

Research Productivity of Pakistan in Medical Sciences during the period 1996-2012

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Abstract. – OBJECTIVES: This study aimed to investigate the degree of research outcome in medical science subjects in Pakistan during the period 1996-2012.

MATERIALS 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 a Pakistan. The main source for information was Institute of Scientific Information (ISI) Web of Science, Thomson Reuters and SCI-mago/Scopus.

RESULTS: In global science, Pakistan contributed 58133 research papers in all science and social sciences both in ISI and non ISI indexed journals. However, in medical sciences the total number of research papers from Pakistan are 25604, citable documents 23874, citations 128061, mean citations per documents 6.45 and mean Hirsch index is 35.33. In Pakistan, the upward trend of articles published in global medical science was from the period 1996-2008. However, from 2008 the trend is markedly declined.

CONCLUSIONS: Pakistan significantly improved its international ranking positions in research during the period 2000-2008. However, the upward trend of research papers published in global medical science could not be retained and from the year 2008 the trend started declining. This trend of research papers further declined in year 2012 compared to year 2011. It is suggested that, Pakistan must take strategic steps to enhance the research culture and increase the research and development expenditure in the country.

Key Words:

Research papers, Indexed Journal, Pakistan.

innovations in medical sciences offer solutions to overcome the challenges and contribute to improving the living standards and quality of life. Over the past two decades, the increased longevity of humans significantly attributed to the advancement in medical sciences research. Investment in research is essential for the progress in science and technology as well as for social and economic development¹. To recognize and quantify the progress of research of a country, bibliometric indicators are essential tools to understand the size, growth and global spread of research. These indicators are mainly based on the number of scientific research documents published². Science and research cannot exist if researchers do not evidence or publish their experimental findings and results. Scientific writing and its outcome in the form of research publication are essential components of academic excellence. Scientific publications are a key indicator of the development of a country, a healthy scientific research environment is a prerequisite for scientific and economic progress³.

The research pursuing behavior is essential in economic success of a country⁴. 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 nations as well as individual countries. Pakistan has been the subject of a multitude of changes in science and technology during the last two decades. This study aimed to investigate the degree of research productivity in medical science subjects in Pakistan during the period 1996-2012.

Introduction

Research in science sectors especially in medical sciences play an important role in the country's communal and economic growth along with long-term sustainable development. The research

Materials 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 publication in medical sciences published in both ISI and non-ISI indexed journals. The data about number of universities were collected from the Higher Education Commission of Pakistan and World Association of Universities⁵⁻⁶. 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)⁷. Data for research documents in medical science subjects published in both ISI and non-ISI journals during the period 1996-2012 were obtained from Scimago/Scopus⁸. Data for research papers published in ISI indexed journals only were obtained from the Institute of Scientific Information (ISI) Web of Science⁷. For ISI indexed journals, we logged on to Web of Science, the territory was selected, country name 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, we analyzed data through Scimago. In Scimago, and ISI web of Science sites, region and country was selected, subject field "Science" and "Medicine" were opted and detailed information regarding the bibliometric indicators including total number of research papers (documents), citations per document and H-index in science, social science and medicine 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 \pm Standard Error of Mean (SEM). p -value < 0.05 was considered significant.

Results

In Pakistan, the total number of universities which are chartered under Higher Education Commission (HEC) of Pakistan is 150. There are total 85 scientific journals and among them only 13 are indexed in a leading indexing institute; Thomson Reuters, Institute of Scientific Information (ISI). The total number of research papers published from Pakistan in both ISI and non-ISI indexed journals during the period 1996-2012 is 58133; citable documents 55915; citations per

documents 6.22, and the country's Hirsch Index (h -index) is 111. Based on the number of research publications, the current ranking of Pakistan in global science is 46 (Table I).

Table II shows that, in Pakistan the total numbers of research papers published in global ISI indexed journals during the period 1996-2012 are 35484; among them, 29418 are original articles, 828 review articles, 604 editorials, 2702 conference proceeding papers, 1605 meeting abstracts and 327 are published under the headings of other types such as brief communications, letter to editor etc.

