

## Evaluation of scientific status of endocrine, diabetes, and metabolism research centers in Iran using exergy method

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### Abstract

The aim of this study was to determine the scientific status of endocrine, diabetes and metabolism research centers in Iran using *exergy method* in terms of scientific publications indexed in the Web of Science, Scopus, and Google Scholar database in 2013. This study is a cross-sectional one. The study population included 6 Iranian endocrine, diabetes and metabolism research centers. Data were collected by referring to the Iranian Ministry of Health and Medical Education personally and also using the above-mentioned citation databases. Data were analyzed using Microsoft Excel and descriptive statistics. The results revealed that endocrine, diabetes and metabolism research centers of Shahid Beheshti and Tehran University of Medical Sciences were top centers in Iran in terms of the quality of scientific publications. Diabetes Research Center of

Ahvaz University of Medical Sciences was found to have the weakest performance. This article is the results of the first study in Iran, regarding the evaluation of research centers by exergy analysis.

## Keywords

Scientometrics; Exergy method; Endocrine research centers; Diabetes and Metabolism Research Center; Performance Indicators

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## Introduction

Thermodynamics, a branch of physics and chemistry, is a Greek word consisted of two parts, “Thermo” and “dynamics”. The first means heat and the latter means power, which together mean heat power. It describes the microscopic phenomena resulting from change of temperature, pressure, and volume in a physical system (Ariffin, 2012).

In thermodynamics, a part of space or an object is considered that represents the system. A thermodynamics general system has a total energy (E) that can be in various modes (chemical, electrical, mechanical, thermal and so forth), but it is assumed that the system is closed and no energy is exchanged. Only a part of the energy can be converted to the work that is well known as Exergy or X (Prathap, 2011a). In terms of thermodynamics, Exergy is the maximum useful work that a system performs (Prathap, 2012). X is external energy (Ex stands for external) (Sciubba & Wall, 2007). Gibbs defines Exergy as freely work or available performance. In the nature, energy can be in various forms and therefore exergy can be in various forms, too (Prathap, 2011d). Besides thermodynamic field, the term “Exergy” can be used in the other fields in which quantity and quality need to be determined. Bibliometrics is also one of these cases (Prathap, 2011a).

In bibliometrics, according to the thermodynamic definitions of Exergy, it can be said that this indicator is a term similar to energy with this formula  $X = i^2P = iC = C^2 / P$  that i represents quality and average citations to the articles or impact based on  $i=C/P$ , C is total citations to the under study articles and P is total papers of a person, group, or organization. In fact, Exergy is a quantitative amount, which represents quantity and quality. It is considered as a research performance indicator of the person, group, or organization (Prathap, 2011c).

The quality and quantity of scientific production of universities, organizations and countries is a promoting factor. Scientific productions, also reflects the level of knowledge and technical information, and they have a fundamental role in scientific and technical exchange complex system (Abdekhoda et al., 2010).

Endocrinology, Diabetes and Metabolism Research Centers are among important research centers affiliated with Iranian universities of medical sciences. To evaluate the research centers growth using scientometrics and bibliometrics methods is necessary. Persian literature overview shows that thermodynamic indicators have not been used in bibliometrics research in Iran. The basis of these rankings return to India and Nishy's study in 2012 that ranked India's leading research institutes based on this index (Nishy et al., 2011).

Prathap evaluates the studies in the field of monsoon winds using bibliographic approach and Exergy index (Prathap, 2014). In another study, he evaluated scientific production in India and China on the basis of international cooperation using this index (Prathap, 2013a). Also in the same studies, he evaluated the articles of neuroscience specialist by the use of mentioned index (Prathap, 2013b; Prathap, 2013b). Prathap conducted similar studies in 2010 and 2013. Another study was to evaluate Indian Institutes of Technology (IITs) research performance in 2013 using Web of Science and Scopus data and comparing the performance of similar institutions in the world (Prathap, 2013a). He compared bibliometrics indices to econometrics indices in 2012 that one of these indices was Exergy (Prathap, 2012). Nishy (2012) and Prathap (2011) in their studies introduced two new mappings; iPX and iCX based on quantity, quality and Exergy indices. These two mapping were very effective to present the new rankings (Nishy et al., 2011; Prathap, 2011b).

