OR cross-sectional OR case-control OR trial OR intervention OR etiological*).

*Hill DL. Latin America shows rapid rise in S&E articles *InfoBrief*. National Science Foundation; 2004. Available from http://www.nsf.gov/news/news_summ.jsp?cntn_id=100462 [access in 2006 Jul 13 jul]

In order to identify articles related to Brazil, we included the term “*and Brazil*” to the combination described above. Data were retrieved for entries between January 1st to December 31st of the first and last years of the analyzed subperiod. For this search, the studied time period was defined in the “Limits” tab of the PubMed search interface. The number of articles published in English (or in any other language) was obtained using another field in the “Limits” tab. In order to verify the consistency of the information thus obtained, we also carried out searches using the same Boolean combinations in the Web of Science database.

RESULTS

For the entire 1985-2004 period, we retrieved 211,727 articles from the MEDLINE/PubMed database, of which 1,958 (0.9%) were related to Brazil. Of these,

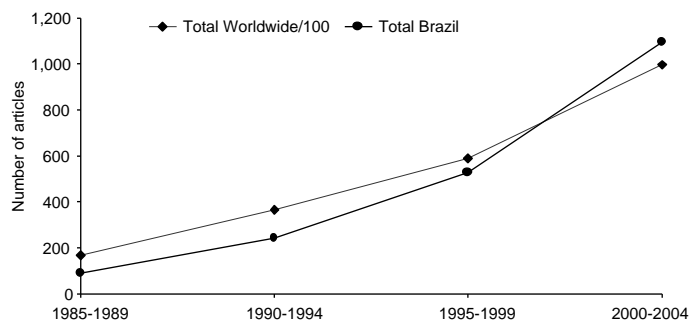


Figure 3 - Number of worldwide (/100) and Brazilian publications in epidemiology retrieved from MEDLINE/PubMed, 1985 to 2004.

91 articles (0.5% of the total) were from the 1985-1989 period, whereas 1,096 (1.1% of the total) were from the 2000-2004 period, indicating an approximately 12-fold increase in the number of articles, and a twofold increase in terms of the percentage of articles indexed in the database. Of the total 1,958 articles related to Brazil, 741 (38%) were published in Brazil, 513 (26%) in the United States, 361(18%) in Great Britain, and the remainder (343) in other countries. Figure 1 shows the growing trend for articles published by Brazilians in Brazilian, North-American, and British journals. There is also a predominance of the English language among articles by Brazilian authors indexed in the MEDLINE/PubMed database, totaling 71%. This high proportion remained stable throughout all periods studied. Of all articles published in Brazilian journals, 33% were in English. The ascending curve seen in Figure 1 was the consequence of an increase in the different

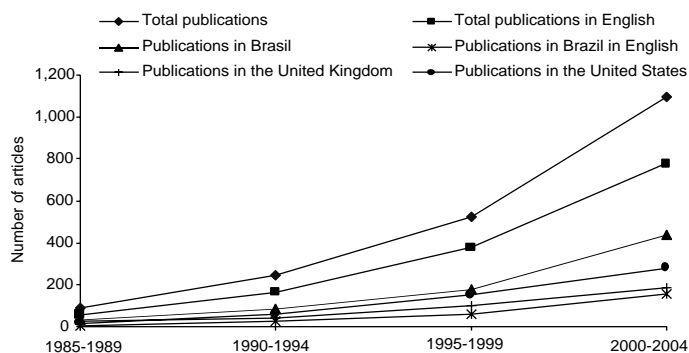


Figure 1 - Number of Brazilian publications in epidemiology (total, in English, and by country of publication) retrieved from MEDLINE/PubMed, 1985 to 2004.

types epidemiological of studies. Thus, if we consider more complex studies – such as those with longitudinal design – alone, we see an increase similar to that seen for epidemiological studies in general. In the 1985-1989 period, we identified 21 longitudinal studies, increasing to 61, 136, and 275 in the following subperiods, representing 23%, 25%, 26%, and 25% of all studies in each period.

The same search when conducted in the Web of Science database retrieved a smaller number of articles (742), with only a single article in the 1985-1989 period. The growing trend was similar to that observed using MEDLINE/PubMed data (Figure 2).

When compared to global production (Figure 3), in spite of the substantial difference in magnitude, growth across the two decades analyzed was faster in Brazil than it was worldwide. Thus, whereas in 1985-1989 Brazilian production accounted for 0.5% of global production, in the subsequent subperiod this proportion increased, reaching 0.7% in 1990-1994, 0.9% in 1995-1999, and as much as 1.1% in 2000-2004, corresponding to a relative growth of more than twice that observed globally. Figure 4 shows Brazilian epidemiological production in the 1985-2005 period in relation to

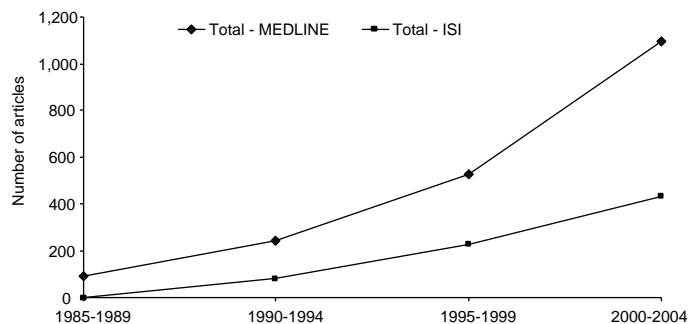


Figure 2 - Number of Brazilian publications in epidemiology retrieved from MEDLINE/PubMed and ISI/Web of Science, 1985 to 2004.

