Original Article

Current Status of Scientific Citation Index Expanded Article Publications and Relationship with the Human Resources of Medical Schools in Korea

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Abstract

Objective: The purpose of this paper was to quantify both the output and the impact of the relationship between Korean medical schools and their human resource departments and their ability to support the basic data for research goals of Korean medical schools. **Methods:** The SCOPUS database was used to identify SCIE (scientific citation index expanded) articles produced by Korean medical schools between 1997 to 2008. The SCIE criteria, impact factors, and citation numbers were classified according to the database of Thomson Scientific Company. The human resources of medical schools were collected, such as the number of professors, graduate students, clinical fellows, residents, interns, and research assistants, through use of the medical deans' association biannual report. **Results:** There was a significant difference across Korean medical schools in the number of the SCIE articles and citation numbers, resulting in only a few institutions producing most of the impact. Among the variables, the proportion of professors of basic medical science (p<.01) and the number of research faculties per professor (p<.01), were related significantly to the SCIE per professor. The only factor affecting both SCIE number and SCIE per professor was the number of research faculties per professor. The number of graduate students in the medical school had no impact on productivity. **Conclusion:** For the medical schools with restricted resources, the strategic plans for proper management of human resources are needed to promote scientific publication. ***(Journal of Korean Society of Medical Informatics 15-3, 321-340, 2009)***

Key words: Medical School, Scientific Citation Index, H-index, Human Resources

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I. Introduction

Recently, the number of SCI (Scientific Citation Index) articles has been widely used for evaluation of medical school's productivity so that all the medical schools are trying to increase the number of SCI articles. According to the 2007 Report of Korean Ministry of Education, Science and Technology, the number of articles published through the journals indexed in Science Citation Index Database by Korean researchers has been increased to 25,494, which occupies 2.71% of SCI articles of the world[1]. According to the data, the number of articles of clinical medical science was 4,277, which occupies 16.77% of the SCI articles of 2007 in Korea. The SCI publication status of Korean medical science field has been reported by National Medical Academy in 2006[2]. In the report, the accumulated number of SCI articles is 19,695 for biomedical research and 26,023 for clinical medicine. Thus, the number of articles of medical schools has shown huge expansion in recent years. For these sparkling advances in medical scientific publications, many factors are related with the productivity. These days, the medical schools are competitively investing the human and financial resources on the research. Especially the expanding number of professors and research faculties are implicated. But the investment plans were not based on their resources and capabilities so that the resources management is not efficiently functioning for their goals. Though those reports mentioned above listed the number of SCI articles, there is no report which analyzed the relationship between the resources and productivity of medical publications of each medical school. The results of such study may be of interest to a number of stakeholders, such as potential students, employers of graduates, university administrators, potential donors, funding agencies, and governments.

Thus the study was conducted to compare a quantitative and qualitative scientific publication status of the Korean medical schools during the past 12 years in relation with the resources of the medical schools. The interests are oriented to: how many papers have been published by Korean medical schools; where have these papers been published; how many times have these articles been cited; how are the output and impact measures distributed among the medical schools; and finally how the resources of the medical schools are affecting the productivity. The current research is expected to serve a basic data to set a strategy to increase the SCIE articles for the medical schools.

II. Materials and Methods

Scientific Citation Index Expanded (SCIE) Articles: The question frame is 'How many is the papers?" and "How often have the papers, published between 1997 and 2008 by full time faculties in academic year 1998 to 2005, been cited as of January 31, 2009?" The original articles and reviews are included, but bibliographies, meeting abstracts, editorials, introductions to special issues, letters, discussion pieces, corrections, and book reviews were excluded. Twelve years of archives of the SCIE articles of each medical school from the year 1997 to 2008 were extracted from SCOPUS database (Elsevier B.V., Amsterdam, Netherlands), which is one of the largest abstract and citation database of research literature and quality web sources. In the SCOPUS database, the articles were sorted by using the command designed to extract only full papers (original article and reviews) and to confine the affiliation as "medical school or medical college".: (AF-ID (########) AND AFFIL (medicine) OR AFFIL (medical) AND NOT AFFIL (oriental medicine) AND NOT AFFIL (veterinary medicine)) AND SUBJAREA (mult OR agri OR bioc OR immu OR neur OR phar OR medi OR nurs OR vete OR dent OR heal) AND PUBYEAR AFT 1996 AND PUBYEAR BEF 2009 AND (EXCLUDE (DOCTYPE, "cp") OR EXCLUDE (DOCTYPE, "le") OR EXCLUDE (DOCTYPE, "er") OR EXCLUDE (DOCTYPE, "sh") OR EXCLUDE

(DOCTYPE, "ed") OR EXCLUDE (DOCTYPE, "ip") OR EXCLUDE (DOCTYPE, "no")) (Fig. 1). AF-ID is designated identification number of each institution. The AF-ID, the name of institutions and name variants of the institutions are listed in Appendix 1. The command describes list articles where 'the database field affiliation ID is ########' and 'the affiliation includes medicine or medical' and 'the affiliation exclude oriental medicine or veterinary medicine' and 'subject of the articles contains multidisciplinary, agriculture, biochemistry genetics and molecular biology, immunology, neuroscience, pharmacology, medicine, nursing, veterinary medicine, dentistry and health professions' and 'the publication year is from 1997 to 2008' and 'the types of articles are limited to article and reviews'. The affiliation name and name variants of medical school is listed in appendix 1. Among the articles, the SCIE listed journal was extracted. The criteria of SCIE, impact factors and citation numbers were classified according to the database of Thomson Scientific Company. Resources of the Medical Schools: The statuses of resources of medical schools were collected from biannual report of educational status of medical schools in Korea by medical dean's association. The reports of 1998/9, 2000/1, 2002/3, and 2004/5 were used. The generated data fields were 1) graduate students; basic medical science (master, doctor course), clinical medical science (master, doctor course), 2) hospital; number of hospitals, number of beds, number of interns, number of residents, number of fellows, 3) professors; basic science (full professor, associate professor, assistant professor, instructor), clinical science (full professor, associate professor, assistant professor, instructor), 4) research faculties; basic science (assistant, assistant researcher), clinical science (assistant, assistant researcher). The status of the human resources of the medical schools is listed in appendix 2. SPSS 15.0 and Pearson correlation test was done was used for the statistical analysis.

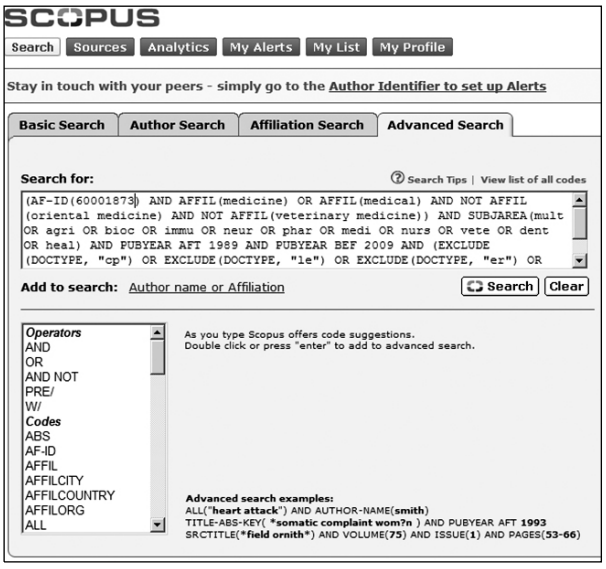

Figure 1. The figure shows advanced search area of SCOPUS Database to where the search command is attached.

