Towards International Recognition of Spanish Scientific Publications

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Published papers play a vital role in all stages of scientific research. They are the starting point for all research projects since they reflect the state of knowledge regarding the topics they discuss, and are the preferred channel through which the results of completed research are made known. Scientific papers facilitate the spread of new knowledge, which then forms the base of the work of other scientists. In this way the contributions made by successive generations power the growth of science. In the final analysis, scientific papers drive scientific progress. However, these publications also perform other functions, e.g., they establish the priority of discoveries via the date of reception, and scientists are rewarded by being cited by other authors. In the most applied or clinical areas of endeavor, scientific papers are an essential means of keeping up to date; they therefore contribute towards good professional practice.

Based on these premises, bibliometric studies—or studies on scientific production—are essential tools in the analysis and assessment of the research performed in different countries. The data they produce successfully complement other types of indicator such as the economic investment made in research, or the human resources involved in research activities. Studies on scientific papers frequently make use of the Web of Science, a multi-disciplinary database very useful for analyzing international science since it covers a selection of journals based on their quality and international interest.

The number of papers by Spanish authors recorded in the Science Citation Index Expanded Database, which is accessible via the Web of Science, increased exponentially between 1980 and the present. In 1980 this database contained about 4000 articles from Spain (0.7% of the entire database in that year), but by 2003 this figure had increased to 31 000 (reaching 2.8% of world production). This increase of over 600% is very much greater than the increase in the total size of the database (100%) (Figure 1). Of these papers, nearly 45% concerned medical topics, an area covering a wide range of disciplines and involving both basic research (biomedicine) and clinical research (clinical medicine).

This growing presence of Spanish researchers in international bibliographic databases is very positive and reflects the strengthening of the Spanish research system as well as the increasing orientation towards the international arena that has occurred in recent decades. This tendency is the result of different factors, some that might be called "intrinsic," i.e., inherent to the scientific process, and others that might be termed "extrinsic." With respect to the former, it should be remembered that science, by definition, is an international, collective

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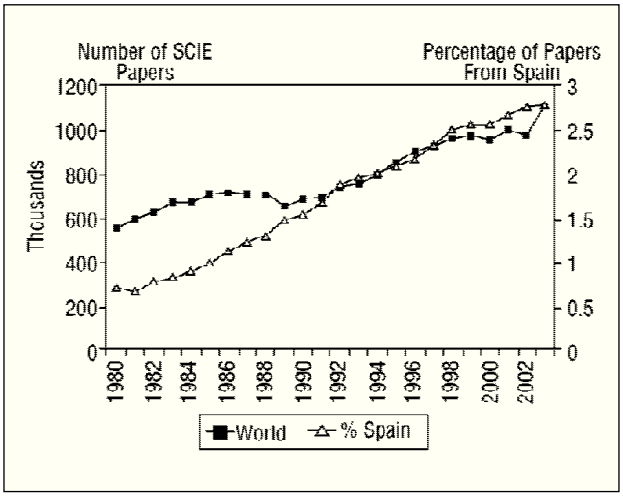

Fig. 1. Annual change in the number of scientific papers recorded in the SCI Expanded Database and the percentage of Spanish papers. Source: Web of Science.

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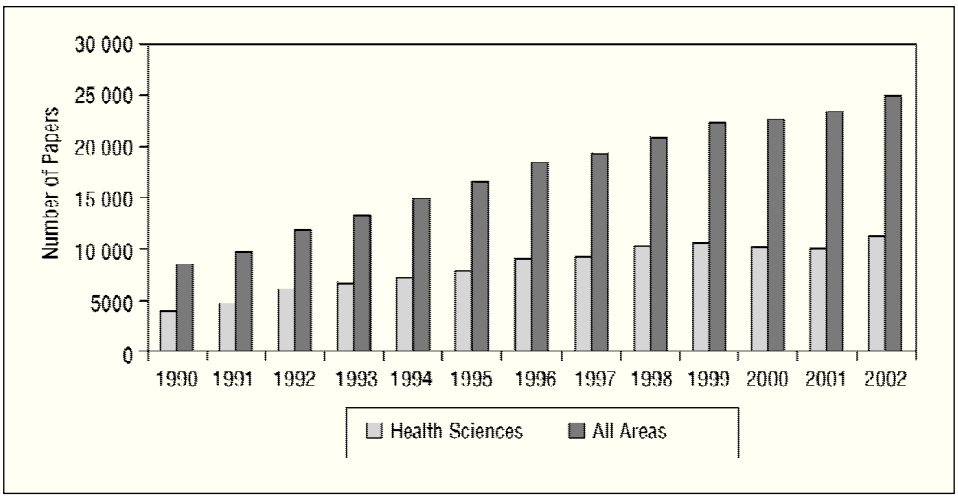

