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▣ ORIGINAL ARTICLE

Bibliometric Analysis of the Korean Journal of Parasitology: Measured from SCI, PubMed, Scopus, and Synapse Databases

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Abstract: The Korean Journal of Parasitology (KJP) is the official journal of the Korean Society for Parasitology which is celebrating its 50th anniversary in 2009. To assess the contributions and achievements of the KJP, bibliometric analysis was conducted based on the citation data retrieved from 4 major databases; SCI, PubMed, Synapse, and Scopus. It was found that the KJP articles were constantly cited by the articles published in major international journals represented in these databases. More than 60% of 1,370 articles published in the KJP from 1963 to June 2009 were cited at least once by SCI articles. The overall average times cited by SCI articles are 2.6. The rate is almost 3 times higher for the articles published in the last 10 years compared to 1.0 for the articles of the 1960s. The SCI journal impact factor for 2008 is calculated as 0.871. It is increasing and it is expected to increase further with the introduction of the KJP in the database in 2008. The more realistic h-indixes were measured from the study data set covering all the citations to the KJP; 17 for SCI, 6 for PubMed, 19 for Synapse, and 17 for Scopus. Synapse extensively picked up the citations to the earlier papers not retrievable from the other 3 databases. It identified many papers published in the 1960s and in the 1980s which have been cited heavily, proving the central role of the KJP in the dissemination of the important research findings over the last 5 decades.

Key words: Korean Journal of Parasitology, KJP, bibliometric analysis, citation analysis, journal impact factor, h-index, SCI, PubMed, PubMed Central, Synapse, Scopus, CrossRef, DOI

INTRODUCTION

The Korean Society for Parasitology (the Society) celebrates the 50th anniversary in 2009. One of the informative and realistic ways of capturing scholarly contributions the Society has made to the parasitology field in its 50-year history, and therefore to the medicine, is to assess the contributions and achievements of the official journal published by the Society.

The Korean Journal of Parasitology

The Korean Journal of Parasitology (KJP) is the official journal of the Society. The KJP has been published for the last 47 years since 1963, playing a central role as the organ of the Society in "the dissemination of new knowledge concerning parasites infecting humans and animals, vectors, host-parasite relationships, zoonosis, and tropical medicine" [1]. It began as a Korean-language journal titled "Kisaengch'unghak chapchi" in 1963. It changed the journal name into the KJP in 1993, and has been published entirely in English since June 1998.

One of the recognitions on the importance of a journal by the international community is the inclusion of the journal in the prestigious databases. The KJP is indexed in MEDLINE from 1989, yet records of every single article published so far are covered in the PubMed database and searchable. (PubMed contains "citations that precede the date that a journal was selected for MEDLINE indexing" [2].) The KJP became a Science Citation Index (SCI) journal in 2008. The coverage of the KJP in Scopus extends backward to 1977. It is covered in KoreaMed and in Synapse from the first issue and in Korean Medical Citation Index (KoMCI) from 2000. There are a dozen other databases in medicine and related sciences which cover the KJP; EMBASE, CAB International, Chemical Abstract, Helminthological Abstracts, Protozoological Abstracts, Zoological Record, Review of Medical and Veterinary Entomology, Tropical Diseases Bulletin, Biological Abstracts, and WPRIM. The KJP is also tracked by CrossRef and by Google Scholar.

The KJP has a system, the KJP web site [3], to distribute articles published in the journal online. At the same time, full texts

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of the KJP articles are released in PubMed Central [4] and in Synapse [5]. The full text articles in these sites and databases are accessible from abstract and citation index databases such as PubMed, Web of Science (WoS, the web-based version of SCI), Scopus, KoreaMed and KoMCI [6-10]. One of the major projects the Society has initiated in 2009 to celebrate the 50th anniversary of the Society is to make a "true digital archive" of the KJP. All KJP articles now have Digital Object Identifiers (DOIs) assigned by depositing metadata to CrossRef [11], and references of the articles are listed in a text format with the DOI reference linking feature implemented. Furthermore, KJP articles have the "cited by" information on how many times they are cited by CrossRef articles and who cite them. In other words, the whole contents of the KJP are not only online but also linked to the outside world for easy access. It is fair enough to say that the KJP is well known and recognized by renowned international abstract and full text databases, and that the KJP has a strong foundation to make the journal visible to researchers in the world.

Bibliometric analysis to assess the KJP's impact

There may be several ways to look at the greatness of a journal—the impact of a journal to the academic world. The widely used and well established methodology to measure the performance and quality of a journal is citation analysis primarily based upon how often the articles published in a journal is cited by other journal articles. For instance, the journal impact factor based on the SCI citation data has been one of the most widely used bibliometric indicators of a journal's importance. Citation analysis is not without its problems [12,13]. However, on the general assumption that the number of citations reflects an article's influence, and therefore quality, it is used extensively as the fundamental yardstick for quantifying the impact and quality of scientific works as well as the intellectual influence of scientists and scholars [14-16].

The starting point of all citation analysis is to count the number of times an article or author is cited in the scientific literature [14]. Based on the citation counts of each article, published in the KJP during the last 47 years bibliometric analysis was conducted in this study to depict the scholarly contributions and achievements of the KJP. The number and the ratio of the KJP articles cited were analyzed by year and by decade to investigate the changes over the last 5 decades. The total number of the citations received was measured by year and the average was computed. Highly cited articles were identified, and the distribution of the most cited articles were analyzed. SCI journal impact factor and h-index were calculated and compared to other parasitology journals to review the position of the KJP.

Needs and backgrounds for 4-database comparison study

The bibliometric analysis of the KJP in this study used 4 major databases covering medicine, i.e., SCI, PubMed, Synapse, and Scopus. This comparison study of 4 databases will illustrate the KJP's scholarly contributions in detail, filling the gaps which could have not been possible by a single database, especially by the SCI used in most citation analysis.