III. Results

1. SCIE articles

The numbers of SCIE articles of medical schools from 1997 to 2008 and the number of citations of each medical school are listed in Table 1. The total number of searched SCIE articles of the 40 medical schools during the period was 35,469 but the sum of the number of SCIE of the medical schools was 51,480 due to the multi-institution, multi co-authoring articles. The number of SCIE articles per year (SCIE/yr) has increased from 1,024 in 1997 to 8,462 in 2008 (Fig. 2). The total number of SCIE article may cause optical illusion because the number was multiplied according to the affiliation of the authors. Also the number does not differentiate whether the authors are corresponding or co-authoring. Thus, the number of SCIE articles of corresponding author (CA-SCIE) of designated school was searched to estimate the productivity of each medical school. The total number of CA-SCIE of 40 medical schools was 29,048, which is 56.4% of the number of SCIE. Annual increase is 8.6% for the

Table 1. The number of SCIE articles and citations of medical schools during 1997-2008

Affiliation	No. of SCIE	No. of CA-SCIE	Citation of CA-SCIE					Citation/ CA-SCIE
			Sum	<10	10 to 19	20 to 29	30 or more	
Seoul National	7,834	5,187	48,073	71.80%	15.50%	6.10%	6.60%	9.3
Yonsei	5,695	3,929	29,832	76.20%	13.50%	4.80%	5.50%	7.6
Sung Kyun Kwan	4,006	2,611	20,456	75.60%	13.00%	5.20%	6.20%	7.8
Ulsan	3,569	2,509	22,031	72.10%	15.30%	6.10%	6.50%	8.8
Catholic Univ. of Korea	2,663	1,727	14,028	74.10%	13.40%	6.80%	5.60%	8.1
Korea	2,508	1,449	8,338	82.50%	11.00%	3.50%	3.00%	5.8
Ajou	1,706	958	8,542	72.70%	15.00%	5.40%	6.90%	8.9
Chonnam	1,522	900	5,618	80.20%	12.70%	4.00%	3.10%	6.2
Hallym	1,392	667	4,592	75.70%	17.10%	3.60%	3.60%	6.9
Pusan	1,125	666	4,849	76.40%	15.60%	3.50%	4.50%	7.3
Hanyang	1,426	664	5,107	75.50%	14.50%	5.40%	4.70%	7.7
Kyungpook	1,266	628	4,654	77.90%	12.90%	4.00%	5.30%	7.4
Kyung Hee	1,129	615	4,844	75.30%	13.80%	5.00%	5.90%	7.9
Chonbuk	974	555	4,625	76.00%	13.90%	3.80%	6.30%	8.3
Inha	1,073	542	3,687	77.90%	13.30%	4.80%	4.10%	6.8
Ehwa	1,196	469	3,794	75.70%	14.10%	5.30%	4.90%	8.1
Wonkwang	663	376	3,136	72.30%	18.60%	4.30%	4.80%	8.3
Inje	1,010	336	1,764	83.60%	10.40%	3.60%	2.40%	5.3
Chungnam	868	333	2,119	80.50%	12.90%	3.30%	3.30%	6.4
Chung-Ang	662	315	1,899	79.40%	14.60%	3.50%	2.50%	6
Keimyung	604	291	2,181	76.60%	13.10%	5.50%	4.80%	7.5
Chosun	581	275	1,519	81.50%	12.40%	2.90%	3.30%	5.5
Dong-A	545	274	1,816	79.60%	11.70%	3.60%	5.10%	6.6
Chungbuk	599	266	2,624	73.30%	13.20%	8.30%	5.30%	9.9
Konkuk	857	261	926	89.70%	7.30%	2.30%	0.80%	3.5
Yeungnam	556	259	1,696	77.60%	13.10%	5.40%	3.90%	6.5
Soonchunhyang	600	255	1,740	78.40%	11.00%	5.50%	5.10%	6.8
Gyeongsang	519	254	1,384	82.30%	12.20%	0.80%	4.70%	5.4
Gacheon	461	215	1,559	79.50%	10.70%	4.70%	5.10%	7.3
Pochon CHA	496	197	1,413	79.70%	12.20%	3.00%	5.10%	7.2
Kangwon	615	196	2,049	64.80%	19.90%	7.70%	7.70%	10.5
Dankook	506	183	1,514	75.40%	11.50%	8.20%	4.90%	8.3
Dongguk	414	135	650	84.40%	10.40%	2.20%	3.00%	4.8
Eulji	461	124	659	83.10%	10.50%	4.80%	1.60%	5.3
Cheju	343	106	343	90.60%	8.50%	0.90%	0.00%	3.2
Catholic Univ. of Daegu	256	104	624	76.00%	19.20%	1.90%	2.90%	6
Kwandong	263	78	321	85.90%	10.30%	2.60%	1.30%	4.1
Kosin	185	58	538	67.20%	19.00%	6.90%	6.90%	9.3
Konyang	209	47	402	76.60%	14.90%	4.30%	4.30%	8.6
Seonam	123	34	331	55.90%	26.50%	17.60%	0.00%	9.7
Total	51,480	29,048	226,277	75.70%	13.90%	5.10%	5.30%	7.8
Foreign		4,272	87,799	52.3%	18.0%	10.1%	19.6%	20.6
National research center		813	8,270	68.1%	16.9%	5.8%	9.2%	10.2

SCIE: The number of SCIE articles during 1997-2008
CA-SCIE: The number of SCIE articles of which the corresponding author is belonged to the affiliation

number of SCIE articles and 7.6% for CA articles. Among the 40 medical schools, the top four medical schools (Seoul National, Yonsei, Seong Kyun Kwan, Ulsan) occupies only 23% of total number of professors but they occupies 40% of SCIE articles and 50% of CA articles. Most of the medical schools are having less than 10,000 citations and 1,000 CA-SCIE (Fig. 3). 27.5% of medical schools publish less than 50 SCIE articles per year and 57.5% of medical schools publish less than 50 corresponding articles per year. Among the

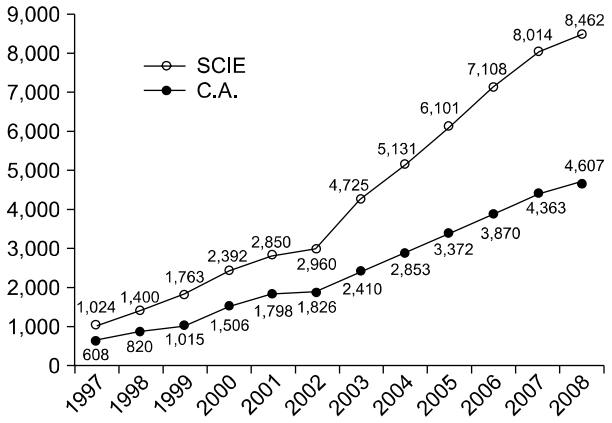

Figure 2. The change of number of SCIE articles of medical schools in Korea. The number of SCIE articles is increased 8.3 fold and the number of corresponding SCIE articles is increased 7.6 fold from 1997 to 2008.

