



Bibliometrics Analysis of the Scientific Publication of the Provincial Capital Cities CDC in China

Bao-jie Jiang¹, Xiao-dong Tan^{1*}, Priscilla Robinson², Mengfan Liu¹, MengChen¹ and Juan Di¹

¹*School of public health, Wuhan University; Wuhan, China.*

²*School of Public Health, Faculty of Health Sciences, La Trobe University, Victoria 3086, Australia.*

Authors' contributions

This work was carried out in collaboration between all authors. AuthorsBJ and XT designed the study. AuthorsBJ,ML, MC andJDperformed the statistical analysis. Authors BJ, XT and PRwrote the protocol, and wrote the first draft of the manuscript. Authors XT and PR managed the analyses of the study. AuthorsBJ, ML and MC managed the literature searches. All authors read and approved the final manuscript.

Research Article

Received 28th June 2013
Accepted 27th August 2013
Published 30th September 2013

ABSTRACT

Aims: To objectively evaluate the level of scientific research of Centers for Disease Control and Prevention (CDCs) of the provincial capital cities in China.

Design : To compare each capital city's scientific research output in China, the authors used authoritative Chinese databases to retrieve scientific research literature published by the 31 Chinese provincial capital cities CDCs nationwide published between January 2007 and December 2011. Data were stored and analysed using NoteExpress2.0 software.

Place and Duration of Study: Department of Medicineand the Centers for Disease Control and Prevention, between May 2012 and July 2012.

Methodology: All the articles published by the CDCs of provincial capital cities between 2007 and 2011 were retrieved from scientific literature databases. Data were stored and analysed in NoteExpress2.0 reference management analysis software. Bibliometric methods were used to statistically analyze the data. We developed an Overall influence

*Corresponding author: Email:723906547@qq.com;

index (Σ IFN) which combined the number of published papers and the impact factor for each one (IF) to derive an overall and objective index.

Results: Overall 9,445 Chinese language and 202 English language papers fulfilled our inclusion criteria. A gradual upward trend in published literature of provincial capital cities CDC was observed between 2007 and 2011. The co-author rate was relatively high and the content of the journals was extensive. The Overall influence index of Beijing CDC is the highest (626.682), and Lasa CDC gets the lowest (1.354).

Conclusion: The development of the level of scientific research is uneven in different areas. The Σ IFN index of the developed regions is higher, and that of western under developed region is lower.

Keywords: CDC; bibliometrics analysis; level of scientific research; published information.

1. INTRODUCTION

For the decade, the working conditions of the global Disease Control and Prevention (CDCs) system gradually improve, so does the capacity for CDCs to undertake scientific research resulting in a large body of research articles and papers of various kinds. There are however few studies of the quantity and quality of CDC research literature.

Scientific publication is one marker of Scientific Research Achievements (SRA) and academic research. The quantity and quality of publications is one of the standards by which the scientific output of an organization can be measured. To some extent, the statistical analysis of the published research literature can objectively reflect the basic trend, standard and development speed of research in certain period. In addition, it can also evaluate the degree of spread and application of scientific research achievement as well as the innovation ability and development status of subject research. Bibliometrics is an interdisciplinary science which uses mathematical and statistical methods to quantify an analysis of published research output. Bibliometrics is becoming widely used in many disciplines, and is becoming an active discipline in information science to which more and more people attach academic weight [1]. In order to objectively evaluate Chinese provincial capital cities scientific research into disease control the authors chose to evaluate CDC' scientific research strength through a bibliometric analysis of published scientific research literature.

We designed an index of research output which combined the number of published periodical articles and impact factor and strength to enable us to perform a comparative analysis of published papers in the scientific literature of the Chinese capital cities CDCs. The derived formula for this index suggests that it might be better expressed as an index of the scientific publication potential of a given city's CDC. This analysis provided a baseline measure for the management of research output from the CDCs.).

2. METHODOLOGY

2.1 Data Collection

Chinese literature: Three comprehensive Chinese literature databases were the main data sources, namely VMIS, CNKI and Wanfang Data, where all literatures between 2007 and

2011 were retrieved. The limited conditions were set as "Author affiliation =***CDC" (***represent the name of each provincial capital city).