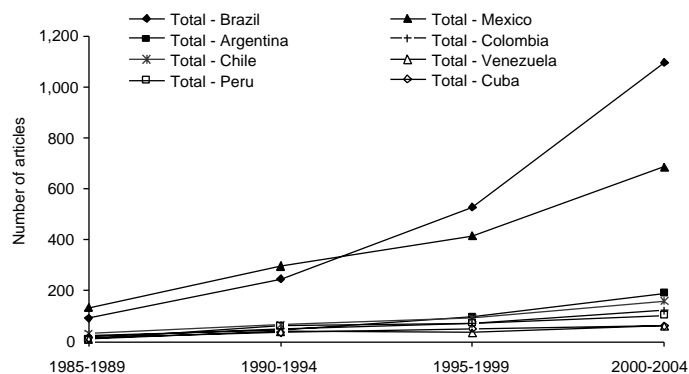


Figure 4 - Number of publications in epidemiology from selected Latin American and Caribbean countries retrieved from MEDLINE/PubMed, 1985 to 2004.

production in major Latin American countries. When compared to most countries analyzed, the difference between production in Brazil increased considerably throughout the period. Interestingly, the production of epidemiological articles in Mexico, which in 1985-1989 was the only country with greater production than Brazil, was significantly lower than Brazilian production in the 2000-2004 period.

Concerning the topics of epidemiological articles published in Brazil, in the first period (1985-9), 74% of articles addressed subjects related to infectious diseases and mother-child health, and the remaining 26% corresponded to 24 articles on cancer, heart disease, mental disorders, and environmental and nutritional problems. This scenario became inverted in the 2000-2004 period, with only 40% of articles addressing infectious diseases and mother-child health, and the remaining 60% – approximately 700 articles – being dedicated to other epidemiological topics, with important increases in the fields of violence and oral health.

DISCUSSION

The results of the present study corroborate evidence previously presented in other studies of the growth of epidemiological research in Brazil in the last two decades. A potential turning point in this process is the year of 1984, which saw the first national meeting on teaching and research in epidemiology, and when the Epidemiology Committee of the *Associação Brasileira de Pós-Graduação em Saúde Coletiva* (Abrasco - Brazilian Association of Collective Health Postgraduate Programs) was created.¹ This committee would become a major stimulus for the development of Brazilian epidemiology. We also found that growth was more intense in Brazil than it was worldwide, and that it was greater than that of other Latin American countries. We therefore conclude that scientific pro-

duction in epidemiology in Brazil is showing growth patterns similar to those found in other fields of scientific knowledge.⁹

The MEDLINE/PubMed database has greater coverage of the health and collective health areas than does Web of Science. Access to the on-line version of MEDLINE/PubMed is universal and free, making it the most accessed bibliographic source for the health area. However, the ISI/Thomson database has been used more often in scientometric studies, among other reasons because it includes journals from other scientific fields, thus allowing for comparisons to be made between the different areas of science. However, ISI/

Thomson is more restrictive in the coverage of indexed journals, and shows major differences from MEDLINE/PubMed. The most important of these is that, whereas MEDLINE/PubMed is a governmental organ linked to the United States National Library of Medicine, ISI/Thomson is a private enterprise, whose transparency has been seriously questioned.¹¹ ISI/Thomson, however, carries out other tasks of great importance to scientometrics, producing measures of the impact of scientific journals published in its database (impact factors), in addition to cataloguing the number of citations that each indexed article has had in subsequent scientific articles (i.e., in articles published in other journals included in this same database). The majority of North-American and British journals in which Brazilians most frequently publish, in the fields of epidemiology, collective health, or general health alike, are indexed in both MEDLINE/PubMed and ISI/Thomson. However, this is not the case for Brazilian journals, since, as already mentioned, in the field of collective health, only *Cadernos de Saúde Pública* and *Revista de Saúde Pública* are indexed in MEDLINE/PubMed, and only the latter is indexed in ISI/Thomson.

Despite the limitations of the present bibliographical search, we believe to have succeeded in attaining our major objective, which was to show the growth and trends in publication, even though the magnitude of production (number of published articles) may eventually be greater than that found in the present study.

Guimarães et al¹⁰ documented the large number of researchers with PhDs in epidemiology in activity in research groups throughout Brazil. In the 1980's and 1990s, these authors identified over 90 doctors inserted into research groups abroad (especially in the United States and England). In its turn, the development of postgraduate programs in collective health, many of which concentrate on epidemiology, has led

to the training of a growing number of epidemiologists from Brazil and from other countries, especially from Latin America and Africa. Obviously, such a large number of researchers is in itself a propelling factor for scientific production. Barata & Goldbaum,³ while analyzing the characteristics of CNPq researchers in the field of public health, observed that the majority of these are epidemiologists, and that the proportion of those trained outside Brazil is decreasing markedly, reflecting a change in place of training between the different generations of epidemiologists.