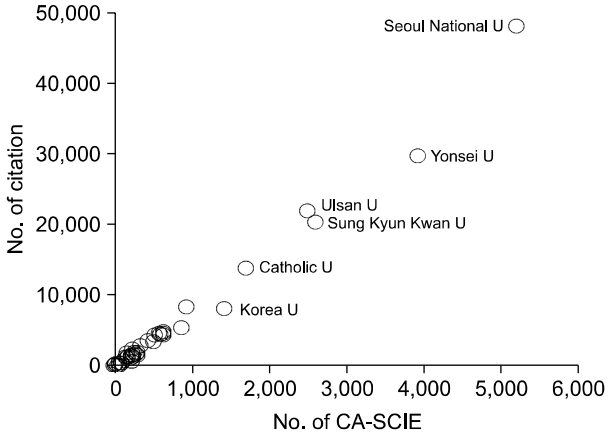

Figure 3. The positions of forty medical schools according to the number of corresponding articles and citation numbers. Most of the medical schools have less than 1,000 cumulative SCIE articles and 10,000 citations.

SCIE articles, 4,272 articles have foreign institutions as corresponding author's affiliation and 813 articles have national research institutions such as KRIBB (Korea Research institute of Bioscience and Biotechnology) or KAIST (Korea Advanced Institute of Science and Technology) as corresponding author's affiliation.

2. SCIE per capita

The SCIE/yr during the period ranges from 10.3 to 652.8 and median was 55.2 (Table 2). The number of SCIE per professor per year (SCIE/Prof./yr) ranges from 0.12 to 1.76 and median was 0.43. But the use of absolute number of SCIE is error prone since it does not discriminate multi-author article over single-author article. The CA-SCIE per year (CA-SCIE/yr) has increased from 608 in 1997 to 4,607 in 2008. The CA-SCIE/yr during the period ranges from 2.8 to 432.3 and median was 25.3. The number of CA-SCIE per professor per year (CA-SCIE/Prof./yr) ranges from 0.03 to 1.17 and median was 0.2. The average number of SCIE article per professor per year (SCIE/Prof./yr) in Korea is 0.5 and the average number of corresponding SCIE article per professor per year (CA-SCIE/Prof./yr) is 0.25. Only one medical school (Seoul National University) exceeded 1.0 in both factors.

3. Citations

The citation number of each article was obtained from the SCOPUS Database. The score provides the total citation number of each individual articles and it does not consider longevity of the article. The number of citations reflects past several years accumulated citations of the articles. Also, the number is multiplicated by the number of affiliations of the authors. So the citation number of CA-SCIE can be considered as true citation number. The accumulated citation number of CA-SCIE was 226,277. Among the SCIE articles published, 75.7% of articles have less than 10 citations and only 10.4% of the articles have citations of more than 20. The average number of citation per CA-SCIE was 7.8. Meanwhile, for the CA-SCIE of foreign correspondences, 52.3% of articles have less than 10 citations and 19.6% of articles have citations 30 or more.

Table 2. The average number SCIE articles and corresponding SCIE articles during 1997-2008

Affiliation	SCIE/Year	CA-SCIE/Year	Prof./Year	SCIE/Prof.	CA-SCIE/Prof.	CA-SCIE/SCIE
Seoul National	652.8	432.3	370.8	1.76	1.17	0.40
Yonsei	474.6	327.4	612.8	0.77	0.53	0.41
Sung Kyun Kwan	333.8	217.6	384.8	0.87	0.57	0.39
Ulsan	297.4	209.1	482.5	0.62	0.43	0.41
Catholic Univ. of Korea	221.9	143.9	841.5	0.26	0.17	0.39
Korea	209.0	120.8	273.3	0.76	0.44	0.37
Ajou	142.2	79.8	186.5	0.76	0.43	0.36
Chonnam	126.8	75.0	145.0	0.87	0.52	0.37
Hanyang	118.8	55.3	240.8	0.49	0.23	0.32
Hallym	116.0	55.6	379.3	0.31	0.15	0.32
Kyungpook	105.5	52.3	169.8	0.62	0.31	0.33
Ehwa	99.7	39.1	197.5	0.50	0.20	0.28
Kyung Hee	94.1	51.3	157.5	0.60	0.33	0.35
Pusan	93.8	55.5	140.0	0.67	0.40	0.37
Inha	89.4	45.2	188.5	0.47	0.24	0.34
Inje	84.2	28.0	407.8	0.21	0.07	0.25
Chonbuk	81.2	46.3	130.5	0.62	0.35	0.36
Chungnam	72.3	27.8	133.0	0.54	0.21	0.28
Konkuk	71.4	21.8	107.3	0.67	0.20	0.23
Wonkwang	55.3	31.3	144.0	0.38	0.22	0.36
Chung-Ang	55.2	26.3	118.3	0.47	0.22	0.32
Kangwon	51.3	16.3	42.3	1.21	0.39	0.24
Keimyung	50.3	24.3	137.8	0.37	0.18	0.33
Soonchunhyang	50.0	21.3	298.8	0.17	0.07	0.30
Chungbuk	49.9	22.2	108.0	0.46	0.21	0.31
Chosun	48.4	22.9	119.8	0.40	0.19	0.32
Yeungnam	46.3	21.6	145.5	0.32	0.15	0.32
Dong-A	45.4	22.8	126.8	0.36	0.18	0.33
Gyeongsang	43.3	21.2	111.0	0.39	0.19	0.33
Dankook	42.2	15.3	114.0	0.37	0.13	0.27
Pochon CHA	41.3	17.9	231.0	0.18	0.08	0.28
Eulji	38.4	10.3	155.5	0.25	0.07	0.21
Gacheon	38.4	17.9	141.3	0.27	0.13	0.32
Dongguk	34.5	11.3	106.8	0.32	0.11	0.25
Cheju	28.6	8.8	38.5	0.74	0.23	0.24
Kwandong	21.9	6.5	69.5	0.32	0.09	0.23
Catholic Univ. of Daegu	21.3	8.7	114.8	0.19	0.08	0.29
Konyang	17.4	3.9	84.8	0.21	0.05	0.18
Kosin	15.4	4.8	124.0	0.12	0.04	0.24
Seonam	10.3	2.8	83.3	0.12	0.03	0.22

SCIE: The number of SCIE articles during 1997-2008
CA-SCIE: The number of SCIE articles of which the corresponding author is belonged to the university
Prof./year: The average number of professors during 1998-2005

4. Impact factor

The current status of impact factors of CA-SCIE are shown in Table 3. Among the 29,048 CA-SCIE articles, 28,370 articles were found to have impact factors. 90.8% of the articles have impact factors less than 5 and only 9.2% of the articles have impact factors of 5 or more. Meanwhile, the percentage of articles with impact factor 5 or more is 33.3% for the articles which have correspondence as foreign institute. Also, it is 20.3% for the articles which have correspondence as National Research Center such as KRIBB or KAIST.