Table III demonstrates the research output of Pakistani universities in ISI-indexed journals in global science during the period 1996-2012. As above reported, in Pakistan, the total number of universities and degree awarding institutes under HEC is 150. Quaid-i-Azam University contributed 4891 articles; University of Karachi 3462; Aga Khan University 3220; University of Punjab 2740; National University of Sciences Technology 1679; University of Peshawar 1299; Bahauddin Zakariya University 1121; Dow University of Health Sciences 846; University of Sindh 716; and Islamia University Bahawalpur 621 (Table III).

Table IV shows the research output of Pakistan 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 16539, citable documents 15058, total citations 64383, citations per documents 3.89 and H-index 78. In addition, Table IV also shows the number of publications, citable documents, total citations, citations per documents and H-index in various field of Medi-

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

Total number of HEC chartered universities ⁵⁻⁶	150
Scientific journals ⁷	85
ISI-Indexed Science journals ⁷	13
Research papers published in global science ⁸	58133
Citable documents ⁸	55915
Citations per document ⁸	6.22
Country H-Index ⁸	111
Based on research publications standing of Pakistan in global science ⁸	46

Note: Concerned references are mentioned against each data.

Table II. Types of research papers published from Pakistan in global ISI Indexed journals during the period 1996-2012 (Ref⁷).

Parameters	Number of publications
Total number of research papers published in ISI Indexed journals	35484
Original articles published in ISI Indexed journals	29418
Review papers published in ISI Indexed journals	828
Editorials published in ISI Indexed journals	604
Proceedings papers published in ISI Indexed journals	2702
Meeting Abstracts published in ISI Indexed journals	1605
Other types of articles published in ISI Indexed journals	327

cine including Biochemistry, Genetics and Molecular Biology, Pharmacology, Toxicology, Pharmaceutics, Neuroscience, Nursing, Psychology, Immunology and Microbiology, Health Professions and Dentistry. In combined medical science subjects the total number of research papers from Pakistan are 25604, citable documents 23874, citations 128061, mean citations per documents 6.45 and mean Hirsch index is 35.33.

Discussion

Bibliometric analysis is frequently used for monitoring and assessing the research outcomes. The combined databases comprehensively cover and provide a unique platform for gathering the information about the availability and visibility of research documents. The re-

Table III. Research output of Pakistani Universities in ISI-indexed journals in global science during the period 1996-2012 (Ref⁵⁻⁷).

Universities	Number of publications
Quaid i Azam University	4891
University of Karachi	3462
Aga Khan University	3220
University of Punjab	2740
National University of Sciences Technology Pakistan	1679
University of Peshawar	1299
Bahauddin Zakariya University	1121
Dow University of Health Sciences	846
University of Sindh	716
Islamia University Bahawalpur	621

search in science in general and medical sciences in particular has an essential role in driving the productivity and monetary growth in which knowledge is crucial to economic development. In this study, we investigate the degree of research outcome in medical science subjects in Pakistan during the period 1996-2012. To the best of our knowledge, this is the first study to evaluate the Pakistan's share in research outcome in medical sciences.

We found that, in global science, Pakistan contributed 58133 research papers published both in ISI and non-ISI Indexed journals in all fields of science, social sciences and other subjects. The Hirsch Index of Pakistan is 111 (Table I). However, in all medical sciences the total number of research papers from Pakistan are 25604, citable documents 23874, citations 128061, mean citations per documents 6.45 and mean Hirsch index is 35.33 (Table IV). When we excluded the non ISI research documents,

Table IV. Research output of Pakistan published in both ISI and Non ISI journals in some major medical science subjects during the period 1996-2012 (Ref⁸).

