ORIGINAL PAPER

International Journal of Occupational Medicine and Environmental Health 2015;28(4):663–673
http://dx.doi.org/10.13075/ijomeh.1896.00401

SCIENTIFIC PUBLICATIONS IN PUBLIC, ENVIRONMENTAL AND OCCUPATIONAL HEALTH JOURNALS BY AUTHORS FROM CHINA, JAPAN AND KOREA IN EAST ASIA: A 10-YEAR LITERATURE SURVEY FROM 2003 TO 2012

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Abstract
Objectives: To compare the number and quality of public, environmental and occupational health articles published in international journals from the 3 major non-English speaking countries of East Asia: China, Japan and Korea. **Material and Methods:** Public, environmental and occupational health articles from China, Japan and Korea that were published in 161 journals from 2003 to 2012 were retrieved from the Science Citation Index Expanded (SCIE) database. We recorded the numbers of total articles, impact factors (IF), citations, number of articles in top 10 journals, references as well as the article distribution from various regions in China. **Results:** From 2003 to 2012, China, Japan and Korea published 5713, 3802 and 1967 papers respectively, with accumulated impact factor of 14 934.55, 8758.36 and 6189.25, the average impact factor of 2.61, 2.30 and 3.15 and the average citation numbers per document of 5.08, 6.49 and 5.25. In the top 10 high-impact public, environmental and occupational health journals, China, Japan and Korea accounted for 50.19%, 20.34% and 29.47% of all the papers published in those journals, respectively. Total impact factors of the most popular 10 papers for China, Japan and Korea were: 26.23, 27.08 and 26.91. Distribution of scientific papers among regions was unbalanced in China, for Hong Kong and Taiwan it accounted for 47.31% of the papers from China. **Conclusions:** From 2003 to 2012, both the quality and number of papers from China published in public, environmental and occupational health journals have greatly improved. China exceeded Japan and Korea in the number, accumulated impact factor, total citation times and the average number of references, while Korea had the highest average impact factor. Japan had the highest journal impact factor among the most popular journals, and the highest average citation number per document.

Key words:
Occupational health, Environmental health, Publication research, Impact factor, Bibliometric indicators, East Asia

Meina Li and Xiaodong Liu contributed equally to this work and should be both considered as 1st authors.
The project was supported by National Natural Science Foundation of China (71303248, and 71233008), the Fundamental Research Funds for the Central Universities, and Young Scientist Foundation of The Second Military Medical University (2012QN09). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.
Received: July 30, 2014. Accepted: November 4, 2014.
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INTRODUCTION

Public, environmental and occupational health is of great concern around the world [1]. The 5th Ministerial Conference on Environment and Health, organized by the World Health Organization (WHO) Europe, focused on protecting children's health in a changing environment [2]. The Conference of Health Aspects of the Tsunami Disaster in Asia, convened by WHO in Thailand, discussed topics related to environmental health [3]. Some developing countries in Asia have provided action-oriented support for occupational safety and health programs [4]. Occupational protection of physicians is also being researched [5]. With China's rapid economic growth, challenges and opportunities concerning environmental and occupational health attracted broad attention [6]. Energy consumption in China is raising fast but improvements concerning intensity of environmental loading from energy consumption fall far behind economic growth rate. Investment in environmental protection of air has obviously declined [7], while outdoor air pollution in Hong Kong, Beijing, and China's other major urban centers far exceeds international health-based standards, and air pollution affects neonatal prematurity [8–9]. In order to improve environmental health, substantial progress has been made to reduce the burden of disease associated with traditional environmental exposures [10]. Chinese central government had implemented a series of environmental management systems including monitors of particulate matter 2.5 ($PM_{2.5}$) nationwide [11], and 2010 budget of China amassed great financial resources to confront its environmental nightmares [12] associated with the direct relationship between expenditures and the existing environmental "health" state [13]. A proposal to increase fundamental research on environmental health in China was also brought forward [14]. Furthermore, China has changed its image of having no occupational health and safety (OHS) system and has better OHS systems in the capital-intensive, larger state-owned enterprises that have been transformed from state enterprises [15]. Occupational health and safety systems in China have been also discussed in some research [16].