Table 3. Impact factor of corresponding articles of the medical schools

Affiliation	<1.0	≥1.0-<2.0	≥2.0-<5.0	≥5.0-<10.0	10 or more	N/A	% of more than 5	H index
Seoul National	545	1,434	2,479	572	60	97	12.2%	30
Yonsei	988	1,001	1,536	295	47	62	8.7%	30
Ulsan	313	687	1,186	247	40	36	11.4%	25
Sung Kyun Kwan	463	746	1,102	238	20	42	9.9%	23
Catholic University of Korea	249	505	790	124	14	45	8.0%	23
Korea	243	468	602	90	11	35	7.0%	20
Ehwa	93	103	199	41	6	27	10.0%	16
Ajou	176	194	450	117	5	16	12.7%	15
Chonbuk	79	140	255	56	6	19	11.2%	15
Chonnam	206	244	348	65	10	27	8.3%	15
Hanyang	94	176	325	45	5	19	7.5%	15
Inha	145	164	188	27	4	14	5.7%	15
Hallym	89	203	330	23	5	17	4.2%	15
Kyung Hee	117	206	236	36	6	14	6.8%	14
Wonkwang	94	103	128	22	1	28	6.1%	14
Pusan	96	172	337	35	2	24	5.6%	13
Kyungpook	83	163	315	57	2	8	9.4%	12
Chungnam	82	88	123	28	2	10	9.0%	12
Gyeongsang	49	73	108	13	0	11	5.1%	12
Chung-Ang	58	85	152	3	1	16	1.3%	12
Kangwon	29	49	92	23	1	2	12.2%	11
Chungbuk	55	72	104	24	2	9	9.8%	11
Keimyung	59	67	125	25	1	14	8.9%	11
Inje	56	95	149	26	1	9	8.0%	11
Pochon CHA	50	48	83	13	1	2	7.1%	11
Chosun	43	105	94	18	1	14	6.9%	11
Yeungnam	56	74	110	17	0	2	6.6%	10
Dankook	58	41	58	19	1	6	10.9%	9
Dong-A	40	80	123	16	2	13	6.6%	9
Cheju	25	36	41	3	0	1	2.8%	8
Soonchunhyang	44	68	114	17	0	12	6.7%	7
Catholic University of Daegu	17	38	39	6	0	4	5.8%	7
Konkuk	45	96	107	7	1	5	3.1%	7
Konyang	17	11	17	1	0	1	2.1%	7
Gacheon	34	54	92	29	4	2	15.3%	6
Seonam	9	9	13	3	0	0	8.8%	6
Eulji	27	39	47	7	0	4	5.6%	6
Dongguk	24	52	49	5	0	5	3.7%	6
Kwandong	25	20	27	2	0	4	2.6%	4
Kosin	15	14	21	6	0	2	10.3%	3
Total	4,990	8,023	12,694	2,401	262	678	9.2%	
Foreign institute	231	641	1,886	1,149	274	91	33.3%	33
National research center	45	156	431	140	25	16	20.3%	17

N/A: Impact facto is not available

5. H-Index

H index is easier to demonstrate the productivity and citation status of the authors or institutions. Table 3 shows H index of the medical schools. The H index ranges from 3 to 30 and median is 12. The Seoul National University and Yonsei University had H index of 30. Meanwhile the H index of foreign institute is 33.

6. Relationship with resources of the professor

The number of SCIE articles, the number of SCIE articles per professor (SCIE/Prof.), the number of SCIE articles cited 30 or more (highly cited), the ratio of SCIE article cited 30 or more in total number of SCIE articles were compared. Total number of SCIE article is closely related to the number of SCIE articles cited 30 or more. But the ratio of highly cited articles does not related with the total number of SCIE articles. The number of SCIE articles per professor was related with

Table 4. Correlations of the research products and resources of the medical schools

Factors	SCIE	SCIE/Prof.	SCIE cited 30 or more	% cited 30 or more
Research products				
Articles				
Total No. of SCIE articles	1.000	.338*	.993†	0.222
No. of SCIE articles per professor	.338*	1.000	.344*	−0.037
Citation				
Total No. of articles cited 30 or more	.993†	.344*	1.000	0.293
Ratio of No. of articles cited 30 or more	0.222	−0.037	0.293	1.000
Human resources				
Professor				
No. of professors of basic medical science	.719†	−0.007	.693†	0.255
No. of full professors of basic medical science	.777†	0.432	.742†	0.201
No. of associate professors of basic medical science	.899†	0.457	.882†	0.159
No. of assistant professors of basic medical science	.725†	0.259	.703†	0.372
No. of instructors of basic medical science	−.999*	−0.335	−0.969	−0.372
No. of professors of clinical medical science	.618†	−0.098	.604†	0.224
No. of full professors of clinical medical science	.754†	−0.034	.729†	0.253
No. of associate professors of clinical medical science	.658†	−0.103	.631†	0.198
No. of assistant professors of clinical medical science	.551†	−0.086	.541†	0.201
No. of instructors of clinical medical science	0.230	−0.148	0.240	0.139
Ratio of professors of basic medical science	−0.281	.444†	−0.269	−0.092
Full professor				
No. of full professors	.759†	−0.032	.735†	0.260
Ratio of full professors	0.225	−0.183	0.215	0.188
Graduate school				
No. of students of basic medical science	.610†	0.064	.598†	0.252
No. of students of basic medical science in masters course	.622†	0.126	.613†	0.268
No. of students of basic medical science in doctors course	.567†	−0.001	.551†	0.224
No. of students of clinical medical science	.697†	0.037	.688†	0.268
No. of students of cinical medical science in masters course	.703†	0.025	.691†	0.270
No. of students of clinical medical science in doctors course	.668†	0.051	.664†	0.258
Total no. of students of masters course	.698†	0.052	.687†	0.276
Total no. of students of doctors course	.651†	0.036	.643†	0.253
Clinical faculties				
No. of residents	.750†	0.052	.716†	0.194
No. of clinical fellows	.541†	0.235	.501†	0.140
No. of graduate school students per professor	0.091	0.022	0.094	0.168
No. of research faculties per professor	.513†	.510†	.534†	0.015
No. of residents per clinical professor	.361*	−0.179	.356*	0.179
Hospital				
No. of hospitals	0.336	−0.060	0.296	0.000
No. of beds	.539†	0.136	.515†	0.175
No. of hospital beds per clinical professor	−0.205	.437†	−0.210	−0.307

* Correlation is significant at the 0.05 level (2-tailed)
† Correlation is significant at the 0.01 level (2-tailed)

the number of highly cited articles. The ratio of highly cited articles did not have relationship with other factors. The correlations between research product and resources are listed in Table 4. Total number of SCIE articles and highly cited articles are related with the total number of professors, the number of basic science professors and the number of clinical science professors. The number of basic science professors did not related with the total number of SCIE articles and highly cited articles but it was significantly related with the number of SCIE per professor. The number of highly cited articles is increasing as the number of full professors increasing but the ratio of full professors did not show any relationship with the factors. The most strongly related professor factor was the number of associate professors of basic medical science (r=.899, p<0.01). The average number of article per professor per year is 0.5 and the average number of CA-SCIE per professor per year is 0.2. The highest number of SCIE article per professor per year is 1.76 in medical school of Seoul National University. In the meantime, the number of articles per professor of Gwangju Institute of Science Technology (GIST) was 5.07. Seoul National University record was 1,403 in 2008 to make SCIE/Prof. about 3.8. The number of full professors and the number of professors of basic science showed high correlation coefficient for the number of SCIE articles and the number of CA- SCIE. But for the SCIE/Prof., the total number of professors showed weak correlations. And the number of professor of clinical science showed no correlation. The clinical professors did not contribute the number of SCIE article per professor. The number