One of the well known limitations of citation analysis is that it depends on the coverage of a bibliographic database used in the analysis. Differences in scope, journal coverage, geographic coverage, document types, time span and currency, the number of English-language and foreign-language source items, and the

Table 1. Differences in the coverage of major databases

Database	Record type	Subject	Geographic	Journals		Korean Journal of Parasitology		"Cited by" data taken from
				Parasitology	All	Year span	No. of records	
SCI (Web of Science)	Citation index	Sciences	Worldwide	30	8,125	2008-	85	Web of science
JCR 2008: Science ed.	Citation analysis data	Sciences	Worldwide	25	6,620	N/A	N/A	N/A
PubMed[a]	Abstract	Medicine	Worldwide	54	21,437	1963-	1,360	PubMed central
MEDLINE	Abstract	Medicine	Worldwide	33	5,000	1989-	842	PubMed central
PubMed central	Full-text	Medicine	Worldwide	4	700	1998, no. 3-	463	PubMed central
Synapse	Full-text	Medicine	Korea	1	60	1963-	1,370	CrossRef
Scopus[b]	Citation index	All disciplines	Worldwide	40	18,000	1977-	1,059	Scopus
CrossRef[c]	Metadata	All disciplines	Worldwide	22	20,723	1963-	1,370	N/A

As of Aug. 18, 2009.

[a]PubMed includes MEDLINE. PubMed contains citations that precede the date that a journal was selected for MEDLINE indexing.

[b]The coverage of articles published prior to 1987 is not complete.

[c]As of Sept. 2009, 31 journals are listed in the parasitology subject area of CrossRef, but 9 of them are redundunt titles.

size of the databases are factors bringing in the different citations to databases [17-20]. Table 1 illustrates the differences in the coverage of major databases. The numbers of parasitology journals included in each database are different, and the year spans of the KJP covered in each database also vary, affecting the citation rates that the KJP should receive from the records in databases.

Another problem noted using bibliographic databases in citation analysis studies is "problems with the tools that are made available by the database provider or host" [21]. SCI, currently produced by Thomson Reuters, has been the source of data for a whole range of citation analysis studies. It is not an exaggeration to state that citation analysis began with the publication of SCI in 1961 [13], and SCI was the only citation index existed for a quite long time. However, another citation index, Scopus, made a debut in 2004 [22] making it possible to search citations from many other journals not covered in SCI.

In addition, progresses made in online databases in recent years and the release of a wide variety of user friendly tools to improve and facilitate access to existing services, compounded with the emergence of full text databases, have made citation analysis possible to utilize many other databases [23]. Most e-journal databases, where one can view full texts of articles, provide the "cited by" feature tracing how many times the articles are cited and which articles cite them. It is similar to the "Times Cited" link which appears on the full record for individual articles in WoS with the linking capability between the citing and the cited articles. PubMed Central (PMC) [24], a digital archive of biomedical and life sciences journal literature developed and managed by the U.S. National Library of Medicine (NLM) [25], has "This article has been cited by other articles in PMC" feature in its full text records. Interestingly enough, PubMed which is the most important medical abstract database of all NLM family databases [26] began displaying "Cited by '*this number*' articles in PMC" to its records in 2009. Obviously the citation tracking feature of PubMed records is integrated with PMC full texts records. Synapse is a digital archive and reference linking platform of Korean medical journals produced by the Korean Association of Medical Journal Editors (KAMJE) [27]. It also implemented the same "cited by" feature found in PMC and e-journal databases, thus making a cited reference searching possible for Korean medical journal articles.

Synapse takes the "cited by" tracking information from the CrossRef database where citing articles deposit their DOIs and metadata associated with them. Citation data of more than 20,000 journals is deposited to CrossRef by about 3,000 publishers from all over the world. Thus, by taking citation information from CrossRef, Synapse overcomes the limitation of being a citation tracking tool of Korean journal articles only, and expands its utility to provide the real data on how often and by whom Korean medical journal articles are cited from foreign journal articles. It is not to mention that Synapse automatically includes citation data of Korean medical journals depositing DOIs to CrossRef (i.e., Synapse journals). This aspect of Synapse is a big advancement in the citation analysis of Korean journals not selected in internationally recognized citation indexes, especially in SCI. In the case of the KJP, the Synapse citation data reflecting CrossRef's reference linking information will compensate for the gap not explainable by the SCI citation data; the activities of the 45-year (1963-2007) period not covered by SCI. The most exciting part is the possibility of finding citations to the earlier KJP articles from the KJP articles published in the later times.

MATERIALS AND METHODS

SCI, PubMed, Synapse, and Scopus

To assess the impact of the KJP, bibliometric analysis was conducted from the citation data gathered from SCI, PubMed, Synapse, and Scopus [6-8,28]. These 4 databases are chosen in this study because the KJP are covered in these databases and because the databases have the "cited by" feature making the cited reference searching or tracking possible, an essential tool in citation analysis.

SCI is the foremost and the best known citation index. Scopus is a rather new citation index. Both SCI and Scopus cover all sciences. PubMed is the most important abstract database in the field of medicine covering journals published worldwide. Synapse is a full text database covering Korean medical journals only (Table 1).

SCI and Scopus are citation indexes directly taking citation information from references of articles indexed in the databases themselves. SCI records display "This article has been cited '*this number*' times (from Web of Science)" links, and Scopus records display "This article has been cited '*this number*' times in Scopus" links, respectively. On the other hand, PubMed and Synapse take citation information from outside sources. PubMed is integrated with PMC, its family database of NLM, and the citation information comes from the references of PMC full text records. Citing articles are directly accessible from PubMed records via "Cited by '*this number*' PubMed Central articles" links to

PMC records. The citation information of Synapse comes from CrossRef's DOI metadata database. Synapse provides forward linking service to its records by "This article has been cited by other articles in Synapse/CrossRef" feature.

