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Research Progress and Prospects of Saudi Arabia in Global Medical Sciences

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Abstract. – OBJECTIVES: Since last decade, Saudi Arabia has been swiftly moving ahead to promote an education and research in the country. This study aimed to investigate the research outcome of Saudi Arabia in medical sciences during the period 1996-2012.

MATERIAL AND METHODS: In this study, the research papers published in various global science journals during the period 1996-2012 were accessed. We recorded the total number of research documents having an affiliation with Saudi Arabia. The main source for information was Institute of Scientific Information (ISI) Web of Science, Thomson Reuters and SCI-mago/Scopus.

RESULTS: In global science data base, Saudi Arabia contributed 103804 documents in all science and social sciences. In medicine the total number of research papers from Saudi Arabia are 16196, citable documents 14732, total citations 102827, citations per documents 6.36 and Hirsch index (h-index) is 92. However, in combined medical and allied health sciences the total number of research papers are 27246, citable documents 25416, total citations 181999, mean citations per documents 7.07 and mean h-index is 41.44. Furthermore, Saudi Arabia contributed 40797 research documents in ISI indexed journals only and also 151 research documents in highly reputable and towering science journals.

CONCLUSIONS: Saudi Arabia's research performance in global medical sciences has markedly increased during the period 2006-2012. The research publications are continuously on mounting path; however, the number of citations has decreased. The country improved its regional as well as international research rankings and graded 45 in the world in year 2012.

Key Words:
Research papers, Citations, Indexed journal, Saudi Arabia.

Introduction

Saudi Arabia is the largest country of Arabian Peninsula, with an approximate population of 29.19 million[1]. The country is highly blessed with natural resources with high income advantages. Saudi Arabia is speedily moving ahead to promote a high-quality education for the citizens and devoted special attention to fostering higher education and research in the country[2]. Research in science especially in medical sciences plays a significant role in the country's economic growth along with long-term sustainable development and eventually contributes to improving the living standards and quality of life[3]. Investment in research is more vital for the progress and prosperity.

To recognize and quantify the research progress of a country, bibliometric indicators are essential tools to understand the growth and global spread of research. These indicators are mainly based on the number of scientific research documents published and their visibility in global science[4]. Scientific publications are a key indicator of the development of a country, and measuring the research output provides information that forms the basis of strategic decisions[5]. The research pursuing behavior is essential in economic success of a country[6].

In order to achieve long-term and sustainable economic growth, spending on research and development is essential to produce a substantial amount of innovative research. There is a direct relationship between research and the overall development of individual states. Saudi Arabia is swiftly moving forward to promote an education and research culture in the country. This study aimed to investigate the research outcome of Saudi Arabia in medical sciences during the period 1996-2012.

Material and Methods

This observational study was conducted in the Department of Physiology, College of Medicine, King Saud University, Riyadh, Saudi Arabia. In this study, we reviewed the research publications in medical sciences published in both ISI and non-ISI indexed journals. The data about number

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Table I. Number of ISI indexed science journals, research papers published in ISI and non-ISI journals, citable documents, citations per documents and h-index during the period 1996-2012.

Parameters	Numbers
Science and social science subjects	
ISI Indexed journals[8]	7
Research papers published in global science[9]	58840
Citable documents[9]	56534
Citations[9]	293556
Citations per document[9]	4.99
Country h-index[9]	124
Based on research publications standing of Saudi Arabia in global science[9]	45
Medicine only	
Research papers in published in medicine[9]	16196
Citable documents[9]	14732
Citations[9]	102827
Citations per document[9]	6.36
Country h-Index in medical sciences only[9]	92

Note: Concerned references are mentioned against each data.

of universities were collected from the World Association of Universities[7]. The information regarding scientific journals indexed in Institute of Scientific Information (ISI) was obtained from Web of Science, Institute of Scientific Information (ISI) Journal Citation Reports, Thomson Reuters[8]. Data for research documents in medical and allied health sciences published in both ISI and non-ISI journals during the period 1996-2012 were obtained from SCI-mago/Scopus[9]. Data for research papers published in ISI indexed journals only were obtained from the Institute of Scientific Information (ISI) Web of Science[8]. For ISI indexed journals, we logged on to Web of Science, the territory was selected, country name "Saudi Arabia" was entered, and the names of journals along with impact factors for each journal were retrieved. For the recording of bibliometric indicators, research outcome in all world scientific journals indexed in Scopus were analyzed the data through SCI-mago scopus. In SCI-mago, and ISI web of Science sites, region and country was selected, subject field "Science" and "Medicine" was opted and detailed information regarding the bibliometric indicators including total number of research papers (documents), citable documents, total citations, citations per document and Hirsch Index (*h*-index) in science, medicine and allied health science subjects were obtained.