Japan is one of the world's most earthquake-prone countries because it sits on top of 4 tectonic plates. The 2011 Tōhoku Japan earth quake disaster has been estimated to be the 5th largest global earthquake since 1990 and caused a tsunami and a nuclear power plant accident, which resulted in environmental health hazards [17]. After the nuclear power plant accident, Japan has been monitoring fluvial discharges of radiocaesium from watersheds [18]. Besides this, environmental health issues, such as indoor air pollution, have been also researched in Japan [19]. Though occupational health activities in Japan have improved in many fields, many problems have still remained unsolved and new ones are arising as industry is continuously changing [20,21]. Rapidly changing economic, social and political environments in domestic and international settings have had adverse effects on the state of OSH in Japan [22]. The transfer of certain industries from Japan to Korea has resulted in occupational diseases [23]. In Korea, occupational accident rate used to show a continuous decline but has remained stagnant since 2000 [24].

The Japan-China-Korea Joint Conference on Occupational Health is organized annually with the objective of making a contribution to the advancement of occupational health through academic and practical knowledge exchanges in the field as well as fostering the friendship between Japan, Korea and China [25].

Although Matthew effect in environmental science publication has been analyzed [26], and comparison of socio-economic status and self-rated health in China, Japan and Korea has been published [27], scientific publications by authors from China, Japan and Korea in the fields of public, environmental and occupational health still have not been reported on. The purpose of this paper is to analyze the contribution of authors from the three countries in East Asia, i.e., China, Japan and Korea in the field of public, environmental and occupational health.

MATERIAL AND METHODS

Search strategy

An electronic search was undertaken in the Sci-Expanded database on September 15, 2013. The search was limited to the papers published between January 2003 and December 2012 by researchers from the People's Republic of China, Japan, and Korea. From 2003 to 2012, the Institute for Scientific Information (ISI) Web of Science lists a total of 161 journals within the subject categories of public, environmental and occupational health [28]. This category included "Epidemiologic Reviews," "Environmental Health Perspectives," "International Journal of Epidemiology," "WHO Technical Report Series" and so on. Research output from these three countries was identified using the authors' addresses. The search strategy is available in the appendix at the end of the article.

Data extraction

The information that was extracted included: title, authors, address, publication name, publishing year, country, International Standard Serial Number, etc. The following 7 domains were used to organize the information: the total number of articles; impact factor; citations of papers; high-impact journals; popular journals; references and publications of region distribution in China.

First, the numbers of each year publications in the public, environmental and occupational health sector from the People's Republic of China, Japan, and Korea between 2003 to 2012 were summarized. Second, the accumulated and average IFs were recorded according to the ISI's 2012 Journal Citation Reports (JCR) [28]. Third, we analyzed the average citation numbers per document and total citations of articles. Then, we compared the publications number in top 10 journals. Later, we determined the 10 most popular public, environmental and occupational health journals including articles from the 3 countries according to the number of such articles published by each journal and the average numbers of references of the published papers in the field of public, environmental and occupational health were counted. Finally, publications of region distribution for China were analyzed.

Data analysis

MS Excel 2007 software program was employed for data collection, and the Statistical Analysis System (SAS) 9.2 program was used for statistical analysis. Curvilinear regression was used to analyze the trends in the number of publications from the 3 investigated countries. Cochrane-Armitage trend test was used to analyze the increasing trend of publication number from the 3 countries between 2003 and 2012 and Kruskal-Wallis test was used to compare the numbers published from the 3 countries. Number of citations was analyzed using descriptive statistics. Significance was determined with 2-tailed tests and $p < 0.05$ was considered statistically significant.

RESULTS

Using this search strategy, 14 130 articles were found and downloaded, each article was scanned and the papers with the first authors' addresses being the People's Republic of China, Japan, and Korea were selected. Finally, a total of 11 482 articles were included in the study.

Total number of articles

From 2003 to 2012 in 161 journals 11 482 papers were those from China, Japan, and Korea. Of these, 5713 (49.76%) papers were from China, 3802 (33.11%) were from Japan, and 1967 (17.13%) were from Korea. The annual number of published papers in the field of public, environmental and occupational health increased significantly from 2003 to 2011 in China, but experienced an apparent drop in 2012 (281 to 876, $r = 0.96337$, $p < 0.0001$). The annual number of published papers from Japan and Korea remained steady from 2003 to 2010, and had a remarkable increase in 2011 and a drop-off in 2012 (Japan: 320 to 378, $r = 0.51015$,