Search strategy and data collection

Two different methods were used to obtain the "Times Cited" information of the KJP from the WoS. For the period the KJP is covered in SCI from 2008 to the present, the full title of the KJP, "Korean Journal of Parasitology" is searched in "Publication Name" field of the "Search" mode. For the years not covered in SCI, "Korean J Para* OR Kisengchung*" was searched in the "Cited Reference Search" mode ("*" in the search statements designates any characters following the character strings would be included in the search. "OR" is a Boolean operator.). The similar searching methods were used for the citation data collection from Scopus. Analytic tools provided by the databases such as "Analyze Results" and "Create Citation Report" of SCI, and "Analytics" and "Journal analyzed" of Scopus were subsequently used for further analysis. To retrieve the PubMed citation data, "Korean J Para* OR kisengchung*" was searched in the "Advanced Search" mode. Every records resulted from the search were eye-checked for the "Cited by '*this number*' articles in PMC", and the number of citations was encoded by hand one record by one. It is because there is no other way of retrieving the times cited information by a search comparable to the cited reference search provided in the citation index databases. The Synapse citation searching was done by selecting "Korean Journal of Parasitology" in the "Journals" field and limiting "Articles Cited by Other Synapse/CrossRef Articles" option in the "Advanced Search" mode.

The database searching of 4 databases was conducted on August 18, 2009. It was done on the same day in order to reduce the possible biases introduced by the different update frequencies of the databases. All collected data was downloaded to Microsoft Excel 2007, and the subsequent analysis and calculations were performed in Excel.

RESULTS

A total of 1,370 articles were published in the KJP from 1963 to August 2009. The numbers of articles published before and after the title change in 1993 were almost the same for the data set used in this study, i.e., 682 articles as Kisaengchunghak chapchi and 678 articles as the KJP. The number of citations each of these articles received was measured from WoS, PubMed, Synapse, and Scopus, respectively. Table 2 and Table 3 summarize the citation data collected from 4 databases by year.

Inconsistencies in citing the KJP

The citation search of the KJP for the period covered in SCI is straightforward. The articles are published in the Korean Journal of Parasitology and indexed in the database under the same English-language journal title. A simple journal search generates the citation data needed. However, the "Cited Reference Search" used for the period not covered in SCI resulted in rather messy data requiring to resolve the inconsistencies and errors. One source of complications is induced by the authors of SCI articles: the references are listed in the SCI as they appear in the citing articles. The title change of the KJP into English from the Korean title certainly adds extra confusions. The initial search of WoS retrieved the 999 articles cited at least once, and these articles were cited 3,604 times altogether by the SCI articles. After the inconsistencies and errors were examined and resolved, the number of cited KJP articles was reduced to 847 articles with the total of 3,589 times cited. (It was found that the KJP was cited in 24 different journal names.) The final citation counts included 48 articles which were cited 113 times as "Kisaengchunghak chapchi" or other Korean language title variations. Eleven records, cited 15 times, were not verifiable and these citations were excluded from the final analysis. The verification of Scopus citation data had the similar difficulties faced with the SCI data. After the data cleansing, 791 articles receiving 3,385 citations, including 16 citations to "Kisaengchunghak chapchi", from the Scopus articles were identified.

The citation data of PubMed and Synapse databases were free from these complications because the citation counts were obtained by checking each record one by one at the initial search stage. If references in the citing articles do not match bibliographic descriptions in the database records, they cannot be "cited by other articles" to begin with. Unlike in PubMed, all KJP articles are indexed using the English-language title in Synapse regardless of the fact that the Korean title was the official title till 1993. Table 2 and Table 3 clearly demonstrate that the Synapse picked up more cited records and a lot more citation counts than PubMed for the years prior to 1993.

Overview: different citation rates of the KJP among 4 databases

The total number of KJP articles cited at least once and the

Table 2. Number of the KJP articles cited, by year

Publication year	No. of articles published	SCI		PubMed		Synapse		Scopus	
		Cited by WoS[a]	%	Cited by PMC	%	Cited by CrossRef	%	Cited by Scopus	%
2009	32	0	0.0	0	0.0	2	6.3	0	0.0
2008	54	11	20.4	6	11.1	11	20.4	11	20.4
2007	48	27	56.3	15	31.3	19	39.6	31	64.6
2006	53	39	73.6	23	43.4	29	54.7	44	83.0
2005	25	19	76.0	17	68.0	23	92.0	21	84.0
2004	29	22	75.9	16	55.2	22	75.9	24	82.8
2003	36	34	94.4	21	58.3	24	66.7	34	94.4
2002	31	27	87.1	20	64.5	21	67.7	30	96.8
2001	39	34	87.2	27	69.2	26	66.7	36	92.3
2000	43	37	86.0	29	67.4	27	62.8	39	90.7
Subtotal	390	250	64.1	174	44.6	204	52.3	270	69.2
1999	40	35	87.5	26	65.0	24	60.0	35	87.5
1998	38	35	92.1	22	57.9	27	71.1	37	97.4
1997	43	33	76.7	24	55.8	28	65.1	36	83.7
1996	39	32	82.1	23	59.0	30	76.9	34	87.2
1995	52	35	67.3	28	53.8	38	73.1	41	78.8
1994	39	26	66.7	22	56.4	33	84.6	32	82.1
1993	49	28	57.1	22	44.9	34	69.4	32	65.3
1992	47	31	66.0	5	10.6	34	72.3	29	61.7
1991	39	27	69.2	2	5.1	32	82.1	29	74.4
1990	38	29	76.3	2	5.3	30	78.9	30	78.9
Subtotal	424	311	73.3	176	41.5	310	73.1	335	79.0
1989	32	22	68.8	2	6.3	29	90.6	22	68.8
1988	36	20	55.6	0	0.0	33	91.7	18	50.0
1987	27	17	63.0	0	0.0	22	81.5	6	22.2
1986	28	22	78.6	2	7.1	24	85.7	17	60.7
1985	41	22	53.7	1	2.4	33	80.5	15	36.6
1984	38	16	42.1	0	0.0	28	73.7	18	47.4
1983	36	17	47.2	1	2.8	30	83.3	19	52.8
1982	24	16	66.7	0	0.0	21	87.5	11	45.8
1981	19	12	63.2	2	10.5	16	84.2	10	52.6
1980	25	12	48.0	0	0.0	21	84.0	11	44.0
Subtotal	306	176	57.5	8	2.6	257	84.0	147	48.0
1979	17	10	58.8	2	11.8	16	94.1	6	35.3
1978	18	14	77.8	1	5.6	13	72.2	9	50.0
1977	14	13	92.9	0	0.0	10	71.4	6	42.9
1976	18	12	66.7	1	5.6	17	94.4	3	16.7
1975	16	8	50.0	1	6.3	12	75.0	2	12.5
1974	16	5	31.3	0	0.0	10	62.5	1	6.3
1973	13	7	53.8	2	15.4	7	53.8	4	30.8
1972	14	5	35.7	0	0.0	8	57.1	2	14.3
1971	9	4	44.4	2	22.2	6	66.7	2	22.2
1970	17	4	23.5	0	0.0	10	58.8	1	5.9
Subtotal	152	82	53.9	9	5.9	109	71.7	36	23.7
1969	18	12	66.7	2	11.1	15	83.3	1	5.6
1968	9	3	33.3	0	0.0	7	77.8	-	0.0
1967	14	6	42.9	1	7.1	11	78.6	1	7.1
1966	13	3	23.1	0	0.0	10	76.9	-	0.0
1965	15	0	0.0	0	0.0	12	80.0	-	0.0
1964	21	4	19.0	0	0.0	20	95.2	1	4.8
1963	8	0	0.0	0	0.0	4	50.0	-	0.0
Subtotal	98	28	28.6	3	3.1	79	80.6	3	3.1
Total	1,370	847	61.8	370	27.0	959	70.0	791	57.7