## Objectives

The aim of this study is to determine the scientific status of Iranian Universities of Medical Science's Endocrine, Diabetes and Metabolism Research Centers using Exergy Method in terms of scientific production indexed in the Web of Science, Scopus, and Google Scholar citation databases in 2013.

## Materials and Methods

This descriptive, cross-sectional study was conducted using new scientometric and bibliometric indicators based on thermodynamics concepts. According to information obtained by visiting the Iranian Ministry of Health and Medical Education, a total of six Endocrine, Diabetes and Metabolism Research Centers were identified. These centers were including Endocrine, Diabetes and Metabolism Research Centers of Tehran, Shahid Beheshti, Shiraz, Isfahan, Yazd and Ahvaz universities of medical sciences.

The research data were collected through direct observation and searching selected citation databases separately. Total English articles and total citation to them for each center were obtained from Web of Science, Scopus and Google Scholar and recorded in researcher made check list. The study duration was 3 years, total articles were collected for 2011 and 2012 separately then total citations were obtained for these articles in 2013. The data were entered into

Microsoft Excel software. Impact ( $i=C/P$ ) and Exergy ( $X=i2P=iC=C2/P$ ) values were calculated for each center separately. Mapping of these centers were presented on the basis of Impact-Article - Exergy (iPX) and Impact-Citation- Exergy (iCX) respectively.

In these mappings, the performance of research centers is shown in a three-dimensional graph, firstly, based on the impact, the number of articles and Exergy, and secondly, based on the impact, the number of citations to articles and Exergy. In this study, the impact represents research centers quality, and the total number of citations to articles represents their quantity, and Exergy by merging these two indicates the quantity and quality of the research centers' performance.

## Results

### Web of Science

Results showed that among all research centers, endocrine and metabolism research center of Tehran University of Medical Sciences had the highest impact and Exergy in terms of number of articles and citation in Web of Science, but scientific quality of this center compared to Shahid Beheshti and Yazd Metabolism and Diabetes Research Center was also lower in 2011. Diabetes research centers of Yazd University of medical sciences had the lowest papers and Citations in web of science. The weakest research performance and the lowest quality were belonged to diabetes research center of Ahvaz University of medical sciences (Table 1) and (Figure 1).

### Scopus

Tehran and Shahid Beheshti research centers had the highest amount of articles and citations in Scopus. Tehran research center had best quality and research performance compared to the other centers. Except Tehran, other research centers in 2012 compared to 2011 were faced lower quality and research performance in Scopus (Table 2) and (Figure 2).

### Google Scholar

Compared to other research centers, Tehran Endocrine, Diabetes and Metabolism Research Center had the best performance in Google Scholar while Ahvaz Endocrine, Diabetes and Metabolism Research Center had the weakest performance (Table 3) and (Figure 3).

**Table 1. Impact (i), the total number of English articles (P), the total number of citations (C) and Exergy (X) of Iranian Universities of Medical Science's Endocrine, Diabetes and Metabolism Research Centers in Web of Science**

