Iranians’ contribution to world literature on neuroscience


*Functional Neurosurgery Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran, †Scientometrics Research Center, Kerman University of Medical Sciences, Kerman, Iran, ‡Research Center for Pharmaceutical Nanotechnology, Tabriz University of Medical Sciences, Tabriz, Iran, §Iranian Center for Evidence-Based Medicine, Tabriz University of Medical Sciences, Tabriz, Iran, ¶Department of Health Information Management, School of Health Management and Information Sciences, Tehran University of Medical Sciences, Tehran, Iran, **Department of Speech and Language Pathology, Faculty of Rehabilitation, Tabriz University of Medical Sciences, Tabriz, Iran, ††Department of Medical Biotechnology, Tehran University of Medical Sciences, Tehran, Iran, ‡‡Functional Neurosurgery Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran, §§Department of Medical Librarianship and Information Science, Tehran University of Medical Sciences, Tehran, Iran and ––Department of Rehabilitation, Science, Faculty of Rehabilitation Science, Tehran University of Medical Sciences, Tehran, Iran

Abstract

Objective: The purpose of this study is to analyse Iranian scientific publications in the neuroscience subfields by librarians and neuroscientists, using Science Citation Index Expanded (SCIE) via Web of Science data over the period, 2002–2008.

Methods: Data were retrieved from the SCIE. Data were collected from the ‘subject area’ of the database and classified by neuroscience experts into 14 subfields. To identify the citation patterns, we applied the ‘impact factor’ and the ‘number of publication’. Data were also analysed using HISTCITE, Excel 2007 and SPSS.

Results: Seven hundred and thirty-four papers have been published by Iranian between 2002 and 2008. Findings showed a growing trend of neuroscience papers in the last 3 years with most papers (264) classified in the neuropharmacology subfield. There were fewer papers in neurohistory, psychopharmacology and artificial intelligence. International contributions of authors were mostly in the neurology subfield, and ‘Collaboration Coefficient’ for the neuroscience subfields in Iran was 0.686 which is acceptable. Most international collaboration between Iranians and developed countries was from USA. Eighty-seven percent of the published papers were in journals with the impact factor between 0 and 4; 25% of papers were published by the researchers affiliated to Tehran University of Medical Sciences.

Conclusion: Progress of neuroscience in Iran is mostly seen in the neuropharmacology and the neurology subfields. Other subfields should also be considered as a research priority by health policymakers. As this study was carried out by the collaboration of librarians and neuroscientists, it has been proved valuable for both librarians and policymakers. This study may be encouraging for librarians from other developing countries.

Keywords: authors’ collaboration, Iran, medical librarians, neuroscience, scientific production, scientometrics.

Key Messages

Implications for Practice

• Medical librarians should contribute to the prioritising of areas of research in neuroscience.
• Medical librarians should be encouraged to collaborate in research decisions by providing evidence for the research trends and identifying gaps in research.
• Identifying Iranian researchers’ publications to help in journals selection policy.

Correspondence: Hafez Mohammadhassanzadeh, Scientometrics Research Center, Kerman University of Medical Sciences, Kerman 76175, Iran, E-mail: hafezhassanzadeh60@gmail.com

© 2012 The authors. Health Information and Libraries Journal © 2012 Health Libraries Group

Health Information and Libraries Journal
• Development of national and/or international databases in neuroscience.
• Collaboration of medical librarians with experts in development of MeSH.

Implications for Policy

• Medical librarians have an emerging role in scientometrics for developing countries.
• Documentation of evidence for policymakers of neuroscience research in Iran.
• Suggestions for ISI Science Citation Index Expanded to include subfields of productive sciences in subject areas.

Introduction

Background

Neuroscience is a field based on the human mind, behaviour and biological cognition. This scientific field is a combination of culture and civilisation and includes some other related scientific fields including clinical and basic sciences, language, aesthetics, training and education, intelligent systems, and neural network models.

