Biomedical Research Output in the Last Decade: Japanese Perspectives

Mahbubur Rahman MBBS, MPH, PhD¹; Junichi Sakamoto MD, PhD¹; Tsuguya Fukui MD, MPH, PhD²

¹ Department of Epidemiological and Clinical Research Information Management, Kyoto University Graduate School of Medicine, Kyoto, Japan
² Department of General Medicine and Clinical Epidemiology, Kyoto University Graduate School of Medicine, Kyoto, Japan

OBJECTIVE: To examine Japan’s overall biomedical research productivity and its trend in the last decade.

METHODS: Articles published during 1991–2000 were accessed through Medline database. The number of articles having affiliation with a Japanese institution was elicited using standard search strategy.

RESULTS: In total 3.8 million articles were published during 1991–2000 while 330,513 articles (8.7% of total) were originated from Japan. With language limited to English, there were 3.3 million articles in total and 252,635 (7.6% of total) from Japan. Yearly numbers of articles significantly increased as a whole and also for Japan. The number of English-language articles from Japan increased by 63% during 2000 compared to 1991 while it was 34% on average for all other countries. On the other hand, the number of Japanese-language articles was 77,878 with a 16.5% decrease in the same time.

CONCLUSION: The number of English-language articles originating from Japan has been increasing at a pace higher than that for all other countries together.

KEY WORDS: Biomedical research; research productivity; Japan; Medline

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Japan is the second largest contributor to biomedical journal¹. During 1990–2000, 9.4% of the total journal articles in Medline database were originated from Japan, the 2nd largest economy with one of the highest per capita income. Japan’s contributions to a variety of biomedical fields have already been reported ²⁻¹⁶. However, its contribution trend as a whole and separately for English and Japanese journals, have not been examined yet. The objectives of this study were to quantify Japan’s contribution to biomedical field in the last decade as a whole and separately for English and Japanese biomedical journals published in Japan and other countries.

Address Correspondence to Dr. Rahman: Department of Epidemiological and Clinical Research Information Management, Kyoto University Graduate School of Medicine, konoe-cho, Yoshida, Saky-ku, Kyoto 606-8501, Japan Phone: 81–75–752–1519, Fax: 81–75–752–1532, E-mail: rahman@phb.med.kyoto-u.ac.jp
METHODS

Journal-articles published during 1991–2000 were searched for their origin (all over the world Vs Japan) using Medline database following the strategy listed in Figure 1. The number of these articles was broken down to yearly numbers and divided into English and Japanese articles. The English-language articles originated from Japan were further divided into articles published in Japan and foreign countries. All the values related to Japan were also expressed as proportions of the total journal articles. Changes in the number of articles during 1991–2000 were compared between Japan and all countries together.

STATISTICAL ANALYSES

Nonparametric test for trend was used to determine...
any significant change regarding the total number of articles in Medline database, articles originating from Japan (English, Japanese) and Japan’s share of articles over the period of time. All the statistical procedures were performed using STATA 7.0 (STATA Corporation, College Station, Texas, USA). Tests of significance were two-tailed and values of \(p<0.05\) were considered significant.

### RESULTS

#### Number of Articles and Share of the Total

In total, 3.8 million articles were published during 1991–2000 while 3.3 million of them were in English. They showed significantly positive trend during 1991–2000 (Fig 2). Among total articles, 330,513 (8.7% of total) were originated from Japan with a positive trend both in number (\(p=0.01\)) and proportion (\(p=0.01\))
over the period of time (Fig. 3&4). Regarding English-language articles, Japan contributed 252,635 articles (7.6% of total), which again has been increased both in number (p=0.01) and proportion (p=0.01) over time (Fig. 3&4). During 1991–2000, 56,587 English-language articles were published in Japan, in which 47,463 articles were originated from within Japan. On the other hand, 77,878 articles were published in Japanese language during the same time span with a downward trend over time (p=0.02) (Fig 5).