Statistical Analysis

The data were analyzed by using Statistical Package for the Social Sciences (SPSS) software version 18. Data were expressed as Mean ± Standard Error of Mean (SEM). $p < 0.05$ was considered significant.

Results

In Saudi Arabia, the total number of universities and degree awarding institutes are 64. There are total 7 scientific journals which are indexed in a Journal Citation Report, Thomson Reuters, Institute of Scientific Information (ISI). The total number of documents in entire data base are 103804, research papers published from Saudi Arabia during the period 1996-2012 is 58840; citable documents 56534; total citations 293556; citations per documents 4.99, and the country's Hirsch Index (*h*-index) is 124. Based on the number of research publications, the current ranking of Saudi Arabia in global science is 45. However, in medicine, the total number of research papers published are 16196, citable documents 14732, total citations 102827, citations per documents 6.36 and *h*-index 92 (Table I).

Table II shows the research output of Saudi Arabia published in both ISI and Non ISI journals in few major medical science subjects during the period 1996-2012. In medicine, the total number of research papers published is 16196, citable documents 14732, total citations 102827, citations per documents 6.36 and h-index 92. In addition, Table II also shows the number of publications, citable documents, total citations, citations per documents and h-index in various field of medicine including Biochemistry, Genetics and Molecular biology, Pharmacology, Toxicology, Pharmaceutics, Neuroscience, Nursing, Psychology, Immunology and Microbiology, Health Professions and Dentistry. In all these combined medical and allied health sciences the total number of research papers are 27246, citable documents 25416, total citations 181999; mean citations per documents 7.07 and mean h-index is 41.44.

Table III shows that, in Saudi Arabia the total numbers of research papers published in global ISI indexed journals only during the period 1996-2012 are 40797; among them, 33483 are original articles, 1399 review articles, 709 editorials, 2409 conference proceeding papers, 2520 meeting ab-

Table II. Research output of Saudi Arabia in medical and allied health science subjects published in ISI and Non ISI indexed journals during the period 1996-2012 (Ref 9).

Subjects	Total documents	Citable documents	Citations	Citation per documents	Hirsch Index
Medicine	16196	14732	102827	6.36	92
Biochemistry, genetics and Molecular biology	5399	5250	39714	7.36	75
Pharmacology, toxicology, pharmaceutics	2210	2159	13811	6.25	45
Neuroscience	662	626	3512	5.31	31
Nursing	243	228	1237	5.09	17
Psychology	136	127	1411	10.38	16
Immunology and Microbiology	1569	1491	14018	8.39	48
Health Professions	200	189	1721	8.61	22
Dentistry	631	614	3748	5.95	27
Total	27246	25416	181999	63.7	373
Mean	3027.33	2824.0	20222.11	7.07	41.44

Ref: The data were recorded from SCI-mago Scopus[9].

stracts, 848 letters and 234 articles are published under the headings of other types such as brief communications, correspondence, communications etc.

Table IV demonstrates the contribution of Saudi Arabia in highly reputable and towering science journals. Saudi Arabia produced 35 papers in Nature Genetics; Science 31; Nature 21; New England Journal of Medicine 16; Lancet 17; Journal of American Medical Association-JAMA 9; Nature Materials 7; British Medical Journal 7; Cell 3; Physiological Reviews 2; Immunity 2 and Cancer Cell 1. The mean average impact factor of these journals is 32.16.

Table III. Types of research papers published from Saudi Arabia in global ISI Indexed journals only during the period 1996-2012 (Ref[8]).

Parameters	Number of publications
Total number of research papers published in ISI Indexed journals	40797
Original articles published in ISI Indexed journals	33483
Review papers published in ISI Indexed journals	1399
Editorials published in ISI Indexed journals	709
Proceedings papers published in ISI Indexed journals	2409
Meeting Abstracts published in ISI Indexed journals	2520
Letters published in ISI Indexed journals	848
Others	234

Ref: The data were recorded from ISI- web of science[8].