Subjects such as neurophysiology, neurochemistry, neuropharmacology, neurosurgery and neurobiology have been taught at Iranian medical universities for some time. In 2002, ‘cognitive neuroscience’ was founded as a PhD degree course at the Tabriz University. It is now possible to apply scientometric and bibliometric methods, as tools, to classify researchers and those assessing the scientific subjects, individually.1,2

Tabriz University was the first Iranian university to establish the academic education of neuroscience and propose a new evaluation plan to determine the research priorities in the area. As a part of this plan, they asked for the collaboration between neuroscientists and medical librarians to develop a scientometric study of evidence of past trends of research and to find research gaps in this field.

Scientometrics is capable of indicating scientific gaps in certain scientific fields and provides suggestions to fill these gaps. Therefore, using scientometrics, it is possible to consider research in a certain scientific field and assess its scientific productivity.3

Literature review

Many studies have been carried out in various medical fields which show the significant role of bibliometric and scientometric indices and techniques in scientific productivity measurement.4–7 The most extensive research in Iran was carried out by Mohammadhassanzadeh et al. and gathered comprehensive data over 30 years from 1978 to 2007, they also identified and found scientific productivity in Iran. This covered 29 fields of medical sciences (according to NLM classification). Their results showed an ascending trend between 2003 and 2007 in the field of the nervous system, ranked fifth in productivity [1135 records in Science Citation Index Expanded (SCIE)].8 This field received 4625 citations during the time of the study. Sharifi et al. analysed Iranians’ mental health researches in Iran-Psych, a national database, between 1973 and 2002. They found a growing trend in the neuroscience field especially from 1998 through 2002.9 Also, an evaluation of the scientific productivity in neuroscience has been carried out in India,10 Italy,11 China12 and Spain.13 Between 1999 and 2008, India ranked 21st in the global publication of neuroscience, producing 4503 papers indexed in Scopus. Bala and Gupta concluded that India had an urgent need to increase research in the neurosciences.10 Berardelli et al. looked at neurological research papers published in peer-reviewed medical journals from 2003 to 2004. They found that Italians publish 7% of neurological papers. As a result of this productivity, Italy took fourth place in the global share of neurological papers.11 Xu et al. studied the scientific output, from Medline, of neuroscience papers in China. They found an increasing trend from <5 papers per year during 1984–1987 to 212 papers per year between 1998 and 2001. They discussed low scientific productivity as a result of weak economic bases.12

None of these related studies analysed subfields of neuroscience or established research gaps within the subfields.
As no research study has been carried out focused on the field of neuroscience in Iran, in this study we tried to analyse published neuroscience papers using the ISI citation indices and applying scientometric methods. We looked at the number of published papers, universities and research institutes, international collaboration, authorship in collaboration with other researchers and citation patterns of papers, identified in each of the subfields of neuroscience.

Objectives

The main purposes of this study were to present the trends of neuroscience publications in Iran and to find research gaps and future research priorities in this field. The aims of the research were as follows:

• To identify the number of papers published in ISI’s SCI indexed journals between 2002 and 2008.
• To determine the distribution of Iranian papers published by subfields in neuroscience.
• To determine the international collaboration pattern of Iranian papers.
• To identify the co-authorship pattern of Iranian papers in neuroscience.
• To trace the journals which published Iranian papers in neuroscience.
• To identify the paper contributions by Iranian universities and research institutions.