English language literatures: Relevant papers were retrieved from the "Science Direct (Elsevier) Journal" database. The same limiters were used as for the Chinese paper retrieval.

2.2 Data Analysis

The download papers were sorted, manually checked and duplicates deleted, and organized in the form of bibliography into a database established using NoteExpress2.0 (a document management analysis software). Package was screened to ensure that at least one of the first three authors must come from prefecture-level CDC.

The NoteExpress2.0 statistical function was used to extract baseline information including author, journal, and publication date. These data were exported to a Microsoft Excel spreadsheet to perform a descriptive and to perform a data manipulation to enable further analysis of the scientific research strength and performance of the provincial capital cities CDCs.

2.2.1 Bibliometrics analysis

① publication information: The number of published papers, the journal's trend analysis, the types of journal, IF and Overall influence index. ② author information: Co-author rate.

The co-author rate is the ratio of the number of papers written by many authors to the total number of papers in one journal, one subject in certain period, is an important indicator representing the degree of scientific research cooperation in bibliometrics. The higher the co-author rate is, the more reliability and higher quality of the literature [2]. The formula is as the follows:

$$DC = 1 - \frac{F_1}{N}$$

(DC represents the co-author rate; F_1 represent the number of published papers by independent authors; N represent the total number of published papers)

2.2.2 Trend analysis

A comparison of the indices for two or several consecutive periods can be used to determine the direction, the velocity and range of increase or decrease to identify trends. Trends rely on constant ratio and relative ratio.

Constant ratio development speed (or total development speed) compares the development speed of a reporting period and a baseline fixed period, indicating that the over all speed development of this phenomenon over time.

The sequential development speed of quantity of published papers is a dynamic and relative number, and is calculated through comparing the development speed of the reporting period and the previous baseline period, indicating the variation of each period.

2.2.3 Overall influence index

A journal's Impact Factor (Impact Factor, IF, a data in JCR, is an international index to evaluate periodicals [3]) is an international index which provides an objective measure by which its scientific research strength may be measured. We search the IF on the basis of China Academic Journal Network Publishing Database on CNKI. Chinese journal IFs have started appearing only in recent years, many journals have not yet been incorporated. We designed an index which combined the number of published periodical articles and IFs of the published journals to objectively identify an overall IF for each city's CDC. The formula we used is as follows:

$$\sum IFN = (IF_1 \times N_1) + (IF_2 \times N_2) + \dots + (IF_n \times N_n)$$

(IF represent the IF of the periodical articles; N represent the total quantity of articles published on this periodical).

3. RESULTS

Initially, 33,366 original Chinese literature papers were identified through the literature retrieval process, (16,849 records were retrieved from Wanfang database, 6,573 from CNKI, and 9,944 from VMIS). After deletion of duplicates and combining the three datasets, 13,518 articles remained. As the main unit of analysis of this paper was Chinese provincial capital cities CDCs, further screening was carried out. This means articles of analysis target which were not assorted with requirement were deleted. Thirdly, papers were screen to ensure that one of the first three authors come from prefecture-level CDC. This process resulted in 9,445 Chinese articles remaining for analysis. There were 1993 papers published in the English language literatures identified through the *Science Direct (Elsevier) Journal* After duplicate papers were removed and ensuring that one of the first three authors was from a Chinese CDC, 202 papers remained (Table1).

3.1 Publication Information

3.1.1 The total quantity of published literature

Based on the number of articles, the distribution and ranking order of the published papers of 31 provincial capital cities CDCs in China are shown in Table 1 (> 100 papers).

From Table 1 can draw a conclusion that, direct-controlled municipalities rank relatively high. Beijing, the national capital ranks in the first place, followed by Shanghai and Guangzhou.

3.1.2 Trend analysis

A time series analysis showed, the specific temporal distribution of the 9,445 Chinese papers to be as follows (Fig. 1).