Subjects	Total documents	Citable documents	Citations	Citation per documents	Hirsch index
Medicine	16539	15058	64383	3.89	78
Biochemistry, genetics and molecular biology	5033	4928	32001	6.36	69
Pharmacology, toxicology, pharmaceutics	1614	1575	11343	7.03	43
Neuroscience	197	182	2138	10.85	23
Nursing	563	542	1445	2.57	18
Psychology	155	151	803	5.18	16
Immunology and microbiology	1361	1301	15124	11.11	49
Health Professions	87	82	582	6.69	13
Dentistry	55	55	242	4.40	9

Pakistan produced 35484 research papers published in ISI Indexed journals only (Table II). In Pakistan, the increasing trend of articles published in global science was from the period 1996-2008 and this trend was markedly increased during the year 2003-2008 (Figures 1 to 4). Although, from the period 2008 the trend was stagnant, but even though based on the “law of flow”, Pakistan produced better research outputs up to the end of year 2011. However, the trend is markedly decreased in year 2012 compared to year 2011 (Figure 5). In addition, Pakistan’s contribution was comparatively lower to the high impact factor journals. Since many of the towering science journals, especially the biomedical journals have higher impact factor and Pakistan’s contribution to those journals is very low. Pakistan’s overall share of original articles has been markedly increased from 2003-2008, while share was decreased in 2012.

Although Pakistan’s ranking is 46 in the world in terms of overall number of articles published both in ISI and non ISI journals (58133). The ranking of Pakistan in global science is further decreased at 50, 58, 206 when compared to

citable documents (55915), Hirsch Index (111) and citations per documents (6.3) respectively (Table I).

Since the birth of Pakistan 1947, the country has been facing many challenges, and from mid 70s brain drain started and further increased in late 80s. No one has taken serious efforts to stop or re-gain it. Certainly, this is the fact that large number of Pakistani scientists, physicians, researchers and also technicians moved to United States, Europe mainly the United Kingdom and Ireland, Middle East and also to Australia. Recently Richard Noorden (2012)⁹ published a report in Nature indicating that, majority of researchers and scientists from the Asian countries are moving to cross-continent. The scientific travel is not only about empirical observation but the scientists also carry with them sort of scientific attestation⁹. The migration of large figure of researchers to other countries creates a gap and hampers the research and science.

In Pakistan, the number of universities and research institutions is also not satisfactory enough, the numbers of HEC chartered universities are