Methods

This study is based on Iranian bibliographic data collected from SCIE database of the Web of Science during 2002–2008. We selected 2002, the year neuroscience was established as an academic field in Iran, as the start year. Policymakers asked us to select this time span in accordance with the beginning of the educational reform plans from 2009 to 2012. We searched the term ‘Iran’ in the Advanced Search section of the country search field of the Web of Science to retrieve all records from Iran in SCIE. Then, we used the ‘subject area’ facility to limit the results to ‘neurosciences’ and ‘clinical neurology’. We selected these topics to merge the related papers of both subjects and remove the duplicate papers occurring as a result of subject overlap. Applied search strategy was presented as follows:

cu = iran
Refined by: Subject Areas = (NEUROSCIENCES OR CLINICAL NEUROLOGY) AND Publication Years = (2008 OR 2007 OR 2005 OR 2004 OR 2003 OR 2002) AND Document Type = (ARTICLE OR LETTER OR REVIEW)

Titles and abstracts of all the retrieved papers were delivered to three experts in neuroscience to review the records in two steps:

First step: a neurologist (the first author) and a neurosurgeon (the seventh author) reviewed all of the retrieved records to specify the subfield of each record;

Second step: an expert of neurology, neuropsychology, psychiatry and neurophilosophy (the last author of the paper) studied the records and first-step experts’ opinions and made final decision to assign every record to one subfield.

These were studied by the experts who classified each into only one of the neuroscience subfields. In cases where papers covered more than one subfield, experts chose the related subfield considered to be of most importance for that record.

Narin suggested counting just articles, reviews and notes as publications showing scientific performance. Leydesdorff and Wagner found out that the Institute for Scientific Information (ISI) did not register ‘notes’ after 1995. Later, Braun et al. discussed the inclusion of letters also as scientific output. So in this study, only reviews and articles together with letters have been considered.

In accordance with experts’ opinions, neurochemistry, neurorehabilitation, neuroimmunology, neuroepidemiology and neurophilosophy were not considered in the results due to there being only one paper in each of the first three subfields, and under four in neuroepidemiology and neurophilosophy. The total number of data downloaded from SCIE was 734 on 30 September 2009. These were classified into 14 subfields by the neuroscience experts as follows:

• artificial intelligence;
• neuroanatomy;
• neurogenetics;
• cognitive neuroscience;
• neurophysiology;
• neuropsychology;
neuropsychiatry;
neurosurgery;
neuropaediatrics;
neuropharmacology;
psychopharmacology;
nurology;
neurohistory; and
neuroradiology.

Each of these subfields was entered into HISTCITE 7.11.7 (Thomson Reuters, Philadelphia, PA, USA) software to be analysed according to the objectives of the study. Also, a secondary analysis was performed utilising Kruskal–Wallis test in SPSS 16 (SPSS Inc., Chicago, IL, USA).

To compute the pattern of co-authorship, collaboration coefficient (CC) was applied. This index was introduced by Ajiferuke and his colleagues for the first time in 1988.17

To identify the citation patterns, the ‘impact factor’ and ‘number of citations’ were applied. Also, to calculate co-authorship patterns, the records were divided into four sections:
- papers with one author;
- papers with two authors;
- papers with three or four authors; and
- papers with five or more authors.

Results

Trends in Iranian neuroscience publications

The trend of papers in the neuroscience subfields during 7 years (2002–2008) has been shown in Fig. 1. This shows that the number of papers has been increased in a period of 5 years (2002–2007), while there has been a descending trend afterwards (2007–2008). Most citations have occurred in 2003.

Iranian publications by subfields in neuroscience

Table 1 shows most of the papers are related to neuropharmacology (264 papers) and the neurology (215 papers), while there were fewer papers related to the artificial intelligence, neurohistory and psychopharmacology in comparison with the other subfields. Most international collaborations were in the neurology (46 papers), neuropharmacology (35 papers) and neuroanatomy (27 papers), respectively. The result of Kruskal–Wallis test showed a significant difference in the number of citations between 14 subfields ($X^2 = 29.33$, $P = 0.006$, CI = 95%).

International collaboration pattern of Iranian papers

As shown in Tables 1 and 2, from the total number of papers in the neuroscience subfields, Iranian researchers published 168 papers in collaboration with non-Iranian researchers. Iranian researchers were the first author in 58.33% of papers. Iranian researchers participated, as the first author, in 13 international scientific collaborations. Most of these collaborations were with United States of America (23.8%) and Canada (4%). Table 2 shows that the greatest number of international collaborations was in 2008. This indicates an increase in the number of collaborations in neuroscience.