From Fig. 1 we can see that as a whole, the publication of all provincial capital cities CDCs had witnessed a general growth, however, a slight fell was seen in 2009, but a research climax was emerged in 2011. H1N1 flu may be the first important impact factor which caused the fell in 2009. CDCs in China made an extra strong effort to struggle with it.

Table 1. Ranking order of published Chinese literature by 31 provincial capital cities CDCs

City	Total Number of Screened Papers in Chinese Journals Retrieval	Ranking Order	Total Number of Screened Papers in English Language Journals Retrieval	Ranking Order
Beijing	1033	1	53	1
Shanghai	961	2	43	2
Guangzhou	779	3	20	3
Tianjin	569	4	16	5
Hangzhou	529	5	7	8
Chengdu	427	6	8	7
Chongqing	400	7	2	13
Wuhan	368	8	18	4
Shijiazhuang	364	9	2	13
Nanjing	346	10	9	6
Nanning	330	11	1	17
Jinan	304	12	2	13
Taiyuan	298	13	2	13
Nanchang	296	14	0	-
Fuzhou	268	15	0	-
Harbin	262	16	4	11
Shenyang	253	17	5	9
Xi'an	219	18	0	-
Hefei	193	19	0	-
Lanzhou	189	20	3	12
Changsha	184	21	0	-
Kunming	182	22	5	9
Urumchi	131	23	0	-
Zhengzhou	124	24	1	17

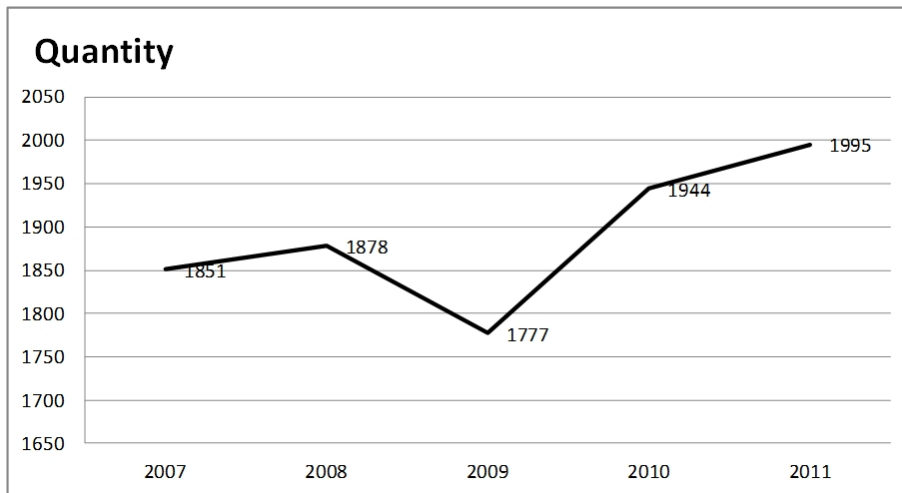


Fig. 1. Trend analysis between 2007 and 2011

3.1.3 Total development speed of published literature

During the five years between 2007 and 2011, the increase in the number of published scientific research paper appears to be rapid but not stable, with the exception of 2009. However, an overall 7.78% more papers were published in 2011 compared with 2007 was noted. An increase was seen in the sequential development speed in the period of 2007-2008, while a decrease was seen in 2008-2009. However, 2009-2011 had witnessed a steady ascend and peaked in the period 2009-2010. Specific data see Table 2.

Table 2. The Trend of the Number of Published Papers between 2007 and 2011

Year	2007	2008	2009	2010	2011
Published Papers	1851	1878	1777	1944	1995
Relative Ratio to Fixed Baseline	----	1.01	0.96	1.05	1.08
Change Rate(%)	----	1.46	-4.00	5.02	7.78
Link Relative Ratio	----	1.01	0.95	1.09	1.03
Annual Growth Rate(%)	----	1.46	-5.38	9.40	2.62

3.1.4 Journal type

The 9445 Chinese literature published by Chinese provincial capital city's CDC during the period of 2007-2011 mainly published in 26 Chinese periodicals (the number of publish articles > 100). There are 632 articles published on Chinese Journal of Health Laboratory Technology, which published the most and account for 6.69% of the whole. In addition to this, published articles were mainly concentrated in periodicals such as *Modern Preventive Medicine*, *Occupation and Health*, *Occupation and Health*, *Chinese Journal of Pest Control*, *China Preventive Medicine*, *Journal of Tropical Medicine*, account for 22.74% of the total. Statistics show that there is an obvious increase in the type of periodicals on which published the literature by Chinese provincial cities CDC (see Table 3).