Databases searched on Aug. 18, 2009. The KJP indexed in SCI from 2008, PubMed from 1963, Synapse from 1963, and Scopus from 1977.
[a]Unverifiable citations (11 records) not counted.

Table 3. Times the KJP aritcles are cited, by year

Publication year	No. of articles published	SCI		PubMed		Synapse		Scopus	
		Cited by WoS[a]	Average	Cited by PMC	Average	Cited by CrossRef	Average	Cited by Scopus	Average
2009	32	0	0.0	0	0.0	2	0.1	0	0.0
2008	54	13	0.2	7	0.1	13	0.2	12	0.2
2007	48	59	1.2	20	0.4	34	0.7	70	1.5
2006	53	96	1.8	35	0.7	54	1.0	115	2.2
2005	25	79	3.2	33	1.3	55	2.2	93	3.7
2004	29	89	3.1	30	1.0	47	1.6	114	3.9
2003	36	281	7.8	49	1.4	80	2.2	296	8.2
2002	31	97	3.1	45	1.5	49	1.6	123	4.0
2001	39	214	5.5	65	1.7	76	1.9	239	6.1
2000	43	175	4.1	89	2.1	82	1.9	196	4.6
Subtotal	390	1,103	2.8	373	1.0	492	1.3	1,258	3.2
1999	40	171	4.3	88	2.2	82	2.1	185	4.6
1998	38	160	4.2	90	2.4	112	2.9	182	4.8
1997	43	150	3.5	70	1.6	101	2.3	175	4.1
1996	39	94	2.4	65	1.7	97	2.5	109	2.8
1995	52	141	2.7	67	1.3	133	2.6	189	3.6
1994	39	169	4.3	72	1.8	143	3.7	190	4.9
1993	49	167	3.4	45	0.9	125	2.6	168	3.4
1992	47	113	2.4	7	0.1	107	2.3	96	2.0
1991	39	81	2.1	2	0.1	114	2.9	88	2.3
1990	38	126	3.3	2	0.1	155	4.1	136	3.6
Subtotal	424	1,372	3.2	508	1.2	1,169	2.8	1,518	3.6
1989	32	81	2.5	2	0.1	126	3.9	70	2.2
1988	36	68	1.9	0	0.0	175	4.9	68	1.9
1987	27	43	1.6	0	0.0	102	3.8	15	0.6
1986	28	130	4.6	3	0.1	193	6.9	96	3.4
1985	41	79	1.9	1	0.0	178	4.3	45	1.1
1984	38	93	2.4	0	0.0	221	5.8	68	1.8
1983	36	61	1.7	1	0.0	194	5.4	47	1.3
1982	24	52	2.2	0	0.0	136	5.7	38	1.6
1981	19	69	3.6	3	0.2	201	10.6	46	2.4
1980	25	80	3.2	0	0.0	100	4.0	23	0.9
Subtotal	306	756	2.5	10	0.0	1,626	5.3	516	1.7
1979	17	51	3.0	2	0.1	76	4.5	9	0.5
1978	18	59	3.3	1	0.1	74	4.1	26	1.4
1977	14	27	1.9	0	0.0	65	4.6	11	0.8
1976	18	29	1.6	2	0.1	71	3.9	4	0.2
1975	16	43	2.7	1	0.1	80	5.0	3	0.2
1974	16	12	0.8	0	0.0	28	1.8	1	0.1
1973	13	14	1.1	2	0.2	32	2.5	4	0.3
1972	14	8	0.6	0	0.0	18	1.3	4	0.3
1971	9	10	1.1	2	0.2	41	4.6	5	0.6
1970	17	7	0.4	0	0.0	19	1.1	1	0.1
Subtotal	152	260	1.7	10	0.1	504	3.3	68	0.4
1969	18	29	1.6	3	0.2	115	6.4	1	0.1
1968	9	4	0.4	0	0.0	46	5.1	0	0.0
1967	14	30	2.1	2	0.1	45	3.2	4	0.3
1966	13	8	0.6	0	0.0	50	3.8	0	0.0
1965	15	0	0.0	0	0.0	49	3.3	0	0.0
1964	21	27	1.3	0	0.0	129	6.1	20	1.0
1963	8	0	0.0	0	0.0	5	0.6	0	0.0
Subtotal	98	98	1.0	5	0.1	439	4.5	25	0.3
Total	1,370	3,589	2.6	906	0.7	4,230	3.1	3,385	2.5

Databases searched on Aug. 18, 2009. The KJP indexed in SCI from 2008, PubMed from 1963, Synapse from 1963, and Scopus from 1977.
[a]Unverifiable citations (15 citations) not counted.

total number of citations the articles received from the articles indexed in each database are the highest in Synapse for the entire study period of 1963-2009. Where SCI and Scopus citation statistics are not much different from that of Synapse, citations given to the KJP from PubMed are far less than the other 3 databases. There may be several factors contributing to the differences in the citation rates of the KJP among 4 databases examined in this study.