Co-authorship pattern of Iranian papers

Table 3 shows that the average of the CC index for the neuroscience subfields in Iran is 0.686. This shows team cooperation of Iranian authors. The highest collaboration occurred during 2002 (0.732) and 2007 (0.705).

Journals that published Iranian papers in neuroscience

The results showed that of the 734 papers written by Iranian authors, 156 papers were published in international journals during 2002–2008. Table 4
shows that four journals had an impact factor >10 and 14 journals had no impact factor. These results were based on the Journal Citation Reports (JCR), Edition 2007; 87% of all the papers were published in journals with an impact factor of 0–4. 73.91% of citations related to papers published in the journals with an impact factor of 2–4.

Distribution of papers in neuroscience among Iranian universities and research institutes

Forty-seven institutes participated in scientific productivity in the neuroscience subfields in Iran; 61.7% and 27.65% of the papers were supported by the Ministries of Health and Medical Education (MOHME), and Science, Research, and Technology.

### Table 1 Distribution of papers and citations among neuroscience subfields

<table>
<thead>
<tr>
<th>Subject subfield</th>
<th>N of papers by native Iranian researchers</th>
<th>N of papers jointly written by Iranian and non-Iranian researchers</th>
<th>Total N of papers</th>
<th>N of Iranian citations</th>
<th>N of international citations</th>
<th>Total N of citations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neuropharmacology</td>
<td>229</td>
<td>35</td>
<td>264</td>
<td>1098</td>
<td>207</td>
<td>1305</td>
</tr>
<tr>
<td>Neurology</td>
<td>169</td>
<td>46</td>
<td>215</td>
<td>269</td>
<td>142</td>
<td>411</td>
</tr>
<tr>
<td>Neuroanatomy</td>
<td>34</td>
<td>27</td>
<td>61</td>
<td>111</td>
<td>80</td>
<td>191</td>
</tr>
<tr>
<td>Neurophysiology</td>
<td>33</td>
<td>13</td>
<td>46</td>
<td>103</td>
<td>85</td>
<td>188</td>
</tr>
<tr>
<td>Neuropsychology</td>
<td>25</td>
<td>7</td>
<td>32</td>
<td>105</td>
<td>27</td>
<td>132</td>
</tr>
<tr>
<td>Neurogenetics</td>
<td>22</td>
<td>8</td>
<td>30</td>
<td>33</td>
<td>76</td>
<td>109</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>17</td>
<td>11</td>
<td>28</td>
<td>17</td>
<td>36</td>
<td>53</td>
</tr>
<tr>
<td>Neuroradiology</td>
<td>8</td>
<td>7</td>
<td>15</td>
<td>11</td>
<td>15</td>
<td>26</td>
</tr>
<tr>
<td>Neuropediatrics</td>
<td>9</td>
<td>3</td>
<td>12</td>
<td>31</td>
<td>4</td>
<td>35</td>
</tr>
<tr>
<td>Cognitive neuroscience</td>
<td>6</td>
<td>3</td>
<td>9</td>
<td>13</td>
<td>7</td>
<td>20</td>
</tr>
<tr>
<td>Neuropsychiatry</td>
<td>6</td>
<td>2</td>
<td>8</td>
<td>29</td>
<td>–</td>
<td>29</td>
</tr>
<tr>
<td>Artificial intelligence</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>6</td>
<td>–</td>
<td>6</td>
</tr>
<tr>
<td>Psychopharmacology</td>
<td>5</td>
<td>–</td>
<td>5</td>
<td>45</td>
<td>–</td>
<td>45</td>
</tr>
<tr>
<td>Neurohistory</td>
<td>–</td>
<td>4</td>
<td>4</td>
<td>–</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>566</strong></td>
<td><strong>168</strong></td>
<td><strong>734</strong></td>
<td><strong>1871</strong></td>
<td><strong>680</strong></td>
<td><strong>2551</strong></td>
</tr>
</tbody>
</table>