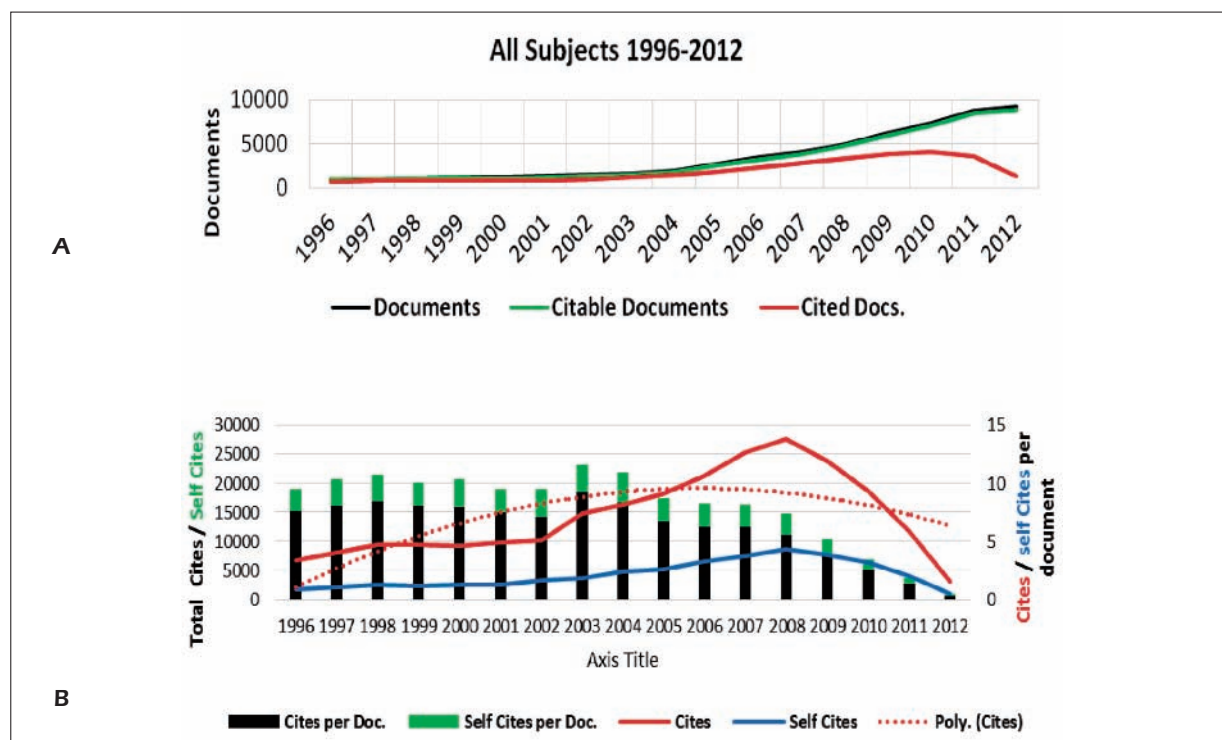


Figure 1. **A**, Total number of documents, citable documents and cited documents in all science and social science subjects during the period 1996-2012. **B**, Total number of cites per documents, self cites per documents, cites and self cites in all science and social science subjects during the period 1996-2012.

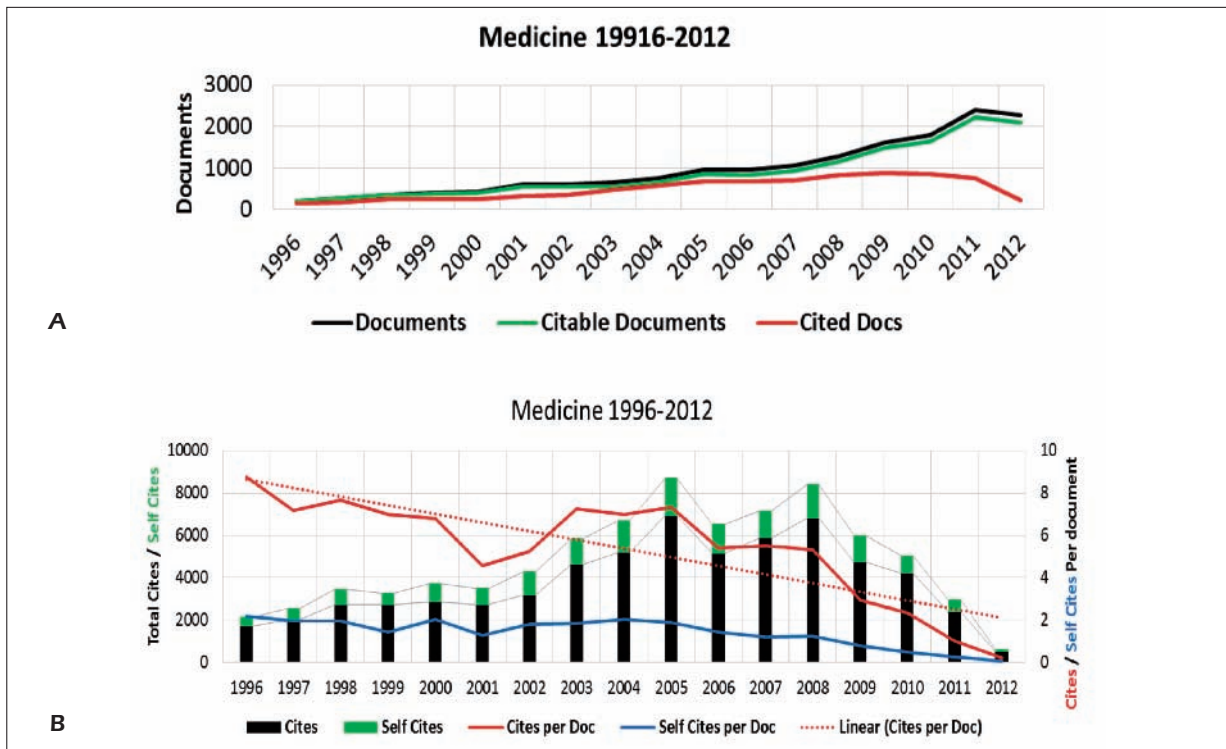


Figure 2. *A*, Total number of documents, citable documents and cited documents in Medicine during the period 1996-2012. *B*, Total Number of cites, self cites, cites per documents, self cites per documents in Medicine during the period 1996-2012.