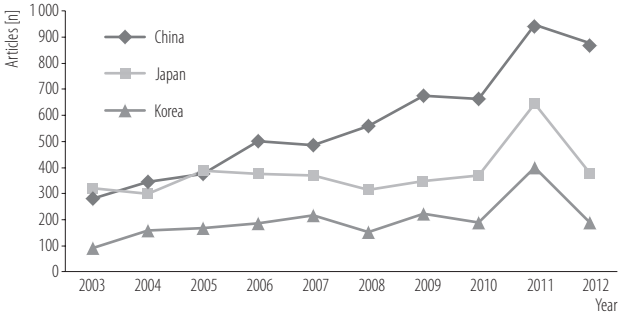

Fig. 1. Trends in annual numbers of articles published by the researchers from China, Japan, and Korea, in 2003–2012

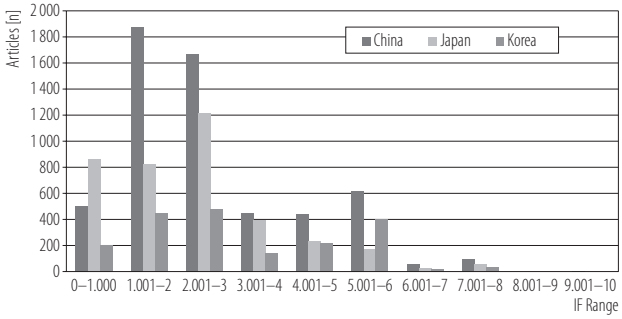

Fig. 2. Distribution of publications from the 3 countries in 2003–2012 related to the impact factor of public, environmental and occupational health journals

p = 0.1319; Korea: 90 to 189, r = 0.51015, p = 0.1319) (Figure 1). The main publication type was article, accounting for 78.02%, 76.83% and 62.55% of total publications from the People's Republic of China, Japan, and Korea, respectively. China had the maximum number of papers and a fast increase rate in their number.

Impact factor

According to the JCR, 161 public, environmental and occupational health journals had IF in 2012. We found that the accumulated IF of the articles from China (14 934.55) was much higher than that of articles from Japan (8758.36) and Korea (6189.25, x^2 = 17.5819, p = 0.0002). However, the articles from Korea had the highest average IF (3.15), followed by China (2.61) and Japan (2.3, x^2 = 15.7377, p = 0.0004) (Table 1). Impact factors of publications mainly ranged from 1 to 3, with 27.5% between 1 and 2 and 29.27% between 2 and 3 (Figure 2).

Citations of papers published in the public, environmental and occupational health journals

The mean standard deviation, 25th percentile, median, 75th percentile, total citation numbers, minimum, and maximum numbers of citations from China, Japan, and

Table 1. Accumulated and the mean impact factor (IF) of the papers from the authors from China, Japan and Korea by year, in 2003–2012

Year	Accumulated IF			Mean IF		
	China	Japan	Korea	China	Japan	Korea
2003	758.83	778.78	260.48	2.70	2.43	2.89
2004	930.89	698.46	426.75	2.70	2.34	2.72
2005	1 076.45	861.79	482.95	2.86	2.22	2.91
2006	1 475.87	883.70	672.80	2.94	2.36	3.60
2007	1 251.59	756.05	686.49	2.57	2.05	3.19
2008	1 485.58	791.41	513.23	2.65	2.51	3.35
2009	1 792.96	831.90	635.07	2.66	2.39	2.87
2010	1 593.31	812.54	501.20	2.40	2.21	2.64
2011	2 698.22	1 553.96	1 588.11	2.85	2.41	3.98
2012	1 870.85	789.78	422.18	2.14	2.09	2.23
Total	14 934.55	8 758.36	6 189.25	2.61	2.30	3.15

Table 2. Distribution of citation numbers of the articles from China, Japan and Korea in public, environmental and occupational health journals, in 2003–2012

Country	Mean	Standard deviation	25th percentile	Median	75th percentile	Citation (total) [n]	Minimum	Maximum
China	5.08	9.38	0	2	6	29 040	0	114
Japan	6.49	11.63	0	2	8	24 684	0	150
Korea	5.25	1.36	0	1	6	10 318	0	117

Korea are shown in Table 2. The average citation numbers per document in the field of public, environmental and occupational health from 2003 to 2012 in China, Japan, and Korea were: 5.08, 6.49 and 5.25, respectively. The most frequently cited paper was from Japan and it had 150 citations. Total citation numbers of China, Japan, and Korea were: 29 040, 24 684, and 10 318, respectively.