### Table 2 Distribution of international papers according to the authors’ country during 2002–2008

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author's country</td>
<td>Number of papers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total (%)</td>
</tr>
<tr>
<td>Iran</td>
<td>3</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>12</td>
<td>23</td>
<td>30</td>
<td>98 (58.33)</td>
</tr>
<tr>
<td>USA</td>
<td>1</td>
<td>–</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>15</td>
<td>16</td>
<td>40 (23.8)</td>
</tr>
<tr>
<td>Canada</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>–</td>
<td>1</td>
<td>7</td>
<td>4 (4)</td>
</tr>
<tr>
<td>UK</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>5 (2.97)</td>
</tr>
<tr>
<td>Australia</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4 (2.38)</td>
</tr>
<tr>
<td>Italy</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>3</td>
<td>–</td>
<td>3</td>
<td>3 (1.78)</td>
</tr>
<tr>
<td>Japan</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>1</td>
<td>–</td>
<td>1</td>
<td>3 (1.78)</td>
</tr>
<tr>
<td>Germany</td>
<td>–</td>
<td>2</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>2 (1.19)</td>
</tr>
<tr>
<td>Spain</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>2</td>
<td>2 (1.19)</td>
</tr>
<tr>
<td>Finland</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1 (.59)</td>
</tr>
<tr>
<td>Czech</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1 (.59)</td>
</tr>
<tr>
<td>Denmark</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>1</td>
<td>1 (.59)</td>
</tr>
<tr>
<td>France</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>1 (.59)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6</strong></td>
<td><strong>12</strong></td>
<td><strong>14</strong></td>
<td><strong>16</strong></td>
<td><strong>22</strong></td>
<td><strong>46</strong></td>
<td><strong>52</strong></td>
<td><strong>168 (100)</strong></td>
</tr>
</tbody>
</table>

Also 10.6% of papers were published independently. Table 5 shows that 24.96% of the papers were written by researchers of the Tehran University of Medical Sciences. 19.87% of the international papers were written by researchers affiliated to Tabriz University of Medical Sciences.

Discussion

In the present study, we tried to introduce an overview of the status of the neuroscience publications among Iranians. According to the findings, Iranian researchers have published 734 papers related to neuroscience in journals indexed in SCIE during 2002–2008. Most of these papers have been published in 2006, 2007 and 2008 which shows an ascending trend of publications in this area. This findings support previous scientometric reports of Iranian neuroscience researches (1973–2002 in IranPsych).8,9 Xu et al. considered China’s neuroscience output in the Medline database from 1984 through 2001. They showed an ascending trend of the papers published in this field in recent years. 12 This indicates the progress of the neuroscience researches in other countries such as India (1999–2008 in Scopus)10 and Italy (2003–2004 in European, American, and specialist journals)11 as well as Iran. None of the related scientometric studies in the field considered subfields of neuroscience. Also, they applied different data sources and time spans which strengthen the evidence of growing trend of neuroscience in different time periods.

From the total number of 734 papers, the neuropharmacology and neurology subfields, with 264 and 215 papers respectively, had the highest number of papers among other related subfields of neuroscience. This can be explained by the presence of talented researchers, more facilities and powerful infrastructures in these scientific subfields in Iran.

