

Growing Trend of China's Contribution to the Field of Rheumatology 2000–2009: A Survey of Chinese Rheumatology Research

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ABSTRACT. *Objective.* In the past decade, rheumatology in China has achieved great advances. However, scientific publications on rheumatology in the 3 major regions of China — Mainland (ML), Hong Kong (HK), and Taiwan (TW) — are unknown. We assessed the performance of rheumatology research in China from 2000 to 2009.

Methods. Twenty-two journals included in the rheumatology category of the Journal Citation Reports database were selected. We analyzed the following measures for 2000–2009: (1) total number of articles originating from ML, HK, and TW; (2) impact factor (IF) of those articles; (3) total number of citations and average number of citations per article; and (4) number of articles about clinical trials, randomized controlled trials (RCT), and case reports. We also noted the total number of articles from the 3 regions published in 10 top-ranking journals.

Results. There were 788 articles for the 3 regions of China, including 259 from ML, 372 from TW, and 157 from HK, with a positive trend between the years 2000 to 2009. From 2006 on, published articles from ML exceeded those from HK, and in 2008, published articles from ML exceeded those from TW. HK had the highest average IF and highest average citations of each article compared with articles from ML and TW. TW published the most RCT, clinical trials, and case reports, as well as the most articles in the 10 top-ranking journals in the last decade, followed by ML and HK.

Conclusion. Chinese contributions to the field of rheumatology have increased rapidly since 2000, particularly from ML. HK had the highest quality research output according to average IF and average citations per article. (J Rheumatol First Release September 1 2010; doi:10.3899/jrheum.100524)

Key Indexing Terms:

RHEUMATOLOGY CHINA TAIWAN HONG KONG RESEARCH CLINICAL TRIAL

China is the largest developing country in the world; currently, a huge part of its population is at risk of rheumatic diseases^{1,2}. The prevalence of rheumatic complaints ranges from 11.6% to 46.4%¹. Rheumatic disorders are the leading cause of physical disability and have a substantial effect on the quality of life of patients as well as on the use of health-care resources. China is a country with a vast territory, complex topography, and diverse climates; thus, there are differing disease patterns between China and Western countries, and even within different regions in China^{1,2,3}. During the past few decades, there have been great advances in the field of rheumatology in the country⁴, including traditional Chinese and Western medicine approaches to diagnosis and treatment^{5,6,7,8,9,10,11}, the use of specific alternative therapies for pain and inflammation^{12,13}, and epidemiological studies on genetic polymorphisms^{14,15,16,17,18,19,20}.

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In December 2007, the Essential Science Indicators database demonstrated that the scientific output of China (471,890) has rapidly increased (ranked sixth among the 20 most-cited countries in all fields), following the United States (2,864,275), Japan (777,992), Germany (738,067), England (653,177), and France (529,636)²¹. However, rheumatology publications by Chinese authors were not reported. Our study attempts to elucidate and compare the development of contributions to rheumatology research from 2000 to 2009 in the 3 regions of China: Mainland (ML), Hong Kong (HK), and Taiwan (TW).

MATERIALS AND METHODS

Twenty-two journals were selected from the Rheumatology category of the 2008 Journal Citation Reports (JCR) database, according to the Institute for Scientific Information (ISI). A computerized search of these journals was conducted in the PubMed and ISI database and all articles were collected from the 3 regions of China over a 10-year period (2000–2009). The rheumatology journals included were *Aktuelle Rheumatologie*, *Annals of the Rheumatic Diseases*, *Arthritis & Rheumatism-Arthritis Care & Research*, *Arthritis Research Therapy*, *Best Practice and Research in Clinical Rheumatology*, *BMC Musculoskeletal Disorders*, *Clinical and Experimental Rheumatology*, *Clinical Rheumatology*, *Current Opinion in Rheumatology*, *Journal of Musculoskeletal Pain*, *Journal of Rheumatology*, *Journal of Clinical Rheumatology*, *Joint Bone Spine*, *Lupus*, *Nature Clinical Practice-Rheumatology*, *Osteoarthritis Cartilage*, *Rheumatic*

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Disease Clinics of North America, Rheumatology International, Rheumatology, Scandinavian Journal of Rheumatology, Seminars in Arthritis and Rheumatism, and Zeitschrift für Rheumatologie. Only data from articles and reviews were analyzed, excluding publication types such as meeting abstracts, editorial materials, news items, letters, and corrections. We used the 2008 impact factors (IF) published in the JCR.