High-impact public, environmental and occupational health journals

A total of 2124 papers from China, Japan, and Korea were published in the 10 top-ranking public, environmental and occupational health journals. Researchers from China, Japan, and Korea published 1066, 432 and 626 papers in 10 high-impact public, environmental and occupational health journals, which accounted for 50.19%, 20.34% and 29.47% of all the papers published in those journals, respectively (Table 3).

Popular public, environmental and occupational health journals

The journals that published majority of the articles are listed in Table 3. "Biomedical and Environmental Sciences," "Epidemiology," and "The American Journal of

Table 3. Papers published in the 10 highest-impact public environmental and occupational health journals by researchers from China, Japan and Korea, in 2003–2012

Rank	Journal			Researchers [n(%)]			
	title	ISSN	IF 2012	China	Japan	Korea	total
1	Epidemiologic Reviews	0193-936X	9.269	2 (100)	0 (0)	0 (0)	2
2	Environmental Health Perspectives	0091-6765	7.26	96 (51.34)	57 (30.48)	34 (18.18)	187
3	International Journal of Epidemiology	0300-5771	6.982	57 (53.77)	29 (27.36)	20 (18.87)	106
4	WHO Technical Report Series	0512-3054	6.1	0 (0)	0 (0)	380 (0)	0
5	Epidemiology	1044-3983	5.738	525 (51.57)	113 (11.1)	2 (37.33)	1 018
6	Journal of Clinical Epidemiology	0895-4356	5.332	24 (58.54)	15 (36.59)	14 (4.88)	41
7	Bulletin of the World Health Organization	0042-9686	5.25	33 (53.23)	15 (24.19)	8 (22.58)	62
8	European Journal of Epidemiology	0393-2990	5.118	37 (49.33)	30 (40)	97 (10.67)	75
9	American Journal of Epidemiology	0002-9262	4.78	167 (49.26)	75 (22.12)	71 (28.61)	339
10	Cancer Epidemiology Biomarkers & Prevention	1055-9965	4.559	125 (42.52)	98 (33.33)	97 (24.15)	294
Total	–	–	–	1 066 (50.19)	432 (20.34)	626 (29.47)	2 124

Tropical Medicine and Hygiene" included most papers from China, "American Journal of Epidemiology," "The American Journal of Tropical Medicine and Hygiene," and "Health Physics" published most articles from Japan, and "Epidemiology," "Journal of Toxicology and Environmental Health," as well as "The American Journal of Tropical Medicine and Hygiene" included most papers from Korea. As for the accumulated impact factor (IF) of the most popular journals for the 3 countries, Japan had the highest IF (IF = 27.08) and China the lowest one (IF = 26.23) (Table 4).

References

The average reference number of the published papers in the field of public, environmental and occupational health from 2003 to 2012 in China (24.25) was higher than that of the articles from Japan (22.97) and Korea (20.23). The average number of references from 2003 to 2012 increased significantly in the case of China (20.02 to 29.91, r = 0.73288, p = 0.0159), while the average number of references of the published papers in Japan and Korea remained steady (Japan: 23.16 to 22.97, r = –0.0532, p = 0.8838; Korea: 21.01 to 29.42, r = 0.1055, p = 0.7716). These differences among the 3 countries were not statistically significant (x^2 = 3.1071, p = 0.2115).

Publications of region distribution for China

From 2003 to 2012, 4 regions in PRC – mainland China, Hong Kong, Taiwan, and Macau – published 3005, 713, 1990 and 5 papers respectively, with the accumulated impact factors of 6485.811, 2048.711, 6389.826 and 10.198, and with the average impact factors of 2.16, 2.87, 3.21 and 2.04. Mainland China published 3005 papers higher than those of Hong Kong, Taiwan and Macau, and had the highest accumulated impact factor, while Taiwan had the highest mean impact factor. Hong Kong and Taiwan accounted for 47.31% of the papers from China.

DISCUSSION

To our knowledge, this is the 1st report to assess contribution of the authors from China, Japan and Korea to public, environmental and occupational health research.