Table 4 Distribution of papers and citations according to journal impact factor

<table>
<thead>
<tr>
<th>IF</th>
<th>Number of journals</th>
<th>Number of papers (%)</th>
<th>Number of citations (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to &lt;1</td>
<td>17</td>
<td>92 (12.53)</td>
<td>74 (2.9)</td>
</tr>
<tr>
<td>1 to &lt;2</td>
<td>36</td>
<td>147 (20)</td>
<td>298 (11.68)</td>
</tr>
<tr>
<td>2 to &lt;3</td>
<td>45</td>
<td>309 (42)</td>
<td>1401 (54.91)</td>
</tr>
<tr>
<td>3 to &lt;4</td>
<td>25</td>
<td>90 (12.26)</td>
<td>485 (19)</td>
</tr>
<tr>
<td>4 to &lt;5</td>
<td>7</td>
<td>19 (2.58)</td>
<td>107 (4.19)</td>
</tr>
<tr>
<td>5 to &lt;6</td>
<td>5</td>
<td>10 (1.36)</td>
<td>64 (2.5)</td>
</tr>
<tr>
<td>6 to &lt;7</td>
<td>1</td>
<td>3 (0.408)</td>
<td>10 (0.392)</td>
</tr>
<tr>
<td>7 to &lt;10</td>
<td>2</td>
<td>5 (0.681)</td>
<td>13 (0.509)</td>
</tr>
<tr>
<td>&gt;10</td>
<td>4</td>
<td>4 (0.544)</td>
<td>72 (2.82)</td>
</tr>
<tr>
<td>NA</td>
<td>14</td>
<td>55 (7.4)</td>
<td>27 (1.05)</td>
</tr>
<tr>
<td>Total</td>
<td>156</td>
<td>734 (100)</td>
<td>2551 (100)</td>
</tr>
</tbody>
</table>

NA, not available.

(MSRT), respectively. Also 10.6% of papers were published independently. Table 5 shows that 24.96% of the papers were written by researchers of the Tehran University of Medical Sciences. 19.87% of the international papers were written by researchers affiliated to Tabriz University of Medical Sciences.

Table 3 Co-authorship patterns of Iranian authors during 2002–2008

<table>
<thead>
<tr>
<th>Year</th>
<th>Single-authored</th>
<th>Two-authored</th>
<th>Multi-authored*</th>
<th>Mega-authored**</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Papers</td>
<td>Citations</td>
<td>Papers</td>
<td>Citations</td>
<td>Papers</td>
</tr>
<tr>
<td>2002</td>
<td>–</td>
<td>–</td>
<td>4</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>2003</td>
<td>4</td>
<td>20</td>
<td>5</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>2004</td>
<td>4</td>
<td>19</td>
<td>9</td>
<td>65</td>
<td>20</td>
</tr>
<tr>
<td>2005</td>
<td>7</td>
<td>12</td>
<td>17</td>
<td>65</td>
<td>39</td>
</tr>
<tr>
<td>2006</td>
<td>4</td>
<td>12</td>
<td>21</td>
<td>73</td>
<td>64</td>
</tr>
<tr>
<td>2007</td>
<td>7</td>
<td>4</td>
<td>22</td>
<td>28</td>
<td>68</td>
</tr>
<tr>
<td>2008</td>
<td>11</td>
<td>1</td>
<td>17</td>
<td>2</td>
<td>69</td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
<td>68</td>
<td>95</td>
<td>280</td>
<td>294</td>
</tr>
</tbody>
</table>

CC, collaboration coefficient.
*Three or four authors.
**Five or more authors.