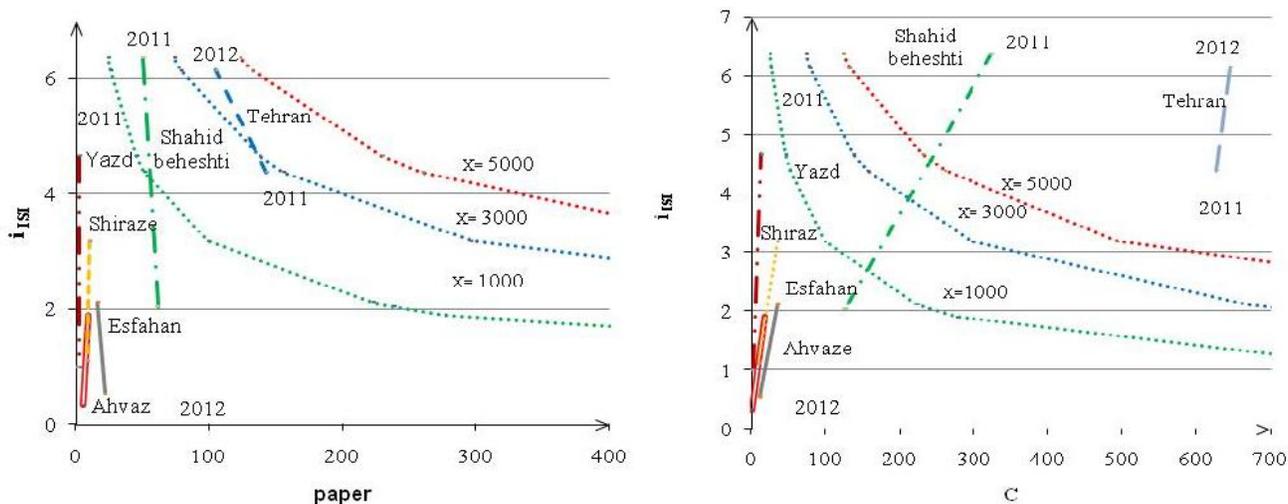
Index	Year	Endocrine, Diabetes and Metabolism Research Centers					
		Ahvaz	Yazd	Isfahan	Tehran	Shahid Beheshti	Shiraz
I	2011	1.90	4.67	2.12	4.38	6.37	3.18
	2012	0.33	1.00	0.55	6.15	2.05	1.11
X	2011	36.10	65.33	76.24	2749.15	2071.08	111.36
	2012	0.67	3.00	6.55	3974.44	260.15	11.11
C	2011	19	14	36	627	325	35
	2012	2	3	12	646	127	10
P	2011	10	3	17	143	51	11
	2012	6	3	22	105	62	9

**Table 2. Impact (i), the total number of English articles (P), the total number of citations (C) and Exergy (X) of Iranian Universities of Medical Science's Endocrine, Diabetes and Metabolism Research Centers in Scopus**

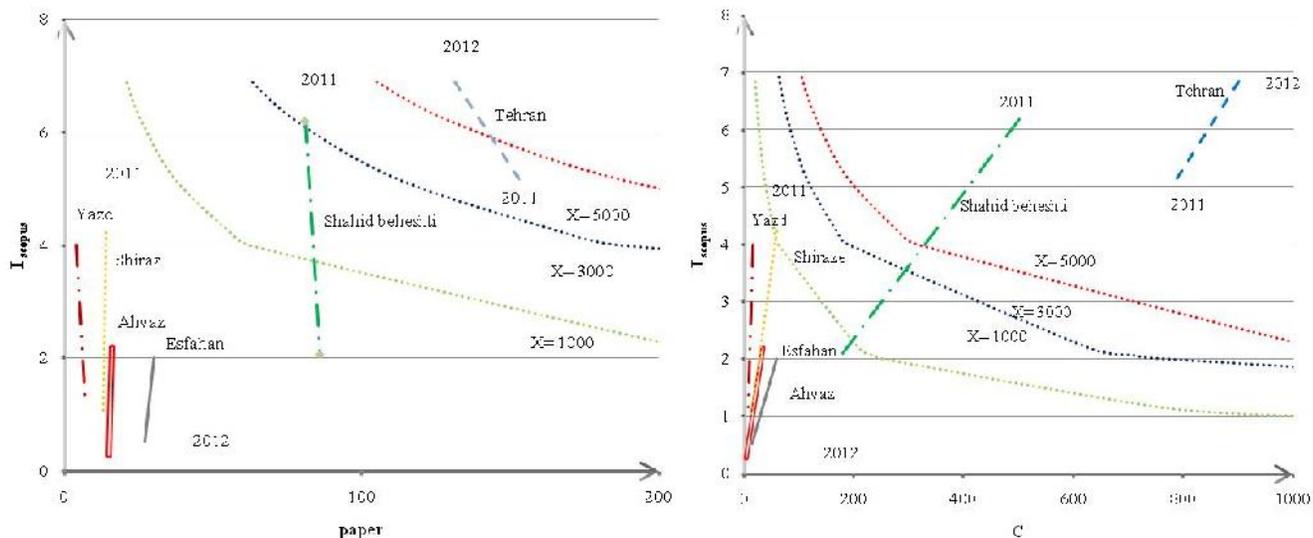
Index	Year	Endocrine, Diabetes and Metabolism Research Centers					
		Ahvaz	Yazd	Isfahan	Tehran	Shahid Beheshti	Shiraz
I	2011	2.19	4.00	2.00	5.16	6.19	4.21
	2012	0.27	1.14	0.52	6.92	2.06	1.00
X	2011	76.56	64.00	120.00	4068.76	3098.78	248.64
	2012	1.07	9.14	7.26	6279.76	364.29	13.00
C	2011	35	16	60	789	501	59
	2012	4	8	14	907	117	13
P	2011	16	4	30	153	81	14
	2012	15	7	27	131	86	13