From 2003 to 2012, China, Japan and Korea published 5713, 3802 and 1967 papers respectively, with accumulated impact factors of 14 934.55, 8758.36 and 6189.25, average impact factors of 2.61, 2.30 and 3.15, and average citation numbers per document of 5.08, 6.49, and 5.25. In the top 10 high-impact public, environmental and occupational health journals China, Japan and Korea accounted for 50.19%, 20.34% and 29.47% of all the articles published in those journals, respectively. The total impact factors of the most popular 10 papers for China, Japan and Korea are: 26.23, 27.08 and 26.91. The average number of references of the published papers from China, Japan and Korea is: 24.25, 22.97, and 20.23, respectively. Four regions in PRC, i.e., mainland China, Hong Kong, Taiwan, and Macau published 3005, 713, 1990 and 5 papers, respectively. Hong Kong and Taiwan accounted for 47.31% of all the papers from China.

As the 3 non-English speaking countries in East Asia: China, Japan and Korea attach great importance to public, environmental and occupational health and international recognition, public, environmental and occupational health research design and application were more in line with the international practice. Therefore, the number of papers related to public, environmental and occupational health has continuously increased in China.

In this study, the papers were retrieved from the world's largest and comprehensive academic information source – the Science Citation Index Expanded (SCIE) database of the Web of Science. The impact factor is known as a significant scientometric parameter of a journal's value not only meant for comparison of journals, but also used for assessment of the quality of individual papers, scientists and departments [29]. Though current publication practices may distort science [30], research assessment based

Table 4. The 10 public environmental and occupational health journals publishing most papers written by researchers from China, Japan and Korea, in 1998– 2012

Rank	China			Japan			Korea		
	journal		researchers	journal		researchers	journal		researchers
	title	IF 2012	[n]	title	IF 2012	[n]	title	IF 2012	[n]
1	Biomedical and Environmental Sciences	1.154	673	American Journal of Epidemiology	4.78	75	Epidemiology	5.738	380
2	Epidemiology	5.738	525	The American Journal of Tropical Medicine and Hygiene	2.534	181	Journal of Toxicology and Environmental Health Part A Current Issues	1.733	139
3	The American Journal of Tropical Medicine and Hygiene	2.534	215	Health Physics	1.017	72	The American Journal of Tropical Medicine and Hygiene	2.534	99
4	American Journal of Epidemiology	4.78	167	Industrial Health	0.87	349	American Journal of Epidemiology	4.78	97
5	Journal of Toxicology and Environmental Health Part A Current Issues	1.733	143	Environmental Health Perspectives	7.26	57	Radiation Protection Dosimetry	0.909	90
6	Cancer Epidemiology Biomarkers & Prevention	4.559	125	Preventive Medicine	3.496	80	Cancer Epidemiology Biomarkers & Prevention	4.559	71
7	Journal of Environmental Science and Health Part B Pesticides Food Contaminants and Agricultural Wastes	1.211	124	Aviation, Space, and Environmental Medicine	0.782	52	Environmental Geochemistry and Health	2.076	65
8	Quality of Life Research	2.412	113	Journal of Epidemiology and Community Health	3.392	133	Industrial Health	0.87	64
9	Public Health	1.35	109	Radiation Protection Dosimetry	0.909	317	Journal of Occupational Health	1.634	46
10	Fluoride	0.758	100	Statistics in Medicine	2.044	52	BMC Public Health	2.076	43
Total	–	26.23	2 294	–	27.08	1 368	–	26.91	1 094

on a balance between publications and economic output, if done properly, may be a way out of the impact-factor game [31]. Impact factor remains to be a reasonable indicator of quality for general medical journals [32], and there has been no better indicator for the evaluation of paper quality up to now [33].

Though the number of citations might be influenced by extrinsic factors, such as reputation of the authors for example, it was reassuring to find that the best papers in physics, medicine and biology are on average cited more often [34]. Science is principally driven by the efforts of a vanishingly small fraction of researchers publishing the majority of scientific research and garnering the majority of citations [35].

References are cited for many reasons, including objects of research and the research content [36]. Citable documents and citations per document were used to assess publications in environmental sciences in some research [37]. Due to the fact that the impact factor is not the most ideal indicator reflecting the quality of papers, this paper employed impact factor, citations and numbers of reference as standards to evaluate the quality of publications.

Limitations of the study

There are certain limitations of this study. On one hand, the purpose of this study was to evaluate the number and quality of the publications from China, Japan and Korea in the international journals on public, environmental and occupational health. Thus, the search was limited to the public, environmental and occupational health category of the SCIE database. However, publications related to public, environmental and occupational health were not all included in the Science Citation Index Expanded category. For example, the "Lancet" published some papers related to public, environmental and occupational health, which were not included in the research scope of this study [10,38]. On the other hand, because the SCIE database divided publications into articles, reviews and letters, etc., the proportion of randomized clinical trials, clinical trials and case reports could not be compared among the selected papers.