Fig. 2. Scientific papers from Spain in the SCI (CD-ROM version) 1990-2002.

activity; the advances made interest the entire scientific community irrespective of nationality or geographical location. Achieving the greatest circulation of research results in order to make them useful and accessible is a natural and legitimate goal. Publishing in internationally distributed journals guarantees that more scientists will become aware of the work being performed. The above-mentioned extrinsic factors, however, are related to policies regarding the management and assessment of research and professional practice. These factors influence researchers when choosing the journal in which to publish their results. In assessment processes (e.g., involving the concession of scientific promotion, financial assistance for research, grants and even the award of prizes), there is no doubt that papers published in prestigious international journals receive greater recognition. This is an effective stimulus for publishing in such journals, and also leads to an increase in the international visibility of a country's research.[1]

The process of internationalization that today affects many aspects of our lives is also present in the world of science. Current computer technologies not only facilitate access to new knowledge from any part of the world, they also improve communication. The result has been increasing international collaboration between researchers, the establishment of research networks, and the growing use of international channels for the dissemination of results. In recent years this has led to changes in the publication strategies of researchers in many developed countries. They now prefer to publish in international rather than national journals since the former allow wider circulation of their results and make their work more visible. This gradual transition has been described to have 3 consecutive stages:[2,3]

– In stage 1, authors direct their work towards the international journals in the main databases corresponding to their specialities (e.g., SCI or MEDLINE). This guarantees wide visibility of their work.

– Stage 2 involves greater selectivity with respect to the journals chosen: there is a preference for English language journals, which have been reported to have greater circulation and greater recognition in terms of cited references.

– Finally, the aim of stage 3 is to publish in journals of the highest quality and with the greatest prestige from among these international publications. One of the indicators most often used when making a choice of a journal is its impact factor, which is calculated and published annually in *Journal Citation Reports* by the Institute for Scientific Information (ISI), Philadelphia. Publishing in journals with a high impact factor can become an objective for many researchers.

The data available for Spain clearly reflect this transition. Between 1980 and 1999, the number of scientific papers from this country in the Science Citation Index Expanded Database increased by a factor of eight. If we look at the biomedical and health sciences alone, Spanish production between 1990 and 1999 (restricted SCI, CD-ROM version) increased by a factor of 3, a rhythm of growth very similar to that seen for scientific publications as a whole in Spain (2.8 compared to 2.9) (Figure 2). The increase in the number of papers in international journals in recent years has been greater than that registered for national journals recorded in Spanish databases (IME *Índice Médico Español* and ICYT *Índice Español de Ciencia y Tecnología*). Indeed, a negative trend has been observed with respect to publication in national journals. Researchers are therefore clearly orientated towards international publications (stage 1), probably driven by a mixture of the above-mentioned intrinsic and extrinsic factors.

The migration towards journals published in English is also apparent in Spain. Table 1 shows the reduction

in the number of papers published in Spanish recorded in the SCI database between 1980 and 2000. The same has been seen for papers published in other languages such as French or German. This reduction has been accompanied by an increase in the number of English language papers: indeed, in 2000, 96% of the papers in the SCI Expanded Database were published in English. Stage 2, the transition stage, is therefore underway.

Arriving at stage three, however, is more difficult. However, the data available show that Spanish researchers tend to publish in journals with relatively high impact factors, with variations depending on discipline. The analysis of papers by Spanish authors in the area of biomedicine and health sciences reveals a trend to publish in specialized journals in the first and second quartiles in terms of impact factor.[4]

Internationalization does not occur at the same rate in all areas and all disciplines. The phenomenon makes greatest sense at the level of basic research, which involves an international scientific community that shares aims and concerns. In this respect, English has become the established *lingua franca* for communicating beyond geographical and linguistic frontiers. However, the process of internationalization is also reaching into clinical research, although its introduction in this area is less aggressive since conflicting national and international interests often coexist.

The work of Miguel-Dasit et al[5] published in this issue of the REC analyses the international visibility of papers by Spanish cardiologists and radiologists in the clinical area of "imaging diagnosis in cardiology." There is no doubt that this is an area of great interest with great potential for the future: these techniques are becoming increasingly important in the diagnosis of cardiovascular disease.[6] Two results in the work by Miguel-Dasit et al are especially interesting: the increasing international visibility of Spanish authors in this area and the important role of the journals published by the scientific societies of both disciplines.