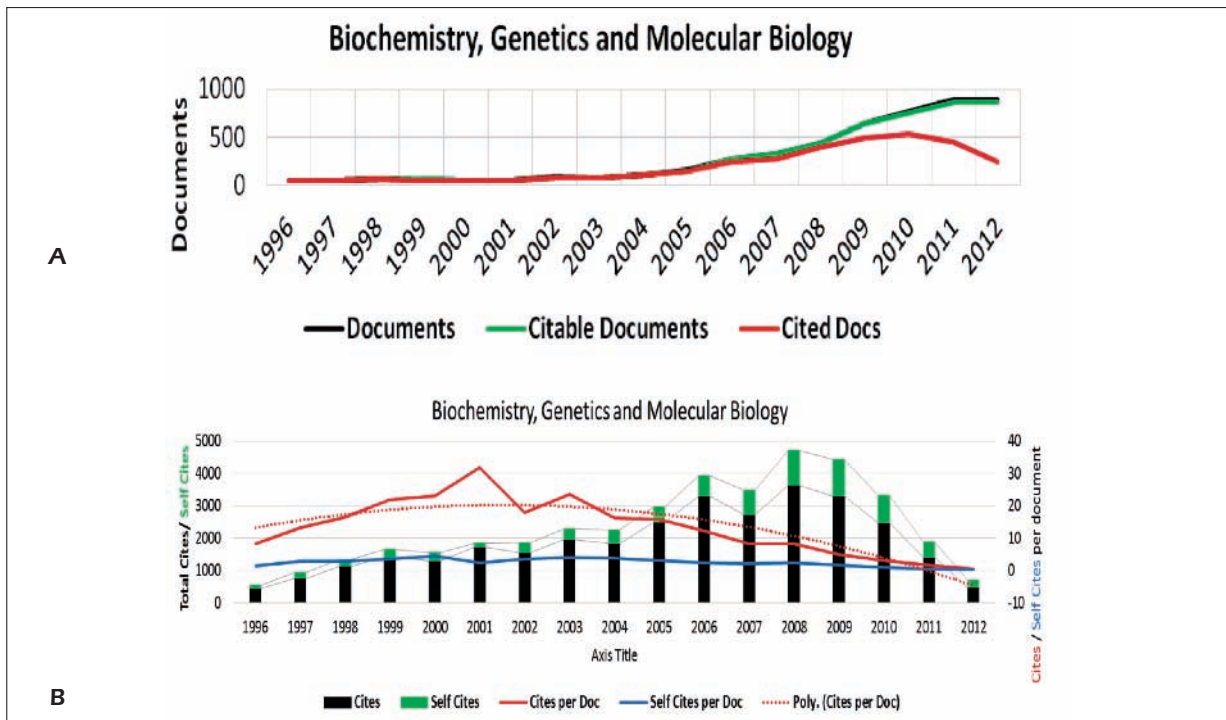


Figure 3. *A*, Total number of documents, citable documents and cited documents in Biochemistry, Genetics and Molecular Biology during the period 1996-2012. *B*, Total Number of cites, self cites, cites per documents and self cites per documents in Biochemistry, Genetics and Molecular Biology during the period 1996-2012.