Discussion

In the present study, we investigated the extent of research outcome of Saudi Arabia in medical sciences during the period 1996-2012. To the best of our knowledge, this is the first study to evaluate the Saudi Arabia's research share in medical sciences. We found that, in global science, Saudi Arabia contributed 103804 research papers in all science and social sciences both in ISI and non ISI indexed journals; the h-Index of Saudi Arabia is 124 (Table I). However, in medicine the total number of research papers from Saudi Arabia are 16196, citable documents 14732, total citations 102827, citations per documents 6.36 and h-index is 92 (Table I). In combined medical and allied health sciences the total number of research papers are 27246, citable documents 25416, total citations 181999, mean citations per documents 7.07 and mean *h*-index is 41.44 (Table II).

Based on publications in ISI- indexed journals only, Saudi Arabia produced 40797 research documents in ISI web of science[8] (Table III) and also contributed 151 research documents in highly reputable and towering science journals whose mean Impact Factor is 32.16 (Table IV). The worldwide country ranking is 45 in terms of number of articles published both in ISI and non ISI journals

Table IV. Research output of Saudi Arabia in highly reputable science journals during the period 1996-2012 (Ref 8).

Name of the Journal	Impact Factor	Article	Editorial	Letters	Review	Total
N Engl J Med	51.65	10	2	4	–	16
Lancet	39.06	7	5	4	1	17
Nature	38.59	17	3	1	–	21
Nature materials	35.74	6	1	–	–	7
Nature genetics	35.20	33	1	1		35
Cell	31.95	3		–	–	3
Science	31.02	20	7	4	–	31
Physiol Rev	30.17	–	–		2	2
J Am Med Assoc– JAMA	29.97	8	1	–	–	9
Cancer Cell	24.75	1	–	–	–	1
Immunity	20.72	2		–	–	2
Br Med J	17.21	2	2	3	–	7
Total	N/A	109	22	17	3	151
Mean	32.16	9.08	1.83	1.33	0.38	12.58

Ref: The data were recorded from ISI- web of science[8].

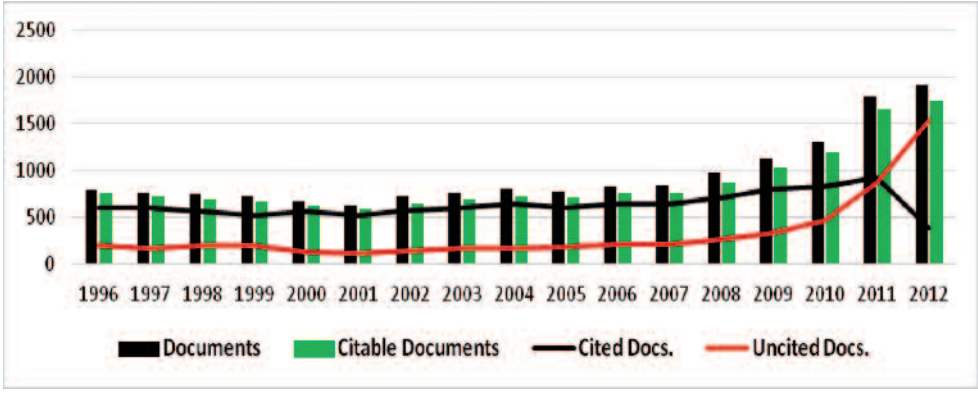

Figure 1. Total number of documents, citable documents, cited documents and un-cited documents in medical sciences during the period 1996-2012.

(58840) and 55 based on the global h-index-124[9]. In Saudi Arabia, the increasing path of articles published in medical sciences was from the period 2005 to date and this trend is markedly increased during the year 2011-2012 (Figure 1). The number of cited documents also increased during the period 1996-2011 but decreased in year 2012 (Figure 1), and cites per documents and self cites are also decreased (Figure 2). This is a fact that, a country that produced large number of publications there is chances of decrease in citations.

Since the last few years, Saudi Arabia has continuously been increasing funding for education and research. The education budget was $32.62 billion in 2009, $36.63 billion in 2010 and $45.18 billion in 2011. In addition, a supplement of $21.8 billion was also injected to establish new universities, research labs and scholarship programs for higher education. In Dec 2012, the educational budget reached the highest-ever level of $54.54 billion for year 2013[2].

Saudi universities are collaborating with science and talent rich institutes and incorporated well-trained scientists and researchers in their institutes to increase research productivity and visibility. All this has enabled Saudi academics to be active in international collaboration (Figure 3). The collaboration between Saudi Universities and eminent researchers is increasing the strategic research growth by bringing the world's most prominent research minds to the country to promote research culture. In addition, Saudi scholars are now returning to their placental places from USA, UK, Canada, Europe, Australia and Japan.