Effects of the number of parasitology journals covered in the databases

The low citation numbers obtained from PubMed should be attributed to the fact that PMC, where PubMed takes the "cited by" data, currently provides full texts of about 700 journals. To be more specific, PubMed indexes the most number of parasitology journals (40 journals) among 4 databases, but only 4 parasitology journals are available from PMC nonetheless (Table 1). On the contrary, Synapse covers only one parasitology journal, the KJP, but gets the cited reference information from at least 22 CrossRef journals.

Effects of "Kisaengch'unghak chapchi"

Another factor resulting in the low citation counts in PubMed is the discrepancies in the description of the journal title between the citing articles and the database. PubMed records of the KJP articles published when the KJP used the Korean title are indexed as "Kisaengchunghak chapchi". Therefore, any PMC citations to the KJP articles published till 1992 could have not been matched to the PubMed records if they are cited by the English-language title. As illustrated in Table 2 and Table 3, not only the number of records cited but also the times cited counts drastically dropped to 0s and 1s for the years between 1963 and 1992 in PubMed.

On the other hand, Synapse retrieved the most number of citations among 4 databases compared in this study for the "Kisaengchunghak chapchi" period. The "Journal Name" and the "Cited Journal Name" fields of Synapse records and therefore CrossRef records of the KJP articles are described with the English-language title for the entire issues. It is true that it could have been missed out if the earlier articles were cited as "Kisaengchunghak chapchi" in the references of citing articles, but it seemed it is less likely to happen. The probability that the KJP articles would be cited by a Romanized Korean-language title in foreign journals is extremely low. Citations to the earlier articles of the KJP were split between the Korean-language title and the English-language title in SCI and in Scopus. However, because the data was combined as one item (the inconsistencies were corrected) after the citation data was downloaded for analysis, the statistics of SCI and Scopus were not affected much by this split—the citations to either titles were included in the data set.

KoMCI data in Table 4 shows that Korean medical journals cited the KJP appropriately as the KJP more than 95% of the times in recent years. Therefore, the title description issue should not matter a great deal in citation analysis in the future.

Effects of the journal self-citations

The number of cited articles and the total times cited are almost always higher in Scopus than in SCI and in Synapse for the recent 15 years from 1993 when the KJP has changed the journal title into English. It might well be because Scopus covers more parasitology journals than SCI (Table 1). However, one sure factor in favor of the higher citation rate of Scopus is that it has the KJP articles indexed within the database. It covers the KJP from 1977, so that the citations from the KJP itself (journal self-citations)

Table 4. The KJP citations of Korean medical journals

KoMCI	The KJP cited in references	Total references	Self-citation rate (%)	KoMCI IF	KoMCI ZIF	No. of variant titles of the KJP cited	Cited as the KJP	Total cites from KoMCI journals	Rate cited as the KJP (%)
2000	124	872	14.2	0.277	0.084	4	145	169	85.8
2001	202	951	21.2	0.663	0.205	7	248	276	89.9
2002	87	549	15.8	0.244	0.049	9	105	143	73.4
2003	107	763	14.0	0.171	0.014	10	131	172	76.2
2004	126	646	19.5	0.224	0.045	7	154	177	87.0
2005	67	466	14.4	0.185	0.062	5	112	120	93.3
2006	129	1,176	11.0	0.204	0.074	7	192	219	87.7
2007	118	924	12.8	0.436	0.192	5	256	265	96.6
2008	116	1,145	10.1	0.222	0.040	4	155	163	95.1

KoMCI: 2000-20008. Available from: http://komci.org. IF, journal impact factor; ZIF, journal impact factor excluding self-citations.

were added to the "cited by" counts. On the other hand, the SCI data do not include self-citations of the KJP, for the journal was not indexed till 2008. The PMC coverage of the KJP begins with the September 1998 issue. Thus, the citations reflected on PubMed records included self-citations from the KJP articles published since.

According to KoMCI data shown in Table 4, the overall journal self-citation rate of the KJP has been in the range of 10-20%, citing more than 100 references to the KJP a year during the last 10 years. The recent introduction of the KJP into SCI will certainly inflate the total citation counts of the KJP; for the database will index references listed in the KJP articles, and thus the journal self-citations to the KJP.

Effects of DOIs assigned to the KJP

The Society's KJP DOI project undertaken as a 50th anniversary project made the citation tracking for all KJP articles published possible through DOI metadata in the CrossRef database. The very surprising consequence of these efforts is certainly that it revealed the citations to the earlier KJP articles from non-SCI articles, especially from the KJP articles published till 2007 before it became a SCI journal. The Synapse statistics showed that many KJP articles of the early period are still cited, and cited heavily. Synapse identified 445 articles published before 1990 which were cited by CrossRef articles. It takes up 46.4% of 959 cited articles identified in Synapse. In comparison, SCI identified 286 pre-1990 articles, and Scopus, 186 articles. The top 30 most cited articles identified in Synapse via DOI included 26 articles published befored 1990.

DISCUSSION

The number and the ratio of the cited KJP articles

Of 1,370 articles published in the KJP from 1963, 847 articles were cited by SCI articles at least once (Table 2). Synapse identified 959 KJP articles cited at least once by CrossRef articles. That is, 112 more articles were identified in Synapse through DOI reference linking information than what was cited by SCI articles. The difference comes mostly from the pre-1993 years. Especially, the number of cited articles identified which were published before 1976 is incomparable to the other database. It is almost natural that a much smaller number of PubMed KJP records (370 articles) were cited by PMC records due to the small number of journal coverage in PMC as explained above.

Synapse statistics show that more than 70% of the KJP articles were cited at least once. In particular, the ratio of cited papers for the pre-1993 period is very high, mostly in the range of 70-90%. Twenty out of 21 (95.2%) articles published in 1964, and 16 out of 17 (94.1%) articles published in 1979, were cited at least once since they were published. It is very inspiring to know that more than 80% of cited articles published in the 1960s and the 1980s have been cited.