**Changes during 1991–2000**

The number of all articles and English-language articles increased by 22% and 34%, respectively, during the last decade (Table 1, Fig 2). English-language articles from Japan, however, surpassed the overall growth with 63% increase in the year 2000 compared to 1991 (Table 1). Similarly, English-language articles published in Japan (25%) and authored by Japanese (19%) showed significant positive changes (Table 1). On the other hand, Japanese-language articles showed 17% negative change (Table 1). Japan’s share of articles went up by 14% as a whole, and 22% in English-language articles while its share of English-language articles published in Japan went down by 5%.

**DISCUSSION**

If we consider the number of total articles (2nd in the world), Japan’s overall research output in biomedical science is proportional to economic size (2nd in the world) and per capita gross national product (US$32,030, 7th in the world)\(^{13}\). However, when limited to the high level journals (5–20 journals from each category of biomedical field), its share of research outputs were: 0.7% in general medicine\(^{3}\), 3.1% in basic medical science\(^{4}\), 1.1% in epidemiology\(^{5}\), 11.4% in nuclear medicine\(^{6}\), 8.3% in orthopedic science\(^{7}\), 7.3% in anesthesia\(^{8}\), 6.5% in ophthalmology\(^{9}\), 6.0% in urology and nephrology\(^{10}\), 8.2% in dermatology\(^{11}\), 5.7% in rheumatology\(^{12}\), 3.4% in infectious diseases\(^{13}\), 7.9% in hematology\(^{14}\), 8.3% in cardiovascular diseases\(^{15}\) and 5.0% in the number of randomized controlled trials\(^{16}\). These rankings ranged from 2nd to 14th in the world\(^{3,5-7,9-16}\). The results here indicate that, although the overall quantity of Japan’s biomedical research output is 2nd in the world, its contributions to high-level journals are not always in line with its overall ranking in biomedical science. The main reason could be the fact that high-level clinical journals tend to accept articles of sophisticated research design [randomized controlled trial (RCT)]. And Japan’s share of RCT is meager (9th in the world in overall number) in this regard\(^{16}\). Japan is doing relatively well in high-level basic science research, which has been overwhelmingly led by the USA and the UK.

The tremendous increase in the number of English-language articles (by 63% compared to 34% for all other countries) from Japan coupled with the decrease in the number of Japanese-language articles reveals the fact that Japanese authors are more interested in publishing their research findings in English. Overall increase in the number of articles could be attributable to government sectors’ liberal funding policy for research and development, and increase in the number of biomedical researchers in Japan.

The limitations of this study are those attributable to the data source and to the search strategy. First, we used Medline database, although other database might have more articles from Japan. However, Medline database is considered most complete and thorough database\(^{18}\), superior to others\(^{19}\), and a single most effective means to identify relevant items to solve clinical and research problems\(^{20}\). Second, the number of publications elicited from Medline is only a gross estimate of research productivity irrespective of their quality. There is no search strategy to divide review articles from original contribution. Actually only journal articles were included in the analysis together, i.e., letters, correspondence, editorials, book reviews and news were excluded. Moreover, some articles could have been published both in English and Japanese. And thus the estimated research productivity in that case has been overestimated. Third, many local journals, and reports of research conducted at non-governmental and international organizations were published in Japan both in English and Japanese without being cited in Medline. Fourth, Medline database considers only corresponding authors’ affiliation as a place of origin of the article, which might not be appropriate in some cases. There were studies conducted in joint collaboration by mixed teams of local and international researchers and only communicating authors’ affiliations were included as origin of research in the Medline database. Fifth, although we undertook a vigorous search strategy by including all possible educational institutions, cities and prefectures, there might be additional articles, which could not be identified by our search method with these factors taken into account, actual number of research output for Japan might be different from our estimates.

In conclusion, Japan’s research output in biomedical science judged by the number of journal articles in
English has increased tremendously while the same in Japanese-language has declined over the last decade.

References

ANNOUNCEMENT

SGIM 2004 Annual Meeting

SGIM returns to Chicago for our 27th Annual Meeting

Shaping the Future of General Internal Medicine

May 12–15, 2004
Sheraton Chicago Hotel and Towers