The work of Miguel-Dasit et al suggests that radiologists became incorporated into the international scientific community some time after cardiologists. The number of papers concerning radiology published in international journals has been increasing (stage 1), although they are still not concentrated in the best journals of the speciality (stage 2). International production concerning cardiology is less intense but more stable, and a greater percentage of what is produced appears in the field's most prestigious journals. It is interesting to note that, although these results refer to a small number of papers, similar behaviors have been reported in the more general areas of radiology (a high rate of increase in production plus a tendency to publish in journals in the second quartile) and cardiology (lower rate of increase in production plus a tendency to publish in journals in the first quartile) in Spain (SCI data for 1994-1999).[4] Secondly, there is a need to highlight the important role played by the Spanish journals produced by the scientific societies representing these disciplines, i.e., *Radiología* and REVISTA ESPAÑOLA DE CARDIOLOGÍA: these journals published half of all the papers identified for each speciality. Currently these journals are faced with the challenge of capturing quality original articles despite the migration of authors towards foreign publications. It is a fact that the process of internationalization has endangered the survival of some national journals which have had to develop new strategies in order to remain attractive to researchers. Many have potentiated their international facet by increasing their presence in international databases, by being available on-line, or by offering their contents in English.

TABLE 1. **Annual Distribution of Papers by Language (Science Citation Index Expanded Database, Web of Science)**

	1980	1990	2000
English	84.5%	90.5%	95.9%
French	3.8%	1.9%	1.0%
German	5.1%	2.5%	1.1%
Spanish	0.7%	0.4%	0.3%
Japanese	0.7%	0.5%	0.3%
Total no. of papers	554 598	689 629	956 533

The use of English as the language of publication is a good strategy for increasing the international visibility of a journal, especially in the most basic areas of research or as an addition to the Spanish edition in clinical areas. Nowadays, many clinical or applied journals have their largest readership within their own country, in which they play an important role in the integration and cohesion of national scientific communities and contribute towards professional and ongoing training—all of which recommends that the local language be used. This has been understood by a number of Spanish clinical journals that have decided to maintain their Spanish edition despite the growing internationalization of science; some, however, also produce an English edition in order to increase their visibility outside the country. The production of journals that are attractive to both specialist researchers and practicing physicians is an important challenge now being faced by many journals.[7]

As part of the process of internationalization, the overwhelming desire to publish in the "best" journals and the linking of quality to impact factors has extended to all areas. However, the editors of several medical journals point out that the best journal in which to publish depends on the readership to whom the work is directed,[8] and that this is more important than any obsession with impact factors. Curiously, publishing in journals with a high impact factor, which are recorded

in the main databases and which are published in English (i.e., prestigious international journals), can be counter-productive if they are not read by the researchers to whom the paper is mainly directed. The paradoxical situation could arise in which these papers hardly become known in the very country in which the research was performed—where potentially the main readers may be and where the work may be of greatest use. As a result of this scant dissemination among the paper's main readers—who are also those who may cite the work–these articles are referred to less often and may have less true impact than if they had been published in the mother tongue. For example, papers concerning medicine in a given country can have a greater effect on practice and even on medical management if they are published in the language of that country.

The limitations of the impact factor system—which are amply recorded in the literature[9]—should not be forgotten either. Although the impact factor allows the most prestigious international journals to be identified (which usually select original articles based on very strict criteria), it says nothing about the real impact that a paper eventually has. Further, great variability has been recorded between the articles published by each journal. To gain insight into an article's true impact, other indicators might be used, such as the number of times it is cited by other authors or the number of times electronic documents are read. Apart from these indicators—and here referring particularly to clinical research—it would be interesting to assess other aspects of the impact of research, such as its influence on clinical practice, or perhaps its social impact.[10]

Although Spanish researchers now publish in high quality, prestigious, international journals, recognition of their work in terms of the number of times their papers are cited is, in many disciplines, still below what might be expected (i.e., below world means for the corresponding disciplines). According to the North American *Science & Technology Indicators* for 2002, Spain produced 2.3% of the papers recorded in the SCI Expanded Database in 2002, yet these accounted for only 1.6% of all citations. We might therefore recognize a new stage in this process of internationalization, one in which the research performed by a country receives recognition in accordance with its capacity, effort and contribution to international science. Spain still has a long way to go in this respect, although some studies[11] show that in recent years the international visibility and true impact of papers published by Spanish authors is growing, as measured by the number of citations they receive per paper and the percentage of papers cited.

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