The articles published in 2008 and 2009 have cumulated not many citations obviously because there was not enough time for them to be cited. However it is evident that there is a strong tendency for the articles published in recent years are cited more extensively. The overall ratio of the KJP articles ever cited from SCI is 61.8%, but the ratio increased over the years from 28.6% in the 1960s to the 73.3% in the 1990s (Subtotals of Table 2 are the figures aggregated by decade). The proportion of cited articles in each year of the 2000s is much higher than those of the years before 2000. The rate almost reaches to 90%.

Total number of citations

Synapse received a total of 4,230 citations to 959 KJP articles by CrossRef articles (Table 3). The total number of citations was bigger in Synapse than in SCI and Scopus, because Synapse is superior in collecting the KJP self-citations especially for the pre-1993 period. However the citation counts were higher from 1993 in SCI and in Scopus than in Synapse. The PMC citation counts were far less than the other 3 databases with almost no citations to the pre-1993 period.

There was not much difference in the total numbers of times cited between SCI and Scopus. They were 3,589 and 3,385 respectively. However, 2 differences are to be noted here. For the post-1993 period, Scopus retrieved more citations than SCI by 15%, corresponding to the KJP's average self-citation rate. (It is expected that the SCI data will catch up with this gap in 2 or 3 years, since the KJP is a new addition to the database.) On the other hand, Scopus has cumulated fewer citations to the pre-1993 articles than SCI. It is because the Scopus records include references going back to 1996 [22], whereas the SCI coverage of references goes back to theoretically to the 1960s.

A useful way to compare and foresee the citation rates of the KJP among different databases is probably to examine the citedness of papers published in 2006 and 2007, i.e., the years used in citation analysis of the JCR 2008, the latest edition. In these current years, Scopus cumulated the most number of citations to the KJP, and SCI was the next. The citation counts of PubMed records retrieved are 1/3 of the SCI citations, and Synapse records

retrieved 1/2 of the SCI citations.

Average citation rates

The overall average times cited by SCI is 2.6, and the rate is almost 3 times higher for the articles published in the last 10 years, when it is compared to the rate of 1.0 for the articles of the 1960s (Subtotal of Table 3 are the figures aggregated by decade.). Again, SCI and Scopus displayed a similar pattern in the overall average citation rates by year.

There are several years when the average citation rate is much higher than the years surrounding the year. It seemed they were influenced by one or two heavily cited articles. The year 2003 is at the peak in SCI and Scopus. It is because Dubey's article [29] was much cited to double the average for the year.

An important phenomenon revealed by the Synapse citation data is that the average citation rate of the "Kisaengchunghak chapchi" is higher, and much higher, than the KJP years (post-1993). The 10.6 citations per article published in 1981 are the highest of all years. These high average citation rates of the early years of the KJP, such as 6.1 of 1964, 6.4 of 1969, and 6.9 of 1986, indicate that the articles in the KJP issues are read constantly, and cited. We all know that much of these citations are from the KJP articles by the junior researchers who entered the field in the later times.

SCI journal impact factors

The KJP was added to SCI in 2008, so the first official SCI journal impact factor will be that of 2010 to be announced in 2011. Table 5 shows SCI journal impact factors of the KJP calculated for the years 2000 through 2008 in the same way they are announced in the JCR Science Editions [30]. Despite of the handicap the KJP was not a SCI journal till 2008, the impact factor ranged between 0.3 and 1.0, slowly increasing over the years. The 2005 impact factor is much higher (1.046) due to the Dubey's article published in 2003 which was cited 26 times in 2005. The 2004 impact factor was also influenced by the same article cited 19 times in that year.

Table 5. SCI journal impact factors of the KJP, 2000-2008

Publication year	The KJP Impact factor[a] [T]/[A]	Cites to the previous 2 years [T]	Articles published in the previous 2 years [A]	Rank / No. of parasitology journals[b]	SCI impact factor[b]	
					Median	Aggregate
2000	0.346	27	78	20/21		
2001	0.313	26	83	22/22		
2002	0.451	37	82	23/22		
2003	0.457	32	70	22/21	1.119	1.575
2004	0.493	33	67	20/21	1.162	1.605
2005	1.046	68	65	16/22	1.293	1.699
2006	0.444	24	54	24/23	1.500	1.835
2007	0.513	40	78	22/23	1.597	2.114
2008	0.871	88	101	21/26	1.679	2.328

[a]Calculated in the same way the SCI journal impact factor is calculated.
[b]JCR: Science edition. 2000-2008. The Median and the Aggregate Impact Factors for the 2000-2002 period is not reported.

The impact factors of the KJP were located in a lower region if compared to other SCI parasitology journals (Table 6). The low rankings might be justifiable taken into account of the fact that it was not a SCI journal up until very recent years (for the years listed in the Table). The 2008 impact factor of 0.871 placed the KJP in the 20th position among 27 journals (including the KJP). Going up a few steps in the impact factor ranks in 2008 coincides with the entrance of the KJP into SCI. Since the coverage of the journal by SCI and the reference linking capability implemented by DOI will enhance the discoverability and the visibility of the journal, it is expected to receive a higher rate of citations from a wider base of sources, and consequently to increase the impacts of the KJP.

Highly cited articles

The most cited article

Table 7 lists 30 most cited articles identified in each database in the order of times cited. Due to the ties in the times cited, 32 articles for PubMed and 33 articles for Synapse were analyzed. The most cited KJP article is Dubey's article published in 2003. It was cited 158 times by SCI and 157 times by Scopus. It was cited highly by PubMed and CrossRef articles, but not listed at the 1st place. It was cited 9 times by PubMed, ranking in the 10th by the times cited. The article was cited 30 times by Synapse and ranked in the 6th place. The most cited KJP article found in PubMed was Chai's article published in 1999, cited 16 times [31]. Synapse identified an article published in 1981 by Seo, et al. [32] as the most cited article. It was cited 46 times. Cited 45 times so far, 2 articles on "helminths" published in 1964 [33] and 1969 [34] were at the 2nd in the ranking. These articles were also found in the most cited articles lists of the other databases.