Table 5. Top 30 journals to where the medical school researchers submit

Rank	Title of the journal	No. of articles	Percent	Citations	Citation/Article
1	Journal of Korean Medical Science	1,339	3.78%	4,152	3.1
2	Yonsei Medical Journal	919	2.59%	3,229	3.5
3	Biochemical and Biophysical Research Communications	700	1.97%	7,130	10.2
4	Journal of Biological Chemistry	517	1.46%	16,960	32.8
5	Molecules and Cells	376	1.06%	2,336	6.2
6	American Journal of Roentgenology	347	0.98%	3,311	9.5
7	Experimental and Molecular Medicine	344	0.97%	1,994	5.8
8	Neuroscience Letters	320	0.90%	2,357	7.4
9	Archives of Pharmacal Research	281	0.79%	979	3.5
10	Korean Journal of Radiology	266	0.75%	688	2.6
11	Brain Research	235	0.66%	2,448	10.4
12	Radiology	218	0.61%	5,496	25.2
13	Journal of Computer Assisted Tomography	206	0.58%	1,555	7.5
14	Gastrointestinal Endoscopy	181	0.51%	1,211	6.7
15	Cancer Research	175	0.49%	4,432	25.3
16	NeuroReport	171	0.48%	2,229	13.0
17	Transplantation Proceedings	161	0.45%	325	2.0
18	Journal of Microbiology and Biotechnology	160	0.45%	486	3.0
19	Cancer Letters	158	0.45%	1,957	12.4
20	FEBS Letters	158	0.45%	1,771	11.2
21	Journal of Gastroenterology and Hepatology	156	0.44%	1,162	7.4
22	Acta Oto-Laryngologica	153	0.43%	452	3.0
23	Journal of Immunology	146	0.41%	4,212	28.8
24	Biological and Pharmaceutical Bulletin	142	0.40%	985	6.9
25	International Journal of Cancer	137	0.39%	2,109	15.4
26	Journal of Biochemistry and Molecular Biology	134	0.38%	581	4.3
27	American Journal of Neuroradiology	132	0.37%	1,293	9.8
28	Abdominal Imaging	126	0.36%	890	7.1
29	Laryngoscope	126	0.36%	858	6.8
30	Gynecologic Oncology	121	0.34%	1,219	10.1

of full professor and the number of basic science professor showed relationship with CA-SCIE per professor. The number of full professors and the number of associate professor are highly related with the proportion of CA-SCIE. The only factor affected both the total number of SCIE article and the number of SCIE article per professor was the number of researchers per professor.

7. Relationship with resources of the graduate students

The total number of students of master course and the total number of doctor course were related with the total number of SCIE articles and the number of highly cited articles. But the number of graduate students did not related to the number of SCIE articles per professor and the ratio of highly cited articles. The number of graduate student per professor did not show any relationship with the factors.

8. Relationship with resources of the clinical faculties

The number of total SCIE articles and highly cited articles are increased as the number of bed is increased. Also, the number of residents was related with the total number of SCIE articles and highly cited articles. The number of resident per professor was related with the total number of SCIE articles and the number of highly cited articles. Clinical fellows had no relationship with any of the research product related factors.

9. Journals

The number of submitted journals was 2,202. The Journal of Korean Medical Science was ranked to top to have 1339 articles occupying 3.78% of the SCIE publications followed by Yonsei Medical Journal to have 919 articles occupying 2.59%. Top 30 journals occupied 24.3% of the articles and 11.9% of citations (Table 5).

IV. Discussion

SCI is scientific citation index database used since 1963, which is now served as on-line service named as Web of Science. The expanded version of SCI is SCIE, which is not different in the aspect of quality of the journals, so expanded version was used. As the competitions among the universities get higher in the research area, the numbers of SCIE articles become a representative of medical schools' research productivity. With these efforts, the number of SCIE articles of Korean medical schools has shown huge expansion during last 12 years. The Korean Ministry of education science and technology (MIST) reported that the number of SCI articles of Korea in 2007 was 25,494 ranking 12th among 180 countries. The number of SCIE articles of clinical medical science field was 4,277 occupying 2.03% of Korean SCIE articles[1)]. The result of current analysis is discordant to the report by National Medical Academy[2)] and by Korean Ministry of Education[1)]. The discordant comes from the difference of method of analysis. The current study strictly handled using SCOPUS DB and SCIE list of Thomson Scientific Company because the Pubmed or Medline do not discriminate thorough information about affiliation. And further, they do not provide citation information and differentiate multi-institution, multi-author articles. Because the type of the articles was limited to 'original article' and 'reviews' to exclude other type of articles such as short communications, letters to the editor, comments and editorials, the number of SCIE article is smaller than previous report. Moreover, the number of corresponding article is much smaller than expected because only one medical school can be counted to be correspondence.

Those previous reports did not give information of relationship of the medical schools and their resources

though the total number of SCIE articles is largely affected by the number of professors and the resources of the university. Therefore, the understanding how the resources of medical school influence on the productivity of SCIE publications of medical school is needed to plan the strategy to promote research for the medical schools. So the author tried to analysis the relationship of medical school's resource and productivity.

The result showed that the number of SCIE articles has been increased from 1,400 in 1998 to 8,462 in 2008 which is 8.3 fold large. Also the number of corresponding SCIE articles of Korean medical schools is increased from 820 in 1998 to 4,607 in 2008 which is 7.6 fold large. The current research demonstrated that the quantitative factors such as total number of SCIE articles is significantly related with qualitative factors such as number of SCIE articles per professor and the total number of highly cited articles.

1. Professors

Most of the professors resources are related with the quantity factor such as total number of SCIE articles and quality factor such as total number of highly cited articles (cited 30 or more). The number of instructors of basic medical science was negatively related with the total number of SCIE articles. Possible explanation for this phenomenon is that to publish a SCIE article, it took more than one year after they were hired so that they negatively affect the total number of SCIE articles. The only factor affect the number of SCIE articles per professor was the ratio of professors of basic medical science (r=.444, p<0.01). The associate professors, especially in basic medical science professors are most highly pressed for tenure. And unlike the professors of the clinical science who have to share much of their activity to manage the patients, the professors of basic medical sciences can concentrate for the research.

2. Graduate school

All of the factors of graduate school except the number of graduate school student per professor were related with the number of SCIE publications. It is quite unreasonable that as the number of graduate school students, especially those of basic medical science, increases, the SCIE article number should be increased because the graduate school student should contribute to the research and submit scientific articles before they graduate. Also, no resource factors of graduate school student were associated with SCIE articles per professor. These phenomenon may suggest that many of graduate school students are not properly involved to research activity and not contributing to the professor's research.