**Table 3. Impact (i), the total number of English articles (P), the total number of citations (C) and Exergy (X) of Iranian Universities of Medical Science's Endocrine, Diabetes and Metabolism Research Centers in Google Scholar**

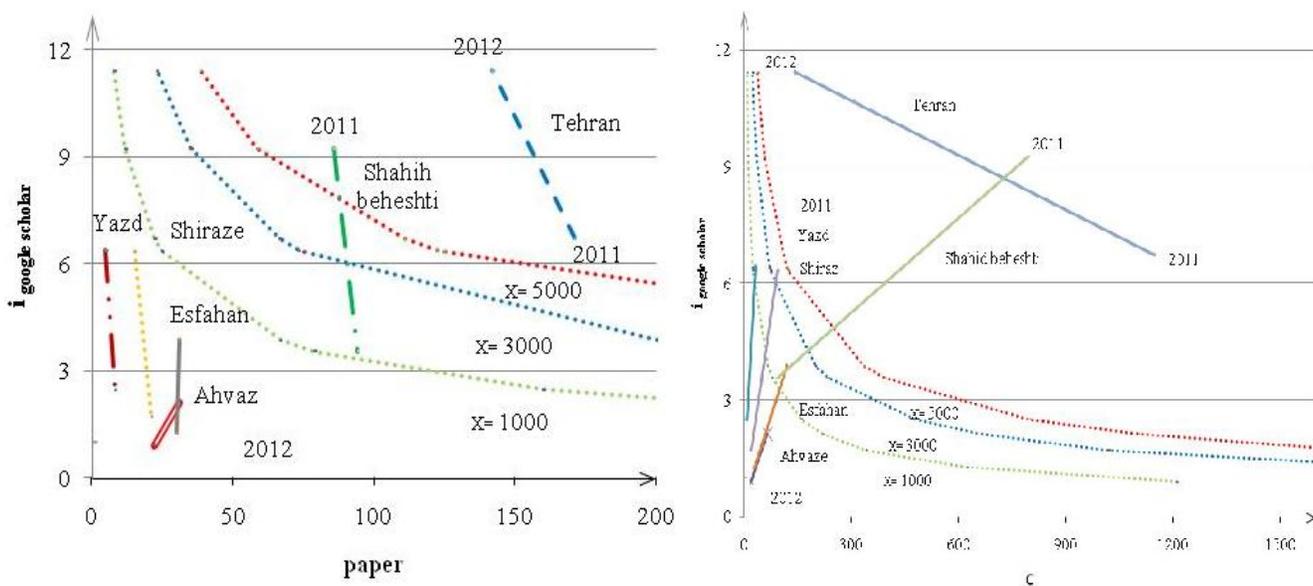
Index	Year	Endocrine, Diabetes and Metabolism Research Centers					
		Ahvaz	Yazd	Isfahan	Tehran	Shahid Beheshti	Shiraz
I	2011	2.13	6.40	3.87	6.73	9.24	6.33
	2012	0.91	2.50	1.27	11.42	3.56	1.71
X	2011	140.52	204.80	464.52	7733.92	7349.13	601.67
	2012	18.18	50.00	48.13	18504.51	1193.88	61.71
C	2011	66	32	120	1150	795	95
	2012	20	20	38	1621	335	36
P	2011	31	5	31	171	86	15
	2012	22	8	30	142	94	21