The top 30 most cited articles

The citation frequencies of top 30 most cited articles by SCI and Scopus were very similar ranging from 15 to 158 times in SCI, and from 13 to 157 times in Scopus. Twenty-two articles

Table 6. Bibliometric Indicators of SCI parasitology journals

Rank by impact factor	Abbreviated journal title	Impact factor	5-year impact factor	Articles 2008	Total no. of articles	Sum of the times cited	Average citations per item	h-index	
								WoS[b]	Scopus 2007[c]
1	Plos Pathog	9.125	9.202	254	924	8,350	9.04	39	25
2	Adv Parasit	5.514	5.708	4	105	1,794	17.09	26	43
3	Trends Parasitol	4.690	4.846	101	1,119	15,726	14.05	52	48
4	Plos Neglect Trop D	4.172	4.172	147	375	758	2.02	11	
5	Int J Parasitol	3.752	3.738	156	1,813	20,397	11.25	56	65
6	Mol Biochem Parasit	2.951	2.782	138	1,554	17,406	11.2	45	
7	Malaria J	2.913	3.088	263	900	4,146	4.61	24	
8	Parasite Immunol	2.523	2.416	75	669	4,787	7.16	27	
9	Parasitol Int	2.152	1.711	82	533	2,498	4.69	19	20
10	Parasitology	2.071	2.306	161	1,531	12,325	8.05	34	
11	Vet Parasitol	2.039	2.129	368	2,807	18,582	6.62	39	50
12	Exp Parasitol	1.751	1.601	240	1,179	5,139	4.36	21	
13	Acta Trop	1.707	2.375	169	2,024	8,923	4.41	33	41
14	Ann Trop Med Parasit	1.652	1.472	96	877	4,554	5.19	22	36
15	Parasitol Res	1.473	1.550	424	2,710	11,036	4.07	27	36
16	Mem I Oswaldo Cruz	1.450	1.652	148	1,785	8,274	4.64	26	
17	Folia Parasit	1.307	1.268	40	487	1,617	3.32	15	21
18	J Helminthol	1.229	1.147	58	520	1,989	3.83	17	23
19	J Parasitol	1.165	1.319	232	2,309	11,694	5.06	34	49
20	Syst Parasitol	0.927	0.973	50	513	1,826	3.56	17	23
	KOREAN J PARASITOL[a]	**0.871**	**1.010**	**54**	**85**	**15**	**0.18**	**2**	**13**
21	Acta Parasitol	0.748	0.835	57	448	1,125	2.51	12	14
22	Parasite	0.736	0.720	90	574	1,467	2.56	13	19
23	Trop Biomed	0.590		42	107	43	0.4	3	
24	Comp Parasitol	0.477	0.637	46	374	899	2.4	12	14
25	Helminthologia	0.443	0.445	40	362	624	1.72	9	13
26	Parasite Vector		0.000	38					

Source: JCR Science Edition: 2008.

[a]KJP data supplied by the author. KJP is not listed in JCR 2008, because the journal became SCI journal from 2008.

[b]h-index of WoS obtained by the "create citation report" based on the search using the "Publication Name" in the WoS Search mode.

[c]Retrieved from: http://www.scimagojr.com. SCImago Research Group, Copyright 2007-2009. Data Source: Scopus.

appeared in both lists. The order of the articles by citation frequency was almost the same, especially at the very top. However, only 10 articles of the Synapse list overlapped with the SCI list.

One distinct characteristics of the Synapse list of the 30 most cited articles is that it included altogether 26 articles published before 1990. Six articles published in the 1960s, 4 articles of the 1970s, and 16 articles of the 1980s made into the list. On the contrary, the Scopus' most cited list had 26 articles published after 1990; 9 articles from the 2000s and 17 from the 1990s. SCI's top 30 list included articles evenly from each decade; 7 from the 2000s, 11 from the 1990s, 7 from the 1980s, 4 from the 1970s, and 1 from the 1960s articles. The PubMed list is concentrated in the 1990s with 25 articles published during the decade and none before 1990 partly due to the complications associated with the citations referring to "Kisaengchunghak chapchi".

Supplement issues

One special point to be noted is that the supplement issues were cited frequently. The KJP published 4 supplement issues. "Malayan filariasis in Korea" published in 1978 [35], "Parasitic amoeba in Korea" in 1981 [36], and "The current pathobiology and chemotherapy of clonorchiasis" in 1986 [37] were published as "a single volume for an article". Finally, the 1990 supplement issue published 11 articles. Of these 14 articles published in the supplement issues, 3 articles were included in the top 30 most cited by SCI articles list [37-39]. One more article published in the 1990 supplement was included in the Scopus list [40]. Synapse picked up only one supplement article [38]. PubMed did not include any, apparently because the supplement issues were published in the "Kisaengchunghak chapchi".