Two reviewers independently performed the search strategy, selection of articles, and data extraction. Disagreements were resolved through discussions and, whenever necessary, with the help of other reviewers. To quantify and qualify research productivity among these 3 regions from 2000 to 2009, we analyzed the following measures: (1) total number of articles originating from ML, HK, and TW; (2) the accumulated IF and the average IF; (3) the total number of citations and average number of citations per article; (4) the number of clinical trials and randomized controlled trials (RCT) and case reports among all the total articles; and (5) the total number of articles published in 10 top-ranking journals.

Statistical analyses. Nonparametric tests were performed using SPSS 13.0 (SPSS Inc., Chicago, IL, USA) to determine any significant change over the study period. The Kruskal-Wallis test was used to detect differences among the 3 regions. Meanwhile, the Mann-Whitney U test was used to detect differences between 2 regions when necessary. All significance tests were 2-tailed, and values of $p < 0.05$ were considered significant.

RESULTS

Total number and percentage of articles. Overall, 30,304 articles were published worldwide in the included 22 journals from 2000 to 2009. There were 788 articles (2.6%) from China: 259 (32.9%) from ML, 372 (47.2%) from TW, and 157 (19.9%) from HK. The number of articles showed significantly positive trends in China (from 28 to 174; $p < 0.001$). The number of articles increased significantly in ML ($p < 0.001$), HK ($p = 0.03$), and TW ($p < 0.001$) during the last decade (Figure 1). From 2006, the number of articles published from ML exceeded that from HK and in 2008, the number of articles published from ML exceeded that from TW.

Impact factor and citation report. The accumulated IF of all articles published in China showed a significantly increasing trend from 2000 to 2009 (from 77.67 to 523.93; $p = 0.001$). The accumulated IF of articles increased significant-

ly in ML (from 0 to 267.40; $p < 0.001$), HK (from 42.18 to 74.25; $p = 0.004$), and TW (from 42.62 to 182.28; $p < 0.001$; Figure 2). From 2006 on, the accumulated IF from ML exceeded that from HK, and in 2008, the accumulated IF from ML exceeded that from TW. HK had the highest average IF (3.539), followed by ML (3.054), and TW (2.931; $p < 0.001$). Figure 3 shows the distribution of articles in relation to IF from the 3 regions of China. Focusing on journals with IF of 1.000–2.000, TW (135) had the highest number of articles, followed by ML (100) and HK (16). In addition, TW had the highest total citations of 2352 in 365 articles, followed by HK (1762 total citations in 150 articles) and ML (908 citations in 253 articles). Meanwhile, HK had the highest average citations of each article at 11.826, followed by TW (6.444) and ML (3.589; $p < 0.001$).

Number of clinical trials, RCT, and case reports. TW published the most RCT (10), clinical trials (24), and case

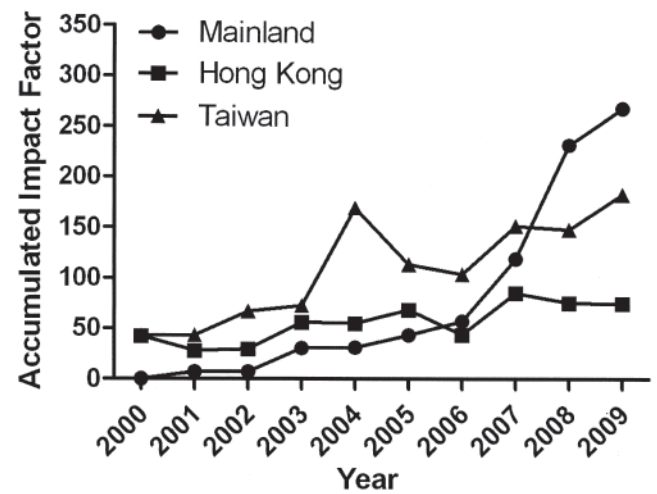


Figure 2. Accumulated impact factor of articles from the Mainland, Hong Kong, and Taiwan, 2000-2009.