**Figure 1) iPX and iCX Mappings of Iranian Universities of Medical Science's Endocrine, Diabetes and Metabolism Research Centers in 2011 and 2012, according to Web of Science data**



**Figure 2) iPX and iCX Mappings of Iranian Universities of Medical Science's Endocrine, Diabetes and Metabolism Research Centers in 2011 and 2012, according to Scopus data**



**Figure 3) iPX and iCX Mappings of Iranian Universities of Medical Science's Endocrine, Diabetes and Metabolism Research Centers in 2011 and 2012, according to Google Scholar data**

## Discussion

The results of this study showed that metabolism research center of Tehran University of Medical Sciences had the largest number of articles and citations. Metabolism research center of Shahid Beheshti was in the second place followed by Isfahan, Shiraz Yazd and Ahvaz. These six research centers have obtained the largest number of papers and citations in Google Scholar database followed by Scopus and Web of Science, which could be due to free access to Google Scholar and problem to access to other two databases.

The total number of citations of these research centers was reduced in 2012 compared to 2011 except Metabolism Research Center of Tehran University of Medical Sciences. Based on findings of this research, the impact or quality of metabolism research center of Tehran and Shahid Beheshti Universities of medical sciences were higher than other research centers. The Scientific performance Shahid Beheshti was better than Tehran in 2011, but this was reversed in 2012. This would be due to receiving more citations per lower articles of Shahid Beheshti in 2011 and the high number of papers and citations in 2012, for metabolism research center of Tehran University of Medical Sciences. The same applies to Yazd diabetes research center because of better scientific quality in 2011 even toward Tehran. Diabetes research centers of Ahvaz University of medical sciences had the lowest level of quality in both years. The most scientific impact of these research centers was due to the number of papers and citations in Google Scholar. Perhaps the reason is duplicate records in Google Scholar.

In a study by Abolghassemi Fakhree and Jouyban, they evaluated scientific products of Iranian leading medical universities including; Tehran, Iran, Shahid Beheshti, Mashhad, Isfahan, Shiraz, and Tabriz based on Scopus data. They showed that Tehran Medical Sciences University had the largest number of articles, citations and impact which was in consistent with our findings. Contrary to this study, they had only use Scopus database to extract data (Fakhree & Jouyban, 2011).

Nishy et al ranked 10 Leading research institute in India using Exergy index. They identified CSIR research institute as the most active institute in terms of scientific production and performance. Contrary to this study they had only use Web of Science database to extract data (Nishy et al., 2011).

In a study by Prathap Exergy and impact of two Leading research institutes in India namely TIFR and CSIR-NCL in the field of international collaboration was evaluated based on citation data from Web of Science. Results showed the better quality and performance of TIFR. He also used iCX mapping to illustrate the quality and quantity of research performance. Prathap also used Web of Science database to extract data (Prathap, 2013c).

In another study by Prathap, he ranked countries, institutes, authors, and journals in monsoon filed based on published productions indexed in Web of Science. Then he ranked ten countries based on exergy. In this study USA had the best research performance and ranked first and among instates National Oceanic Atmospheric Admin had the best scientific performance (Prathap, 2014).

The findings of another study by Parthap, research performance of China and India from 1996 to 2011 according to Web of Science were evaluated. Using iCX mapping he illustrated significant research performance of China compared to India. International collaboration of India was higher compared to China (Prathap, 2013a).

## Conclusions

As author's Knowledge similar researches in this field are very limited. The findings of previous studies and also present study confirm that good research performance of endocrine and metabolism research center of Tehran University of Medical Sciences and weak performance of diabetes research center of Ahvaz University of medical sciences are affected by two main aspects of exergy that is quantity and quality. Exergy as a new index due to its superior features compared with other available scientometrics indicators such as H-index, considering the impact as the quality and integrating it with quantity that is the number of papers and citations, can ranked the performance of scientific research centers, universities and even individuals . It can be used as a complete index to show research performance and also in research financial planning.

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