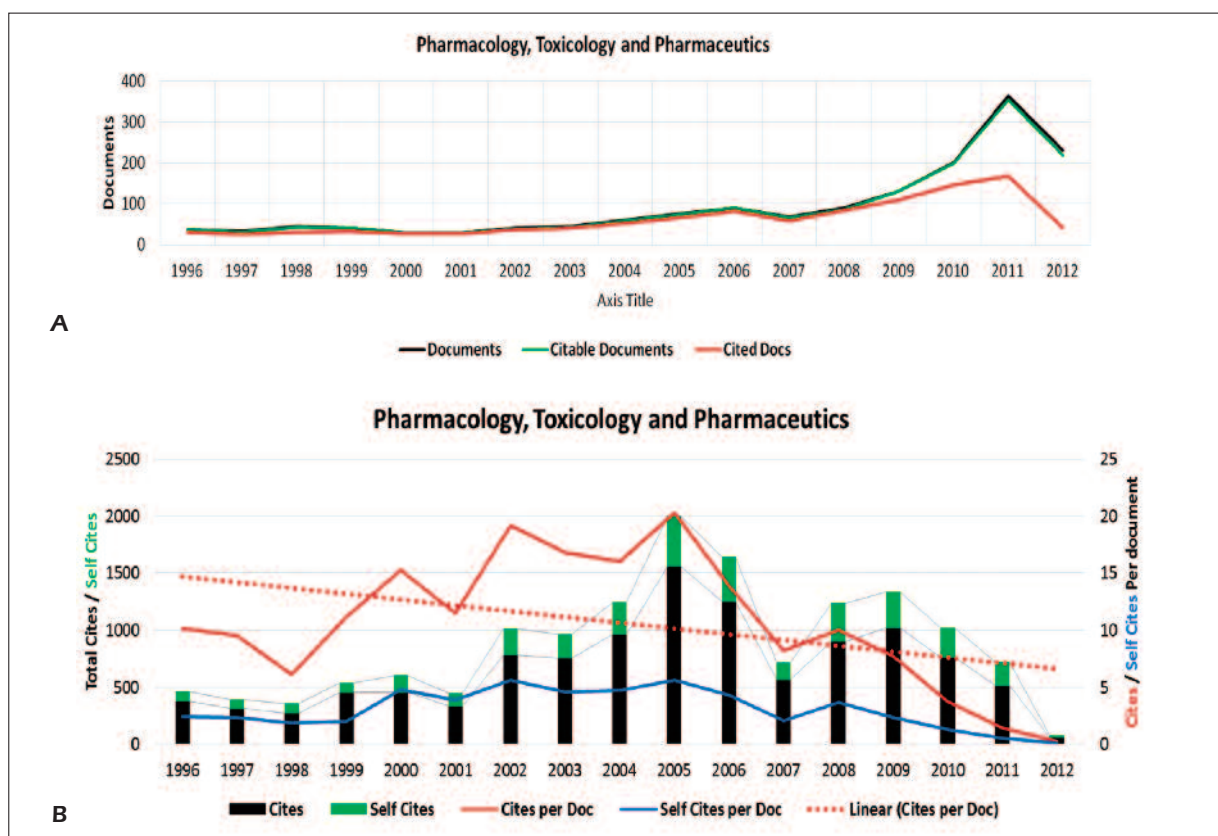


Figure 4. **A**, Total number of documents, citable documents and cited documents in Pharmacology, Toxicology and Pharmaceutics during the period 1996-2012. **B**, Total Number of cites, self cites, cites per documents, self cites per documents in Pharmacology, Toxicology and Pharmaceutics during the period 1996-2012.

150⁵ and the population of the country is more than 180 million people. It shows that for about 1.2 million people there is only one university (Table III).

Choung and Hwang¹⁰ reported that universities play an important role in increasing number of research papers in the ISI database and the related research activities.