Table 3. Main Journal Type by Chinese Provincial Cities CDCs

Journal name	Number of screened literature retrieval	Percentage (%)
Chinese Journal of Health Laboratory Technology	632	6.69
Modern Preventive Medicine	497	5.26
Occupation and Health	377	3.99
Chinese Journal of Pest Control	224	2.37
China Preventive Medicine	210	2.22
Journal of Tropical Medicine	209	2.21
Chinese Journal of Public Health	194	2.05
Disease Surveillance	178	1.89
Preventive Medicine Tribune	177	1.87
Chinese Journal of Public Health Management	174	1.84
Chinese Journal of Epidemiology	170	1.80
Journal of Environment and Health	167	1.77
Journal of Preventive Medicine Information	158	1.67
Chinese Journal of School Health	153	1.62
Journal of Environmental and Occupational Medicine	153	1.62
Chinese Journal of Preventive Medicine	152	1.61

Table 3 continues

Chinese Journal of Prevention and Control of Chronic Non-Communicable Diseases	131	1.39
Chinese Journal of Hygienic Insecticides and Equipments	129	1.37
Chinese journal of vector biology and control	127	1.35
China Tropical Medicine	121	1.28
Chinese Journal of AIDS and STD	120	1.27
Shanghai Journal of Preventive Medicine	118	1.25
Practical Preventive Medicine	112	1.19
Chinese Journal of Public Health Engineering	110	1.17
Journal of Public Health and Preventive Medicine	110	1.17
Chinese Journal of Disinfection	109	1.15
Total	5012	53.07

3.2 Impact Factor Analysis

The impact factor of published journal by Chinese capital cities CDCs is summarized for journals of with IFS > 1. Of the volume of Chinese literature published by Chinese provincial capital cities CDCs in journals with IF > 1, Beijing ranked first (with 101 papers, 9.78%), followed by Guangzhou (with 57 papers, 7.32%) Shanghai (with 49 papers, 5.10%), Tianjin (with 42 papers, 7.38%) and Shenyang (with 35 papers, 13.83%). Based on the percentage of the volume of articles published in journals with IF > 1 to the total volume of articles published by the city's CDC, Shenyang ranks the first (13.83%), followed by Hefei (12.96%), Beijing (9.78%) and Nanchang (9.12%).

3.2.1 Overall influence index

Our results show that the CDCs of cities with developed economies, such as Beijing, Shanghai, and Guangzhou, have a relatively high level of scientific influence in China. However, the ranking of Wuhan, Nanchang, Shenyang and Kunming increased following the comparison of the volume of retrieved publications by each provincial capital city, while the ranking of Nanjing, Nanning and Harbin decline. This suggests that by combining the IFs of journals with the publication quantity, a more comprehensive and objective measure is obtained (see Table 4).

3.2.2 Co-author situation

The higher the co-author rate is, the more reliability and higher quality of the literature [4]. Among the papers published by provincial capital cities CDCs, there are 13 cities whose co-author rate is over 90%, among which Fuzhou's CDC has the highest co-author rate, followed by Wuhan's CDC and Kunming's CDC. In general if a city's co-author rate is high, the reliability of this city's publications is high. It illustrates that in the recent 5 years, provincial capital cities have attached great importance on scientific communication and experience cooperation, creating a good scientific research atmosphere. The co-author rate of each capital city is show as follows (see Table 5).