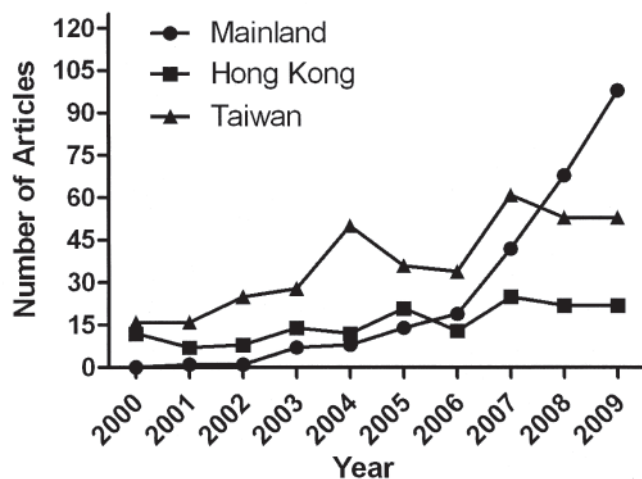


Figure 1. Trend of all articles from the Mainland, Hong Kong, and Taiwan, 2000-2009.

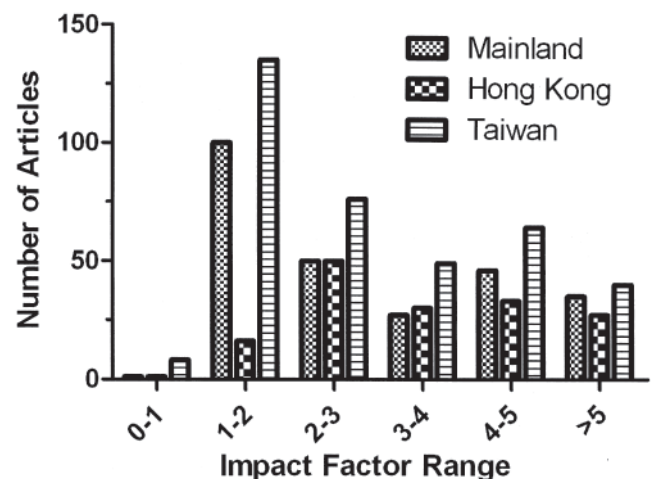


Figure 3. Distribution of articles in relation to impact factor from the Mainland, Hong Kong, and Taiwan, 2000-2009.

reports (83) in the last decade compared with ML (9 RCT, 19 clinical trials, and 23 case reports) and HK (8 RCT, 17 clinical trials and 20 case reports; Figure 4).

Top 10 high IF rheumatology journals. Overall, 350 articles from the 3 regions were published in the 10 top-ranking rheumatology category journals. TW published the most articles (152), followed by ML (108) and HK (90). Of these, 37.14% (103/350) were published in *Journal of Rheumatology*, 25.57% (78/305) in *Rheumatology*, and 21.14% (74/350) in *Arthritis & Rheumatism–Arthritis Care & Research* (Table 1).

DISCUSSION

Rheumatism was first described in ancient Chinese medical books more than 2000 years ago². Although modern rheumatology is a relatively new subspecialty of medicine in China, the Chinese Rheumatology Association in ML was already established by 1985²². Great advances in the field of rheumatology in China have enjoyed increasing attention

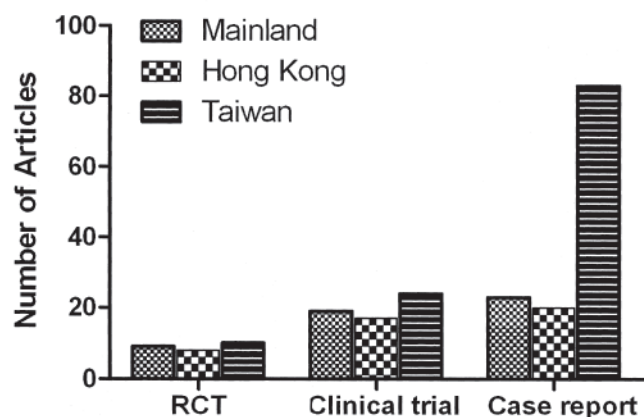


Figure 4. Number of articles on clinical trials, randomized controlled trials (RCT), and case reports from the Mainland, Hong Kong, and Taiwan, 2000-2009.

from scholars all over the world. The status of journal publications could reflect the development or status of the scientific research in the field^{23,24,25}. However, until recently, little has been known about the published research from China in the field of rheumatology. Our analysis provides a picture of the growth, size, and distribution of scientific output in relation to the research of rheumatology in China. The number of publications from China in international journals in the field of rheumatology from 2000 and 2009 showed a 6-fold increase. Moreover, all 3 regions of China showed positive trends in total research output, with a notable increase in ML. For the past few decades, mainland China opened its doors to international trade and switched to a market-oriented economy, facilitating rapid economic growth. Rahman and Fukui found that the gross national product per capita and research and development expenditure are the most important factors affecting scientific publications²⁶. The increasing share obtained by China may reflect the increase in financial resources invested in research activity.