In short, the expansion of the scientific production in epidemiology detected in the present study, based mainly on the MEDLINE/PubMed database, is consistent with the findings of previous surveys using other sources. A natural and immediate unfolding of the realization of such increase in scientific production in epidemiology would be a qualitative analysis of production, centered on issues such as its impact on international epidemiology and its meaning in terms of knowledge of the health conditions of the Brazilian population and implementation of policies and measures to improve them.

International impact deserves special attention, since it is connected to the fundamental characteristic of scientific knowledge: becoming a universal good, to be shared internationally. We found that about 71% of Brazilian scientific articles indexed in MEDLINE/PubMed are written in English, allowing them to be read by researchers from other countries more easily than if they were published only in Portuguese. Language of publication is a polemic issue. One question in this context is what leads an author to choose an international rather than a Brazilian journal. Even in Brazilian journals, an important proportion (33%) of publications in epidemiology are in English. Certain Brazilian collective health journals allow the author to choose the language of publication. However, other alternatives are being introduced, and *Revista de Saúde Pública* has recently innovated in this field, offering the choice of bilingual (Portuguese-English) publication, thus reaching the international audience and allowing Brazilian readers the option of reading the article in their mother tongue, providing greater access to the national audience. SciELO (Scientific Electronic Library On-line), the portal which houses the most important Brazilian scientific journals (including those of collective health and epidemiology), allows free on-line access to publications, and is an important means of dissemination of scientific production in Brazil. Journals indexed in MEDLINE/PubMed offer a link to SciELO, allowing access to the full-text article.

The impact of these choices on the internationalization of these journals is still largely unknown. *Revista de Saúde Pública* is still the only Brazilian collective health journal indexed in ISI/Thomson, and, therefore, with a measured impact factor. This factor, however, is very low (0.2 in 2004), and has not shown an increasing trend in recent years. A likely cause for this is the fact that the majority of its articles are published in Portuguese. We still do not know whether the bilingual (Portuguese-English) publication of articles, begun in 2003, will lead to an increase in the journal's impact factor. All these efforts are aimed at strengthening the process of dissemination of scientific knowledge, allowing free and widespread access to the knowledge produced. Knowledge is traditionally disseminated from central countries (producers) to peripheral ones (receptors and users). We do not know how much an increase in the production of knowledge in a given country can influence this scenario. However, there is no doubt as to the increase in the autonomy of peripheral countries with respect to the solution of their own problems and challenges.

Regarding the impact of scientific production, it is expected that an article will serve as a reference for subsequent articles. ISI/Thomson created the impact factor for scientific journals in order to measure the mean number of citations of articles published in a given journal during a given period. ISI/Thomson also retrieves citations for a given article indexed in its database. Although universally used, the impact factor has been the target of much criticism.⁸ Recently, other initiatives have been developed in this field. A noteworthy effort is Google Scholar, which also retrieves citations for a given article, and which does not have the limitations of ISI/Thomson. However, this system does not measure the impact of specific journals. In applied areas such as collective health, part of the knowledge produced is used by professionals rather than by other researchers. Other impacts are thus expected from applied knowledge in addition to bibliographic impact. However, non-bibliographic impact (for instance, professional practice, technology, patents, regulations, among others) is far from being measurable through standardized procedures, comparable between different fields of study.

The distribution of article production according to subject also allowed us to gauge the increase in the diversification of topics addressed by Brazilian epidemiologists. Almeida-Filho et al² reported an increase in publications addressing inequities in health. This certainly mean to broadening our knowledge of the complex health problems affecting the Brazilian population, a necessary step for policies and actions to be devised and implemented.

Barreto^{5,7} previously argued that the growth of epidemiological knowledge is strongly related to certain characteristics of development in the field, which define the profile of scientific practice among Brazilian epidemiologists. The evidence presented in the present study bring about further elements to show that Brazilian epidemiological research is becoming consolidated at the same pace as other scientific fields in Brazil. This includes its high degree of internationalization, as should be the case with any scientific field. Nevertheless, epidemiology is undergoing such a process without losing contact with its commitments as a social practice, intended to increase our basis of knowledge of the health conditions of the Brazilian population and its determinants and devise possible changes.^{4,6} The strengthening of postgraduate programs

in collective health and epidemiology in Brazil is due, among other factors, to an increase in the financial resources allocated by the Ministry of Health to epidemiological studies in recent years. An example of this is the approval of large-scale projects such as the ELSA – *Estudo Longitudinal de Saúde do Adulto* (Longitudinal Study of Adult Health). It is expected that, in following decades, the development of new instruments for the evaluation of applied scientific fields, as is the case of epidemiology, may take evaluation beyond the limits of bibliometric quantification. Its effects on health-related policies and actions and on professional practice must be the subject of more thorough evaluations providing a better picture of another of science's characteristics, namely its ability to modify the context into which it is inserted.

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