Table 4. Overall influence index of Chinese provincial capital city's CDCs

City	Overall influence index	IF > 1		IF < 1		Number of articles (IF=0)
		Overall influence index	Number of articles	Overall influence index	Number of articles	
Beijing	626.682	143.795	101	482.887	848	84
Shanghai	478.382	60.476	49	403.802	749	147
Guangzhou	420.609	65.055	57	355.554	685	37
Tianjin	322.075	49.269	42	262.448	453	20
Hangzhou	258.879	28.882	21	229.997	450	58
Wuhan	191.893	37.877	32	154.016	314	23
Chongqing	191.830	24.965	21	166.865	329	50
Chengdu	160.853	11.088	6	149.765	330	91
Nanchang	147.714	32.145	27	115.569	248	21
Shijiazhuang	144.139	16.939	14	127.2	339	11
Jinan	129.595	9.462	8	120.133	276	20
Shenyang	129.090	43.014	35	86.076	204	14
Nanjing	116.177	12.004	9	104.173	269	68
Nanning	115.204	8.495	8	106.709	309	13
Taiyuan	110.209	8.694	8	101.515	280	10
Fuzhou	101.902	12.375	9	89.527	252	7
Hefei	89.376	26.905	25	62.471	158	10
Xi'an	79.880	4.44	4	75.44	203	12
Kunming	77.545	2.128	2	75.417	168	12
Harbin	76.208	15.913	15	60.295	159	96
Lanzhou	67.427	2.134	2	65.293	173	14
Changsha	61.771	8.529	7	53.242	159	18
Urumchi	45.273	8.542	8	36.731	117	6
Zhengzhou	43.935	8.525	6	35.41	97	21
Changchun	32.015	2.034	2	29.981	87	4
Haikou	31.381	3.192	3	28.189	66	3
Guiyang	20.863	1.064	1	19.799	55	11
Hohhot	20.767	0	0	20.767	55	44
Yinchuan	16.632	1.064	1	15.568	63	11
Xining	8.862	0	0	8.862	21	1
Lhasa	1.354	0	0	1.354	7	1

Table 5. Chinese capital cities CDC sresearch cooperation information

City	Number of Independent Author	Percentage(%)	Number of Co-author	Co-author Rate(%)
Fuzhou	9	3.36	259	96.64
Wuhan	13	3.53	355	96.47
Kunming	7	3.85	175	96.15
Jinan	12	3.95	292	96.05
Yinchuan	3	4.00	72	96.00
Urumchi	6	4.58	125	95.42
Nanchang	16	5.41	280	94.59
Shijiazhuang	22	6.04	342	93.96
Xi'an	17	7.76	202	92.24
Lanzhou	15	7.94	174	92.06
Harbin	25	9.54	237	90.46
Tianjin	56	9.84	513	90.16
Shenyang	25	9.88	228	90.12

4. DISCUSSION

After data cleaning, 9,445 Chinese language articles and 202 English language articles were identified from the total publications by provincial capital city's CDC between 2007 and 2011, with a yearly average quantity of 1.889, and a fairly steady increase. The quantity of English language literatures publications was much lower with a yearly average of 40 over the five years. In addition, there was a We identified big differences in output between the capital cities. High co-author rate were seen, increasing the credibility of the published articles[5]. The conclusion cannot be generalized. However, the higher the co-author rate the greater cooperation research activity, which deserves support. The CDCs of the cities, which most papers originated in (Beijing, Shanghai and Guangzhou), are also the most developed cities in China. We can also see from Table 1 that most English language literatures were published by developed areas, while few were published by cities in western regions. Beijing published the most, followed by Shanghai, Guangzhou, Wuhan, Xi'an, Urumchi, Yinchuan and Lhasa. Western underdeveloped cities as well as cities with relatively high economic levels such as Changsha, Guizhou and Fuzhou, were not retrieved English language literatures.

As China is a huge and diverse country, it is not surprising that the quantity and quality of work from the CDCs is also diverse. From the analysis of the retrieved articles after screening, there is an obvious increase in Wuhan, Nanchang, Shenyang and Kunming's ranks, based on the criteria combined overall index. While the ranks of Nanjing, Nanning and Harbin fall dramatically. This illustrates that, from equity and objectivity perspective, when the IF of periodicals combined with the volume of publications, the quality of publications by cities such as Wuhan, Nanchang and Shenyang is much higher. Therefore, each provincial capital city's CDC should take its geographic features as well as its economic conditions into consideration, strengthen regional communication, introduce new ideas and new technologies, and make a bigger contribution to the career of disease control.