All 22 journals listed by the JCR in the rheumatology category published papers in English. Moreover, the journals originated from 7 different countries, including the United States (9), England (7), Germany (2), France (1), Italy (1), Canada (1), and Norway (1), but not from China. English-language medical journals and English proficiency greatly influence research productivity^{27,28}. HK and TW have the advantage of a strong foundation in written English. In contrast, English is not commonly used in professional practice for Chinese doctors from ML. In fact, a substantial number of articles from China were published in domestic journals in Chinese. Consequently, for researchers outside China, it is difficult to freely access studies conducted in these regions.

The value of the IF as a tool for assessing the quality of a medical journal is controversial^{29,30}, but it has not been replaced by another index. Indeed, it can be valuable for

Table 1. Articles published in the 10 top-ranking journals from mainland China (ML), Taiwan (TW), and Hong Kong (HK).

Rank	Journal	2008 Impact Factor	ML	HK	TW	Total
1	Annals of the Rheumatic Diseases	7.188	8	4	10	22
2	Arthritis and Rheumatology- Arthritis Care & Research	6.787	24	21	29	74
3	Nature Clinical Practice Rheumatology	5.677	3	2	0	5
4	Current Opinion Rheumatology	4.689	1	0	0	1
5	Arthritis Research Therapy	4.485	16	0	5	21
6	Seminars in Arthritis and Rheumatism	4.379	1	3	4	8
7	Rheumatology	4.136	16	27	35	78
8	Osteoarthritis Cartilage	4.082	12	3	20	35
9	Journal of Rheumatology	3.282	27	27	49	103
10	Best Practice and Research in Clinical Rheumatology	3.066	0	3	0	3
	Total		108	90	152	

conducting direct comparisons in the same scientific field³¹. Moreover, citation count is one of the most important indicators in evaluating academic research³². We found that the 3 regions of China exhibited significant increases in accumulated IF and total citations of articles. Although the accumulated IF and total citations of articles from HK were lower than those from ML and TW, HK ranked first among the 3 regions with respect to average IF and average citations of each article. Thus, HK had higher quality and lower quantity of research output compared with ML and TW.

Our study demonstrated that the number of clinical trials, RCT, and case reports among articles was low in proportion to the total number of articles from China. China lags behind developed countries in conducting trials with a higher grade of evidence, despite the rapid increase of the number of articles from China in the field of rheumatology. Nevertheless, the rapid advancement of medical science requires the participation of developing countries, particularly those with large populations similar to China's. This is because geographic or ethnic differences in the occurrence of diseases often provide insights into causes of disease and possible opportunities for disease prevention. Thus, the rapid development in the field of rheumatology in China should provide valuable contributions to this area. In recent years, the number of hospitals with rheumatology units has grown to cover every province and state of China. The Chinese Rheumatology Association has become more actively involved in international communication. Many clinical and basic studies on rheumatic diseases in China have also been conducted. Additionally, traditional Chinese medicine is also being widely used in the treatment of rheumatic diseases.

Our study has several limitations in terms of the collection and interpretation of data. First, we used the JCR database to identify rheumatology journals for inclusion. The number of journals related to rheumatology is actually higher than the number included in our study. Second, rheumatology research may be published in journals other than those included in the rheumatology category. Finally, a proportion of articles included in the rheumatology category of the Science Citation Index are related to nonrheumatology topics. However, the rheumatology journals cited by the JCR published high-quality, peer-reviewed, and original research papers and review articles on rheumatology. Moreover, our results from a long period of 10 years may reflect in general the actual activity of rheumatology research in China.

Our study showed that the amount of rheumatology research rapidly increased in China over the past decade. The highest average IF and average citations per article came from HK, while the most clinical trials, RCT, and case reports, as well as the most articles in the 10 top-ranking journals, came from TW. In addition, the *Journal of Rheumatology*, was the most popular journal in China from 2000 to 2009.

The proportion of clinical trials from China is relatively low. Therefore, a public policy encouraging continued high-quality research in the field of rheumatology through an increase in government funding, as well as the provision of training opportunities for a sufficient number of scientists and rheumatologists, is urgently needed.

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