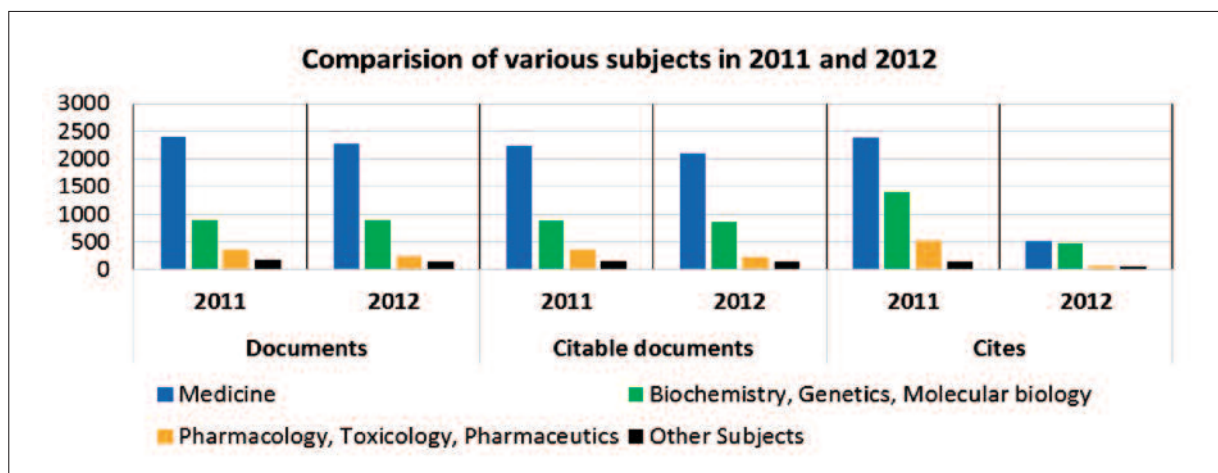


Figure 5. Comparison of total number of documents, citable documents and cites of medical science subjects between the year 2011 and 2012.

In Pakistan, during the period 2003-2008, 51 new universities and degree awarding institutes and 18 new campuses of existing universities were established¹¹. Since, the number of universities were markedly increased, the number of research paper were also increased and after the year 2008 the speedy growth of universities decreased hence the research output also decreased (Figures 1 to 4). This is an established fact that the basic place of the research is the universities; it is suggested that, Pakistan must increase the number of universities and eventually, the research outcome will be further enhanced.

In 2002, extraordinary steps were taken place. HEC established large number of universities and degree awarding institutes, science laboratories, existing educational facilities, research support¹¹, engaged the foreign faculty, re-structured the scientists' salary structure and working environment. This was the main reason that Pakistan produced better results in research during this period. But unfortunately, this exercise was discontinued, but even though Pakistan produced research out puts at the end of year 2011. However, in the year 2012, the numbers of research documents, cites, citations per documents markedly decreased (Figure 5).

In the present study, we also reviewed the ISI indexed journals in Pakistan. The countries in Asia having a large number of ISI indexed journals are as Japan 236, China 155, India 100, Singapore 55, Turkey 54, and Iran 39 and the mean number of journals in the all the Asian countries is 17.97 ± 7.35 ¹². However, in Pakistan there are only 13 ISI Indexed journals.

Meo et al¹² reported that the Asian countries who spend more on research and Development (R&D) have a large number of universities and scientific indexed journals produced more in research outcomes including total number of research publication in various science and social science subjects. In Pakistan, the highest spending on research was during the period year 2002-2007 and number of extraordinary changes took place. HEC instituted existing educational facilities and expanded the research support. As a result, Pakistan produced large number of research papers during that period.

As per World Bank and UNESCO report¹³⁻¹⁴ the R&D expenditure (% of GDP) in Pakistan was increased from 0.11% in 1998; 0.22% in 2002 and 0.67% in year 2007; and it was decreased to 0.46% in 2009. Moreover, the technicians in R&D (per million people) in Pakistan

were 67.58 in year 2006-2008; and decreased to 64.48 in year 2009. These are facts that Pakistan improved the research ranking in global science during the period 2002-2008; and could not be retained, from the year 2008 the trend started declining.

The main strengths of this study are that: we collected the information regarding the Pakistan's share in research from very reliable sources including Institute of Scientific Information (ISI), Web of Science, Journal Citation Reports (Thomson Reuters), and SCI-imago web. These are highly reliable sources in scientific literature. However, sometimes citation count tools may mis-cite a paper, and there are chances of same paper may appear twice with slightly different details. This may inflate the number of citation counts.

Conclusions

Pakistan improved the international research ranking in global science during the period 2002-2008. However, the upward trend of research papers published in medical science could not be retained, and this declining trend of research papers further decreased in year 2012 compared to year 2011. It is suggested that Pakistan must establish a comprehensive strategic plan to enhance the research culture and increase the research and development expenditure in the country.

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Conflict of Interest

No conflict of interest with any institution/organization

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