3. Clinical faculties

The number of research faculties (assistant researcher or research assistant) per professor was only factor to affect the articles per professor. The number of residents or clinical fellows did not relate with SCIE per professor. Of the note, the number of hospital bed per clinical professor was significantly affected to the number of SCIE articles per professor. The possible explanation of this is that the increased number of hospital bed per professor means they can have larger clinical patient cases to make SCIE publications increase.

To increase SCIE articles per professor, the ratio of professors of basic medical science and the number of research faculties per professor need to be increased. The number of associate professors of basic medical science and total amount of research fund are strongly associated with the total number of SCIE articles. These two factors are also strongly associated with total number of articles cited 30 or more. For the clinical professors, the number of hospital bed was related with

Table 6. The total citations of the corresponding articles of top four universities from 1997 to 2008

Affiliation	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Seoul National	2,728	3,405	3,686	5,730	5,148	4,937	5,937	6,282	5,062	3,224	1,608	326	48,073
Yonsei	1,938	1,857	3,156	3,468	3,387	3,506	3,257	3,344	2,922	1,913	952	132	29,832
SKK	288	1,135	1,889	2,722	2,824	1,667	2,171	2,792	2,257	1,641	946	124	20,456
Ulsan	946	1,200	1,558	2,552	1,942	2,606	3,055	2,706	2,663	1,953	707	143	22,031

SCIE per professor. The clinicians with more clinical cases can produce more SCIE articles.

4. Citation

In the report by MIST, the citation number per SCIE article was 3.72. But according to current analysis, the average number of citation is 7.8. The difference is that the report of MIST used only 5 years of citation. But our report reflects total accumulated number of citation regardless of year. Table 6 is top four universities' citation status which shows that the citations of the articles published in from 2000 to 2004 are higher than recent 5 years. And the current analysis did not discriminate self-citations. Although it is possible that an author may be citing his or her work, there is no way to judge self citations are meaningless and moral- hazard. Moreover, it is becoming standard practice to include self-citations in meta-review analysis since there is ample evidence that this practice is common[3].

5. Impact factor

The impact factor, often abbreviated IF, is defined as the mean number of citations a journal receives over a 2-year period. Impact factors are calculated each year by Thomson Scientific for those journals which it indexes, and the factors and indices are published in Journal Citation Reports. It is derived from citations to all articles in a journal so the number is not giving information about the quality nor the quality of the work. By merely counting the amount of citations and disregarding the prestige of the citing journals, the ISI IF is often regarded as a metric of popularity, not of prestige. But even with the debates about the pros[4][5] and cons[6], the IF is being used to decide whether or not the professors get promoted or to have tenure or are offered a position in a department, or are awarded a grant. It may be used for simple measurement to compare the quality of work. The proportion of CA-SCIE having IF more than 5 is 9.2%. On the other hand, those of national research center and foreign institutions are 20.3% and 33.3% respectively. The proportion of CA-SCIE cited 30 or more was 5.3% for Korean medical schools, while that of foreign institutions and national research center were 19.6% and 9.2%. With these simple comparisons, the articles of Korean medical schools can be considered to have lesser citations than these institutions.

6. H-Index

H-index has developed by physicist Jorge Hirsch[7] to quantify both the impact and productivity. The index is based on the distribution of citations received by a given researcher's publications. H-index is highest number of papers a scientist has published that have each received that number of citations. For example: If A has 7 articles cited 5 times, 5 articles cited 5 times and 3 articles cited 6 times, the H-index of A is 5. In other words, a scholar with an index of h has published h papers each of which has been cited by others at least h times. Thus, the h-index reflects both the number of publications and the number of citations per publication. The h-index serves as an alternative to more traditional journal impact factor metrics in the evaluation of the impact of the work of a particular researcher[8]. In the current study, Seoul National University and Yonsei

University were highest to have H-index of 30 followed by Ulsan University of 25. For the H-index, the most highly cited articles are contributing, it determination is a relatively simple. But the H-index seems to be useful method to compare the productivity of the medical schools.

7. Limitations of the study

Every citation study has limitations in the design because the database contains a number of imperfections. The limitations listed below should be kept in mind when interpreting the results. These factors significantly affected to the total number of SCIE articles and caused significant gap in comparison with the numbers of SCIE which the medical schools are scoring as their product. For the number of medical schools, the exact number of medical schools in Korea is 41 because the Yonsei University has two medical schools. But the authors of two medical schools of Yonsei University are frequently using same affiliations so that they were counted as one university. For the resource of publications database, the study only focused on SCIE journals though the articles indexed in Pubmed or Index Medicus Database may be the intellectual impact of academic research. By focusing on SCIE journals, the analysis can provide a valid measure of academic research. Also, only the original articles and reviews are included. The bibliographies, meeting abstracts, editorials, introductions to special issues, letters, discussion pieces, corrections, and book reviews were excluded. The study was closed by January 31 and conducted from February 1, 2009. The articles of 2008 published after January 31, 2009 were not included. And there were miscellaneous problems such as incorrect spelling of affiliation, for example some authors listed their nation as North Korea. There were dozens of articles suspected to have duplicated publication which were discarded before analysis. For the resources data, the data of resources were obsolete to the biannual report of medical dean's association, of which is not complete. Some data is missing so that some important information other than human resources such as the amount of research fund and the number of research centers was not able to be analyzed. For the citations, the citation number did not count the longevity of the articles. The older articles may have higher number of citations in relation with the recent articles which means recent articles may be counted to have lesser citation numbers. And the self citation was not considered to count the citation number.

In conclusion, the current study showed there are huge variations across the medical schools in the aspect of scientific publications. Most of the medical schools of Korea showed limited capacities in relation with foreign or national research institutes. One of the reasons is that the graduate school students, even with the high numbers, are not contributing for the research of the professors. Instead, research faculties other than graduate school students such as research assistant or assistant researchers affect significantly to the SCIE publications. The research strategy should be planned with the consideration of the medical school's resources. With larger hospital and higher number of hospital bed, the clinical professors may play major role to produce SCIE articles. For the medical schools with limited resources, the basic science professors with assistant researchers may play key role to increase SCIE production.

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Appendix 1. Affiliation identification and name variants of medical schools

No.	Name Name variants	Affiliation ID
1	Ajou University	
	Ajou University	60002445
	Ajou University, School of Medicine	60029305
	Ajou University School of Medicine	
2	Catholic University of Daegu	
	Catholic University of Daegu, Catholic University of Taegu-Hyosung	60013400
3	Cheju National University	
	Cheju National University	60023353
	Cheju National University, School of Medicine	60008704
	Cheju National University Hospital, Cheju University College of Medicine, Cheju National University College of Medicine, Coll. of Med. Cheju Natl. University	
4	Chonbuk National University	
	Chonbuk National University	60001187
	Chonbuk National University, School of Medicine	60016650
	Chonbuk National University Medical School, Chonbuk Natl. Univ. Medical School, Chonbuk National University Hospital	
5	Chonnam National University	
	Chonnam National University	60007215
	Chonnam National University, College of Medicine	60017234
	Chonnam National University Medical School, Chonnam National University Hospital, Chonnam Natl. Univ. Medical School, Chonnam University Medical School	
6	Chosun University	
	Chosun University	60009950
	Chosun University, College of Medicine	60000652
	Chosun University Medical School, Chosun University College of Medicine	
7	Chung-Ang University	
	Chung-Ang University	60014237
	Chung-Ang University, College of Medicine	60008072
	Chung-Ang University College of Medicine, Chung-Ang University Hospital, Chung-Ang Univ. College of Medicine	
8	Chungbuk National University	
	Chungbuk National University	60004739
	Chungbuk National University, College of Medicine	60011569
	Chungbuk National University College of Medicine, Chungbuk Natl. Univ. Coll. of Med.	
9	Chungnam National University	
	Chungnam National University	60022417
	Chungnam National University, College of Medicine	60005732
	Chungnam National University Hospital, Chungnam National University College of Medicine, Chungnam Natl. University Hospital	
10	Dankook University	
	Dankook University	60002877
	Dankook University, College of Medicine	60000304
	Dankook University College of Medicine, Dankook Univ. College of Medicine	
11	Dong-A University	
	Dong-A University	60016209