Another important factor influencing the quantity of scientific publications from CDCs is the scientific research management and the regulation of policy. Job promotion regulation also proposes higher demand of research publication. The quantitative analysis of the published papers reveals that a city's financial investment on technology and the cooperation between universities and colleges make a great promotion to the output of scientific papers [6-8]. Meanwhile, the output of high-quality scientific research literature also plays a positive role in the cultivation of various majors' leader. It is beneficial to create an atmosphere to do more scientific research, to improve the academic status of one organization or a subject, to establish strong discipline and key scientific research projects [9]. It also helps each CDC to get a better understanding of its scientists as well as its scientific projects and helps to adjust its self-management. Therefore, each CDC, especially those of the city which shows a low IFN comprehensive influence should strengthen their academic training, invest more on academic research. In addition, more efforts should be made on the management of incentive mechanism of the talents, improve the quality of scientific research literatures and make a better service to the society.

5. CONCLUSION

The health professionals employed at the CDCs work for the good of whole populations, and it is challenging and difficult to objectively evaluate the impact of their work. The quantity and quality of published articles is the important signal to judge scientists' (or scientific

institutions') scientific research strength [4]. The quantitative assessment of scientific output of the CDCs provides a general picture of their work, and enables a comparison between the CDCs. The volume of published papers can be regarded as measure of a specific unit's scientific research strength. In general, the greater the quantity and quality of published articles in peer-reviewed journals the greater the scientific research strength. In conclusion, each CDC, especially those of the city which shows a low overall influence index should strengthen their academic training, invest more on academic research. Otherwise, the differences in the number of publications may relate to the number of scientific staff in each CDC unit. Probably individual CDCs have different number of scientific staff. What is the number of publications per head of the scientific staff? This would be a valuable index to compare publication potential between CDCs for further study. In addition, more efforts should be made on the management of incentive mechanism of the talents, improve the quality of scientific research literatures and make a better service to the society.

CONSENT

Not applicable.

ETHICAL APPROVAL

Not applicable.

ACKNOWLEDGEMENTS

I would like to express my gratitude to all those helped me during the hard retrieval work and I wish to extend my thanks to Dr. Xiaodong Tan and the library assistance who supplied me with reference materials of great value.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Dong L. Effect of bibliometrics on assessment of scientific and technological strength. *Chinese Journal of Family Planning*. 2010;177(6):326-328.
2. Zhu NN. Statistical analysis of theses on knowledge management in the last ten years in China. *Modern Information*. 2008;(11):49-52.
3. Mao L, Chen HL. Statistical analysis and research of Chinese scientific journals cited by SCI. *Journal of Modern Information* 2009;29(12):156-160.
4. Cao T. Analysis on the co-author status of the sports scientific research thesis - A study based on the knowledge map of CSSCI literature metrological analysis. *Journal of Beijing Sport University*. 2012;35(9):49-54.
5. Li D, Ding CH. Statistical analysis of the theses on knowledge management in the field of library and information in China. *Journal of Modern Information*. 2009;29(7):27-30.
6. Lei XW, Yuan YF, Liao P, et al. Prevalence and influence factors of anxiety and depression among scientific personnel. *Chinese Journal of Public Health* 2012;28(8):1096-1098.

7. Wang L, Meng XM, Wei H, et al. Prevalence of published papers by Hebei people's hospital between 2001 and 2005. *Medical Information*. 2009;22(6):882-884.
8. Hu TT, Du J, Zhang Y. Papers of Zhejiang province covered in SCI. *Chinese Journal of Medical Library and Information Science*. 2011;20(2):75-78+81.
9. Zhong WJ. Bibliometrics analysis of medical articles. *Journal of Guangdong Medical College*. 2008;26(3):313-315.

© 2014 Jiang et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<http://www.sciencedomain.org/review-history.php?iid=215&id=12&aid=2089>