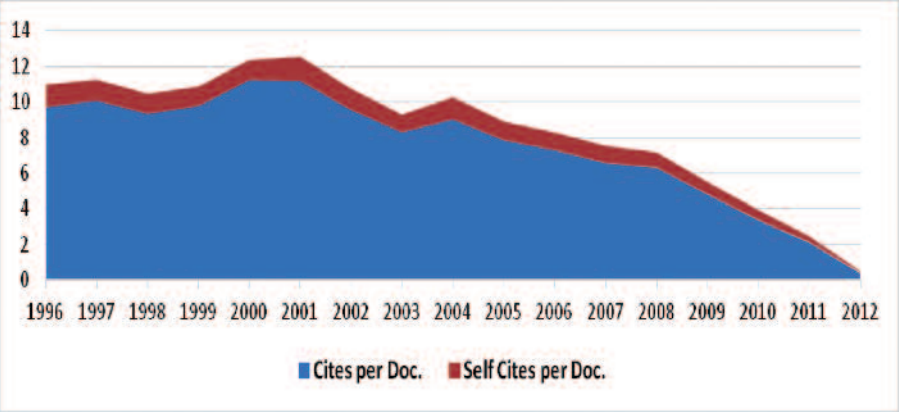

Figure 2. Total number of cites per documents and self cites per documents in medical sciences during the period 1996-2012.

The Country is wisely spending to set up independent research labs and centers for excellence, encouraging researchers by enhance research funding and appreciation. This resulted in achieving the 45th position in the world ranking (Table I).

Choung and Hwang[10] reported that universities play an important role in increasing number of research papers in the ISI database and the related research activities. In Saudi Arabia, during the period 2005-2012, about 30 new universities and degree awarding institutes new campuses of existing universities were established. Since, the number of universities were increased, the number of research paper were also significantly increased. This is an established fact that the basic birth place of the research publications is the universities. In a recent report, Meo et al[11] reported that, the country that have large number of universities are producing more research papers. Similarly, in the present study, we found that, Saudi Arabia increased the number of universities and degree awarding institutes during the period 2005-2012 and in this period research outcome has also been highly increased (Figure 1).

In another study, Meo et al[5] reported that, Middle East countries who spend more on Research and Development (R&D) produced better research outcomes in pharmacological sciences. Similarly, in the present study, we found that, in Saudi Arabia the highest spending on education and research was during the period 2008-2012, Saudi Arabia produced large number of research papers during the same period. The present study results are in agreement with the findings of Meo et al[5].

It is interesting to discuss the factors that contributed to the growth of research in Saudi Arabia. These factors are: establishment of large number of universities, research institutes, increase spending on R&D, collaboration with research rich international institutes, research grants, rewards for researchers, more enrollment of postgraduate and PhD students and system is more open for the international collaboration. It is believed that, these are the basic factors that enhance the research productivity and visibility of Saudi Arabia in global science in general and medical sciences in particular.

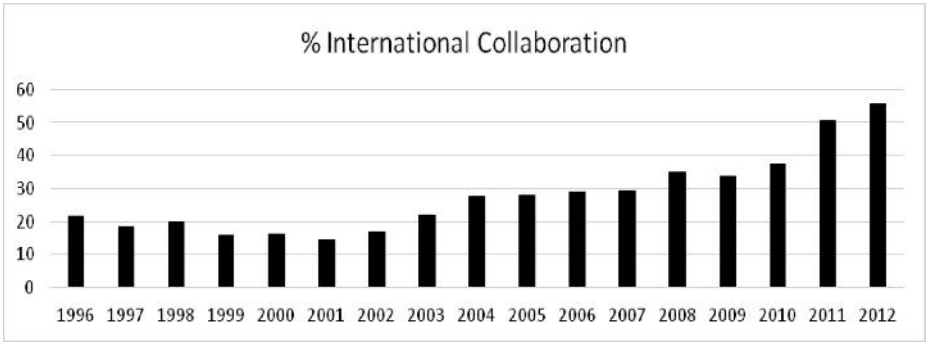

Figure 3. International collaboration in medical sciences during the period 1996-2012.