	Dong-A University, College of Medicine	60015831
	Dong-A University College of Medicine, Dong-A Univ. College of Medicine, Dong-A University Hospital	
12	Dongguk University	
	Dongguk University	60009387
	Dongguk University, College of Medicine	60021951
	Dongguk University College of Medicine, Dongguk Univ. College of Medicine, Dongguk University International Hospital	
13	Eulji University	
	Eulji University, Eulji University Hospital, Eulji University College of Medicine	60030953
	Eulji University, School of Medicine	60031662
	Eulji University School of Medicine, Eulji Medical College	
	Eulji General Hospital	60094653
	Eulji Hospital, Eulji General Hospital, Eulji Hospital College of Medicine, Nowon Eulji Hospital	
14	Ewha Women's University	
	Ewha Womans University	60001018
	Ewha Woman's University, College of Medicine	60030358
	Ewha Womans University College of Medicine, Ewha Womans University School of Medicine	
15	Gacheon University of Medicine and Science	
	Gil Medical Center, Gachon University of Medicine and Science, Gil Heart Center	60080734
	Gachon Medical School	60002270
	Gachon University of Medicine and Science, Gachon Medical School, Gachon University Gil Medical Center, Gachon University	
16	Gyeongsang National University	
	Gyeongsang National University	60023075
	Gyeongsang National University (GSNU), College of Medicine	60009471
	Gyeongsang National University College of Medicine, Gyeongsang Natl. Univ. Coll. of Med.	
17	Hallym University	
	Hallym University	60018986
	Hallym University, College of Medicine	60006034
	Hallym University College of Medicine, Hallym Univ. College of Medicine	
	Hallym University Medical Center	60027264
	Hallym University Medical Center	
18	Hanyang University	
	Hanyang University	60024872
	HanYang University, College of Medicine	60029985
	Hanyang University College of Medicine, Hanyang Univ. College of Medicine, Hanyang University Medical Center	
	Hanyang University Kuri Hospital	60094238
	HYU Hospital of Guri, Han Yang University Kuri Hospital, Hanyang University Kuri Hospital, Kuri Hospital	
19	Inha University	
	Inha University	60028876
	Inha University, College of Medicine	60024050
	Inha University College of Medicine, Inha University	
	Inha University Hospital	60087778

	Inha University Hospital	
20	Inje University	
	Inje University	60015143
	Inje University Sanggye-Paik Hospital	60081368
	Inje University, Inje University College of Medicine	
	Inje University, College of Medicine	60033236
	Inje University College of Medicine	
21	Kangwon National University	
	Kangwon National University	60000872
	Kangwon National University, College of Medicine	60002315
	Kangwon National University College of Medicine	
	Kangwon National University Hospital	
22	Keimyung University	
	Keimyung University	60015576
	Keimyung University (KU), College of Medicine	60032638
	Keimyung University School of Medicine, Keimyung Univ. School of Medicine	
	Keimyung University, Dongsan Medical Center	60094606
	Dongsan Medical Center	
23	Konkuk University	
	Konkuk University	60000142
	Konkuk University, College of Medicine	60015050
	Konkuk University Hospital, Konkuk University School of Medicine, Konkuk University College of Medicine	
24	Konyang University	
	Konyang University	60003863
	Konyang University, College of Medicine	60004392
	Konyang University Hospital, Konyang University College of Medicine	
25	Korea University	
	Korea University	60005273
	Korea University, College of Medicine	60029700
	Korea University College of Medicine	
	Korea University Medical Center	60094642
	Korea University Guro Hospital, Korea University Medical Center, Korea University Hospital, Korea University Ansan Hospital	
26	Kosin University	
	Kosin University	60011679
	Kosin University, College of Medicine	60012736
	Kosin Medical College, Kosin University College of Medicine	
27	Kwandong Daehawkkyo	
	Kwandong University	60024495
	Kwandong University, College of Medicine	60031085
	Kwandong University College of Medicine, Kwandong Univ. College	
28	Kyung Hee University	
	Kyung Hee University	60001873
	KyungHee Medical Center	60025071
	Kyung Hee University Hospital, Kyung Hee University Medical Center	
	Kyung Hee University (KHU), College of Medicine	60028708
	Kyung Hee University College of Medicine, Kyung Hee Univ. College of Medicine	

29	Kyungpook National University	
	Kyungpook National University	60012704
	Kyungpook National University Hospital	60024843
	Kyungpook National University Hospital, Kyungpook Natl. University Hospital	
	Kyungpook National University, School of Medicine	60009801
	Kyungpook National University School of Medicine	
	Kyungpook Natl. Univ. Sch. of Med.	
30	Pochon CHA University , College of Medicine,	
	Pochon CHA University	60005389
	Bundang CHA Hospital	60080542
	Bundang CHA Hospital, Bundang CHA General Hospital, Pochon CHA University Bundang CHA General Hospital	
31	Pusan National University	
	Pusan National University	60008783
	Pusan National University, College of Medicine	60004269
	Pusan National University Hospital, Pusan National University College of Medicine	
32	Seonam University	
	Seonam University	60030516
33	Seoul National University	
	Seoul National University	60013682
	Seoul National University, College of Medical Sciences	60000656
	Seoul National University College of Medicine, Seoul Natl. Univ. Coll. of Medicine	
	Seoul National University Hospital	60021119
	Seoul National University Hospital, Seoul National University Bundang Hospital	
34	Soonchunhyang University	
	Soonchunhyang University	60025615
	Soonchunhyang University, College of Medicine	60023859
	Soonchunhyang University Hospital, Soon Chun Hyang University, Soonchunhyang University College of Medicine	
35	Sung Kyun Kwan University	
	Sungkyunkwan University, Sung Kyun Kwan University	60007511
	Sung Kyun Kwan University, School of Medicine	60016329
	Sungkyunkwan University School of Medicine, Sungkyunkwan Univ. Sch. of Medicine	
36	The Catholic University of Korea	
	Catholic University of Korea, The Catholic University of Korea	60003087
	The Catholic University of Korea, College of Medicine	60001727
	Catholic University Medical College	
	Uijeongbu St. Mary's Hospital	60081351
	Catholic University of Korea, The Catholic University of Korea	
	Daejeon St. Mary's Hospital	60094148
	Catholic University of Korea, Daejeon St. Mary's Hospital, The Catholic University of Korea	
37	Ulsan University	
	University of Ulsan	60032624
	University of Ulsan, College of Medicine	60006240
	University of Ulsan College of Medicine, Univ. of Ulsan College of Medicine	
38	Wonkwang University	
	Wonkwang University	60033270