CONCLUSIONS

The results of the present study clearly indicate that publications by Chinese researchers in international periodicals related to public, environmental and occupational health fields experienced a remarkable increase during the study period. Publications from Japan and Korea remained steady. China published 5713 papers with the accumulated factor (14 934.55), and number of references of published papers (24.25) higher than those of Japan and Korea. Korea had the highest mean impact factor (3.15), while Japan had the highest average citation number per document (6.49) and the highest impact factor of the most popular journals (27.08). The most frequently cited paper was from Japan and had 150 citations. The results showed that both the number and quality of published papers from China, Japan and Korea had greatly improved. China made a rapid progress, but regional distribution remained unbalanced with Hong Kong, and Taiwan, and in total accounted for 47.31% of the published papers.

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Appendix

(#1):IS = (0891-0162 or 1608-5906 or 0002-9262 or 0271-3586 or 0749-3797 or 0090-0036 or 0002-9637 or 1137-6627 or 1232-1966 or 1047-2797 or 0301-4460 or 0021-2571 or 0003-4878 or 0003-4983 or 0163-7525 or 1933-8244 or 1775-8785 or 0004-1254 or 1010-5395 or 1995-7645 or 1448-7527 or 1038-5282 or 1326-0200 or 0095-6562 or 0042-9686 or 0895-3988 or 1471-2458 or 1436-9990 or 0102-311X or 0957-5243 or 1055-9965 or 1877-7821 or 1925-6523 or 0228-8699 or 0301-5661 or 1936-6574 or 1935-7893 or 1833-3516 or 0114-5916 or 1570-677X or 0269-4042 or 0091-6765 or 1476-069X or 0013-9351 or 1635-0421 or 0950-2688 or 1120-9763 or 0193-936X or 1044-3983 or 1021-6790 or 1049-510X or 1355-7858 or 1362-5187

or 0393-2990 or 1101-1262 or 1091-7527 or 0015-4725 or 0213-9111 or 0741-0395 or 1827-1987 or 1654-9880 or 1744-8603 or 1369-6513 or 0017-9078 or 1353-8292 or 0840-6529 or 1527-0297 or 0019-8366 or 0899-823X or 1353-8047 or 0340-0131 or 1876-3413 or 1239-9736 or 0960-3123 or 0300-5771 or 1438-4639 or 1077-3525 or 1232-1087 or 1661-8556 or 0266-4623 or 1735-7179 or 2251-6085 or 1054-139X or 1059-924X or 1094-3412 or 0885-8195 or 0895-4356 or 2040-1744 or 0022-0892 or 0360-1234 or 0917-5040 or 0143-005X or 1559-0631 or 1606-0997 or 0969-1413 or 1875-6867 or 0028-2715 or 1545-9624 or 1076-2752 or 1341-9145 or 1745-6673 or 0022-4006 or 0197-5897 or 1741-3842 or 0952-4746 or 0890-765X or 0022-4391 or 1528-7394 or 1093-7404 or 1099-3460 or 1540-9996 or 1995-7262 or 0025-7079 or 0025-7818 or 0465-5893 or 1555-7960 or 0251-5350 or 1462-2203 or 1463-1741 or 1351-0711 or 0962-7480 or 0738-0658 or 0269-5022 or 0269-2163 or 2047-7724 or 0738-3991 or 1090-3127 or 1545-1151 or 0091-7435 or 1075-2730 or 1354-8506 or 0033-3506 or 1754-9973 or 1662-4246 or 0737-1209 or 1368-9800 or 0033-3549 or 0962-9343 or 0144-8420 or 0033-8451 or 1742-4755 or 0398-7620 or 0034-8910 or 1445-6354 or 0995-3914 or 1403-4948 or 0355-3140 or 0125-1562 or 1448-5028 or 0277-9536 or 0277-6715 or 0035-9203 or 0964-4563 or 0748-2337 or 1538-9588 or 1477-8939 or 0049-4755 or 1360-2276 or 1530-3667 or 0512-3054 or 1080-6032)

Databases = SCI-EXPANDED, Timespan = 2003–2012

#1 and (AD = (China) or AD = (Hong Kong) or AD = (Taiwan) or AD = (Macau)

#1 and AD = (Japan)

#1 and AD = (Korea)