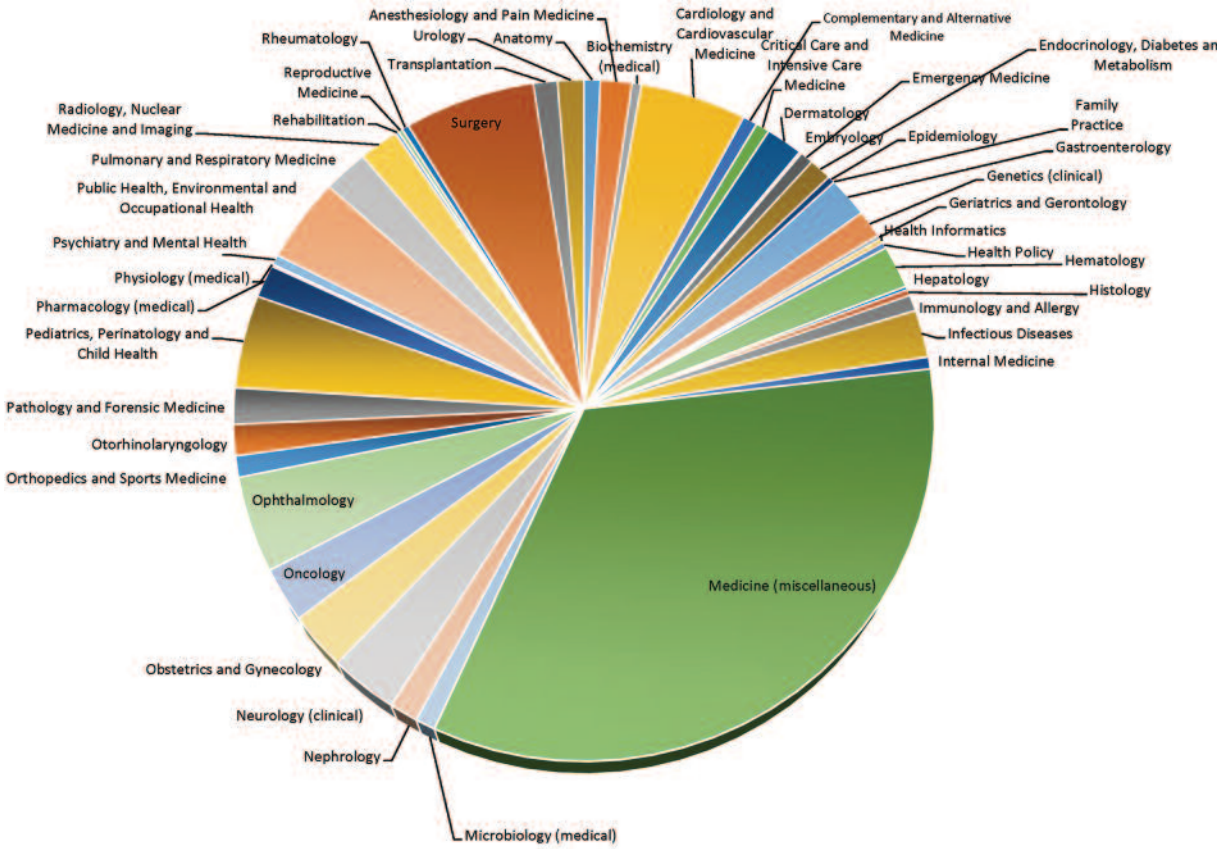

Figure 4. Research documents published from Saudi Arabia in various fields of medical and allied health sciences during the period 1996-2012.

The strengths of this study are: we recorded the information regarding Saudi Arabia's performance in research from very reliable sources including Institute of Scientific Information (ISI), Web of Science, Journal Citation Reports (Thomson Reuters), and SCI-imago web. However, the criticisms of the present study are occasionally citation count tools may mis-cite or re-cite a paper, and there are chances of same paper appearing twice with slightly different details. This may inflate the number of documents or citation counts.

Conclusions

Saudi Arabia has introduced many incentives and their progressive effects have appeared in the country's research outputs. Saudi Arabia's research performance in global medical and allied health sciences has markedly increased during the period 2006-2012. The research publications are continuously on a mounting path; however, the number of citations has decreased. The country improved its regional as well as international rankings and graded 45 in the global science during the year 2012. The existing incentives and the strategies to increase the research and development expenditure in the country must be continued, Saudi Arabia may be the regional hub in research and ultimately in science and technology.

Acknowledgements

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Conflict of Interest

The Authors declare that there is no conflict of interest.

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