Table 7. The 30 most cited KJP articles

SCI			PubMed			Synapse			Scopus		
Article	Rank	Times cited by WoS	Article	Rank	Times cited by PMC	Article	Rank	Times cited by Synapse	Article	Rank	Times cited by Scopus
2003.41.1.1	1	158	1999.37.3.129	1	16	1981.19.2.137	1	46	2003.41.1.1	1	157
2001.39.1.1	2	70	1994.32.3.195	2	14	1964.2.1.20	2	45	2001.39.1.1	2	77
1986.24.Suppl.1	3	56	1996.34.2.127	3	11	1969.7.1.53	2	45	1986.24.Suppl.1	3	46
1993.31.1.1	4	43	1998.36.2.69	3	11	1981.19.2.131	4	36	1994.32.3.195	4	42
1999.37.3.129	5	40	1999.37.4.249	3	11	1981.19.2.151	5	35	1999.37.3.129	5	39
1994.32.3.195	6	38	1995.33.4.331	6	10	2003.41.1.1	6	30	1993.31.1.1	6	36
1975.13.1.60	7	35	1996.34.2.113	6	10	1990.28.Suppl.s103	7	28	1993.31.1.21	7	31
1993.31.1.21	8	29	1998.36.3.155	6	10	1982.20.2.93	8	26	1994.32.1.13	8	29
1994.32.1.13	9	27	2000.38.3.119	6	10	1983.21.2.219	8	26	2000.38.4.209	9	24
1980.18.1.15	10	25	1997.35.2.139	10	9	1994.32.3.195	10	25	1997.35.1.9	10	22
1997.35.1.9	11	23	1998.36.4.241	10	9	1975.13.1.60	11	24	1964.2.1.20	11	20
2000.38.4.209	11	23	1998.36.4.249	10	9	1977.15.2.115	12	23	2000.38.3.119	11	20
1984.22.2.222	13	22	2000.38.2.51	10	9	1986.24.1.25	13	22	1997.35.2.139	13	19
2000.38.3.119	14	21	2003.41.1.1	10	9	1968.6.3.77	14	21	1998.36.4.241	13	19
1964.2.1.20	15	20	1994.32.4.281	15	8	1984.22.2.181	14	21	1999.37.4.215	13	19
1982.20.2.93	16	19	1995.33.1.1	15	8	1983.21.1.58	16	20	1990.28.Suppl.s103	16	18
2003.41.1.35	17	18	1996.34.1.79	15	8	1984.22.1.1	16	20	2001.39.2.143	17	17
1979.17.1.67	18	17	1998.36.1.37	15	8	1993.31.2.99	16	20	2003.41.1.35	17	17
1980.18.2.145	18	17	1997.35.4.233	19	7	1969.7.3.129	19	19	1993.31.2.83	19	16
1981.19.2.137	18	17	1999.37.2.71	19	7	1982.20.2.112	19	19	1996.34.2.127	19	16
1990.28.Suppl.s103	18	17	1999.37.4.243	19	7	1964.2.1.1	21	18	1990.28.Suppl.s63	21	15
1998.36.4.241	18	17	2001.39.2.201	19	7	1978.16.1.1	21	18	1990.28.Suppl.s79	21	15
1999.37.4.215	18	17	1996.34.2.107	23	6	1980.18.2.215	21	18	1998.36.1.37	21	15
1979.17.2.105	24	16	1997.35.1.9	23	6	1981.19.1.55	21	18	1999.37.2.71	21	15
2001.39.2.143	24	16	1997.35.2.87	23	6	1984.22.1.61	21	18	1998.36.2.69	25	14
1978.16.2.148	26	15	1998.36.4.217	23	6	1986.24.1.95	21	18	2005.43.2.47	25	14
1981.19.2.151	26	15	1998.36.4.269	23	6	1966.4.1.33	27	17	1981.19.2.137	27	13
1990.28.Suppl.s63	26	15	1999.37.3.181	23	6	1998.36.4.241	27	17	1982.20.2.93	27	13
1998.36.1.37	26	15	1999.37.4.265	23	6	1978.16.2.148	29	16	2000.38.3.167	27	13
2001.39.4.267	26	15	2000.38.3.177	23	6	1984.22.1.51	29	16	2001.39.4.267	27	13
			2000.38.4.209	23	6	1985.23.1.58	29	16			
			2001.39.1.1	23	6	1995.33.1.1	29	16			
						1999.37.3.129	29	16			

h-index

H-index is a relatively new bibliometric indicator proposed by Hirsch in 2005. "A scientist has index h if h of his or her *Np* papers have at least h citations each and the other (*Np-h*) papers have $\leq$ h citations each" [41]. Because h-index can be found very easily by ordering articles in a document set by "times cited," it has been widely used in citation analysis to characterize the scientific output of a researcher. Originally defined to measure broad impact of an individual, the definition is often extended to the general framework of any group of documents [42,43]. Both SCI and Scopus generate h-index values for a set of documents resulted from a search in its "analyze" menus. If we create a set of documents for a journal in a database search, the h-index of a journal can be easily obtained. As such, the problem with this index is that it differs a great deal by the size of records in the databases. Another problem expected of h-index is that it should increase with time.

Table 6 lists the h-index values obtained from SCI and Scopus for 26 journals listed in the SCI JCR 2008 (i.e., journals covered in SCI before 2006) along with h-index of the KJP. The h-index of WoS was obtained from the "Create Citation Report" based on the search of each journal using the "Publication Name" in the WoS Search mode. The h-index of Scopus 2007 is supplied from "SCImago Journal & Country Rank: 2007" [44]. As shown in Table 6, h-index of the KJP directly generated from WoS is 2. The h-index of the KJP is reported 13 in Scopus 2007 data. With the h-index value of 2, the KJP ranked at the bottom among SCI parasitology journals listed in Table 6. The KJP ranked the 30th

among 40 Scopus journals listed under the parasitology subject category [44]. However, the h-index measured from SCI based on the data collected for this study is 17. It is 6 for PubMed, 19 for Synapse, and 17 for Scopus (underlined in Table 7). They are much higher but more realistic measurements of the KJP as of August 2009, because they are based on the data set covering all the citations to the journal, unlike the h-index directly generated from databases only reflecting the citations to the records covered in the databases. As of August 2009, only 85 KJP articles are indexed in SCI and the number of citations they received over a year from 2008 to the first half of 2009 is only 15. In case of Scopus, the KJP is indexed from 1977, but h-index is calculated using data contained in the Scopus database from 1996 [44].

Further studies suggested

SCI is stabilized in a sense that the back file is closed and only the records of articles currently published are added to the database. However, the expansion of PMC and CrossRef is very rapid and to a great extent in volume. Participating journals are growing and records of back issues of those journals are added along with the records of current issues published. As more number of journals supply reference information into the databases, the chances for retrieving citations the KJP should have received will increase. If the same kind of study is repeated in the future (for instance, a year after), it is very likely to find a more comprehensive set of citations to the KJP from foreign journals, thus making a better picture of the performances of the KJP in international scenes.

This study aimed at investigating the scholarly contributions of the Society by limiting the analysis to the KJP accounted by the citations found from 4 major databases in the field of medicine. Another bibliometric analysis study based on the Society members' publications in international journals other than the KJP is expected to supplement various and important achievements not possible to be captured in this study.

Expectations for the future

The KJP has published important articles during the last 5 decades, and the influences of the KJP to the parasitology researchers should be definitely acknowledged. It is anticipated that the KJP will continue to serve the academic world by disseminating the important research findings in the field of parasitology rapidly and globally.

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