	Wonkwang University (WKU), College of Medicine	60025727
	Wonkwang University School of Medicine, Wonkwang Univ. School of Medicine	
	Wonkwang Medical Center	60004944
	Wonkwang University Hospital	
39	Yeungnam University	
	Yeungnam University	60001170
	Yeungnam University, College of Medicine	60021052
	Yeungnam University College of Medicine, Yeungnam Univ. College of Medicine	
	Yeungnam University Medical Center	60025105
	Yeungnam University Hospital, Yeungnam University Medical Center	
40	Yonsei University	
	Yonsei University	60016912
	Yonsei University, Shinchon College of Medicine	60016728
	Yonsei University College of Medicine, Yonsei Univ. College of Medicine	
	Yonsei University, Wonju College of Medicine	60007143
	Yonsei University Wonju College of Medicine, Yonsei Univ. Wonju Coll. of Medicine, Yonsei University College of Medicine	
	Yondong Severance Hospital	60094975
	Yonsei University, Yongdong Severance Hospital	
	Yonsei University Medical Center	60026252
	Yonsei University Medical Center, Yonsei Cancer Center	

Appendix 2. The average number of humans resources during the period

	Basic science						Clinical science					
	P1	P2	P3	P4	M	D	P1	P2	P3	P4	M	D
Ajou	7.0	20.8	18.5	4.3	39.0	26.0	29.8	36.3	57.0	13.0	94.3	36.5
Catholic Univ. of Daegu	5.5	9.5	6.8	3.8	14.0	5.3	26.0	22.8	21.5	19.0	26.5	5.5
Cheju	1.5	3.5	9.3	6.3	2.5	1.3	1.0	1.8	7.0	8.3	0.3	0.3
Chonbuk	15.3	5.8	7.5	4.5	41.8	42.0	51.8	22.5	15.3	8.0	118.5	55.8
Chonnam	20.3	9.3	7.8	1.5	61.3	49.0	57.3	21.3	22.3	5.5	146.5	118.0
Chosun	19.0	10.8	5.5	4.0	14.8	30.3	35.8	22.0	13.8	9.0	70.8	37.0
Chung-Ang	15.3	9.0	9.3	1.5	51.8	54.5	52.3	17.8	13.0	0.3	78.5	53.0
Chungbuk	6.8	11.8	5.0	3.5	30.3	14.8	16.8	28.8	24.0	11.5	76.3	44.0
Chungnam	16.8	4.8	9.0	4.3	39.3	47.5	43.8	26.0	23.0	5.5	145.3	100.8
Dankook	0.3	7.8	8.0	5.8	7.0	2.5	14.8	31.8	36.5	9.3	58.0	17.3
Dong-A	10.3	8.3	7.0	2.5	14.8	14.8	34.5	28.0	21.8	14.5	78.8	37.8
Dongguk	3.8	11.5	9.3	2.8	9.3	11.0	13.8	21.8	24.5	19.5	35.0	8.0
Ehwa	14.3	11.3	26.5	0.5	19.5	17.3	46.3	45.0	50.0	3.8	79.8	53.5
Eulji	2.5	2.0	9.0	4.0	5.3	5.5	14.5	17.8	52.8	53.0	13.0	2.8
Gacheon	0.5	2.5	10.8	2.0	3.5	3.5	20.5	26.5	52.5	26.0	28.8	3.3
Gyeongsang	17.5	6.0	6.5	2.8	18.8	19.3	27.0	24.0	22.5	4.8	107.5	68.5
Hallym	19.8	11.8	11.3	4.5	27.3	20.3	88.3	81.0	98.0	64.8	102.0	26.5
Hanyang	17.0	11.5	10.5	3.5	34.8	48.3	104.5	39.5	38.0	16.3	142.8	105.8
Inha	13.8	8.0	8.0	2.5	22.5	14.8	40.0	41.5	51.5	23.3	74.0	37.0
Inje	5.3	11.0	17.0	11.0	17.8	19.0	74.0	72.3	140.5	76.8	109.0	50.3
Kangwon	2.3	4.0	6.8	5.5	18.3	6.8	1.3	1.0	8.8	12.8	24.0	6.0
Keimyung	13.3	8.0	5.8	2.0	18.5	22.8	63.8	17.5	16.3	11.3	61.0	33.0
Konkuk	8.5	8.0	9.5	2.0	6.0	6.3	24.3	21.0	21.5	12.5	34.5	9.8
Konyang	1.3	4.0	9.3	5.8	10.8	6.0	9.3	10.8	25.0	19.5	10.8	0.3
Korea	29.8	16.3	9.3	0.0	54.5	76.0	124.0	54.5	36.0	3.5	190.0	140.0
Kosin	18.5	7.0	6.8	4.0	13.0	17.0	28.5	25.0	26.0	8.3	63.5	45.5
Kwandong	2.0	6.0	11.0	3.0	4.3	0.0	2.8	7.3	22.8	14.8	2.8	0.8
Kyung Hee	21.8	10.8	6.0	2.3	40.8	44.0	80.8	19.3	15.5	1.3	87.8	61.0
Kyungpook	21.5	10.3	11.3	2.0	88.8	65.8	61.3	22.5	36.0	5.0	158.5	97.5
Pochon CHA	1.0	6.8	28.5	3.5	1.5	2.8	27.3	35.3	91.3	37.5	9.8	1.0
Pusan	22.5	5.8	8.3	0.8	60.0	41.5	45.5	21.5	30.5	5.3	164.3	105.5
Seonam	2.0	1.8	20.0	4.5	6.0	2.0	2.5	0.8	23.8	28.0	1.0	0.0
Seoul National	38.0	18.0	18.8	1.5	70.8	70.5	132.5	59.8	86.0	16.3	236.5	182.3
Soonchunhyang	21.3	8.8	9.0	7.3	18.5	37.5	74.5	49.5	82.0	46.5	115.0	68.0
Sung Kyun Kwan	8.3	9.8	14.0	2.3	16.8	6.5	90.5	91.3	148.3	20.5	50.0	19.0
Catholic Univ. of Korea	32.0	22.8	17.5	5.3	55.0	69.8	198.3	145.3	217.3	203.3	200.3	193.8
Ulsan	15.3	14.8	8.8	3.8	42.5	19.0	112.5	92.8	109.0	125.8	134.5	65.0
Wonkwang	19.8	5.0	6.5	4.0	19.8	38.5	40.0	19.8	23.5	25.5	53.5	16.5
Yeungnam	13.3	9.8	9.3	2.3	24.8	22.5	56.3	27.3	18.8	8.8	94.3	21.8
Yonsei	52.8	53.5	53.0	2.5	88.5	86.3	195.0	110.8	115.8	29.5	266.0	156.8

P1: Full Professor, P2: Associated Professor, P3: Assistant Professor, P4: Instructor, M: Master course, D: Doctor course