Table 5 Distribution of papers and citations according to journal impact factor

<table>
<thead>
<tr>
<th>IF</th>
<th>Number of journals</th>
<th>Number of papers (%)</th>
<th>Number of citations (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to &lt;1</td>
<td>17</td>
<td>92 (12.53)</td>
<td>74 (2.9)</td>
</tr>
<tr>
<td>1 to &lt;2</td>
<td>36</td>
<td>147 (20)</td>
<td>298 (11.68)</td>
</tr>
<tr>
<td>2 to &lt;3</td>
<td>45</td>
<td>309 (42)</td>
<td>1401 (54.91)</td>
</tr>
<tr>
<td>3 to &lt;4</td>
<td>25</td>
<td>90 (12.26)</td>
<td>485 (19)</td>
</tr>
<tr>
<td>4 to &lt;5</td>
<td>7</td>
<td>19 (2.58)</td>
<td>107 (4.19)</td>
</tr>
<tr>
<td>5 to &lt;6</td>
<td>5</td>
<td>10 (1.36)</td>
<td>64 (2.5)</td>
</tr>
<tr>
<td>6 to &lt;7</td>
<td>1</td>
<td>3 (0.408)</td>
<td>10 (0.392)</td>
</tr>
<tr>
<td>7 to &lt;10</td>
<td>2</td>
<td>5 (0.681)</td>
<td>13 (0.509)</td>
</tr>
<tr>
<td>&gt;10</td>
<td>4</td>
<td>4 (0.544)</td>
<td>72 (2.82)</td>
</tr>
<tr>
<td>NA</td>
<td>14</td>
<td>55 (7.4)</td>
<td>27 (1.05)</td>
</tr>
<tr>
<td>Total</td>
<td>156</td>
<td>734 (100)</td>
<td>2551 (100)</td>
</tr>
</tbody>
</table>

NA, not available.

© 2012 The authors. Health Information and Libraries Journal © 2012 Health Libraries Group

Health Information and Libraries Journal
Developing a database for neuroscience and its subfields as a growing scientific field could be a valuable tool for future research. Also ISI SCIE could add the growing subfields of neuroscience to the Web of Science subjects. Gla¨ nzel and his colleague presented three steps to ‘a new classification scheme of science fields and subfields designed for scientometric evaluation purposes’. According to the first step (‘cognitive approach’), they provided the initial scheme based on comments of scientometricians and external experts. In this classification, they assigned two subfields for neuroscience field. However, our findings based on neuroscientists’ opinions give more detail showing at least 14 subfields for neuroscience. The results of this study support experts’ intervention in the classification scheme but provide elaborated complementary subfields for their classification. On the other hand, MeSH achieved a different approach to facilitate library-based goals. Our effort could also be applicable for the future development of MeSH.

Despite the remarkable research progression in neuroscience, there are still many unanswered questions especially, in the subfield of cognitive neuroscience. Still more research is needed to be able to consider including basics of consciousness neurology, sleepiness, perception, language, memory, learning and decision-making. Furthermore, there are still many unanswered questions about human brain growth, development and its capabilities changes. In addition, in the field of psychiatry, complete inclusion of neurological basics of mental diseases such as psychotic disorders (mania and schizophrenia), Parkinson’s, Alzheimer’s diseases, and addiction, has not been achieved. Therefore, to discover and understand these unknown areas of human science, it is necessary that Iranian neuroscience researchers consider and focus on these subjects by avoiding repetition and taking advantage of native capacities.

According to our research study, from a total of 156 papers in the neuroscience which have published

<table>
<thead>
<tr>
<th>No.</th>
<th>Institute</th>
<th>Indigenous papers</th>
<th>International papers (%)</th>
<th>Indigenous citations</th>
<th>International citations</th>
<th>Total papers (%)</th>
<th>Total citations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tehran University of Medical Sciences</td>
<td>177</td>
<td>31 (18.76)</td>
<td>969</td>
<td>215</td>
<td>208 (24.96)</td>
<td>1184</td>
</tr>
<tr>
<td>2</td>
<td>Beheshti University of Medical Sciences</td>
<td>73</td>
<td>12 (7.22)</td>
<td>256</td>
<td>60</td>
<td>85 (10.2)</td>
<td>316</td>
</tr>
<tr>
<td>3</td>
<td>University of Tehran</td>
<td>54</td>
<td>5 (3.01)</td>
<td>387</td>
<td>18</td>
<td>59 (7.08)</td>
<td>405</td>
</tr>
<tr>
<td>4</td>
<td>Tarbiat Modarres University</td>
<td>45</td>
<td>2 (1.2)</td>
<td>174</td>
<td>16</td>
<td>47 (5.64)</td>
<td>190</td>
</tr>
<tr>
<td>5</td>
<td>Shiraz University of Medical Sciences</td>
<td>40</td>
<td>5 (3.01)</td>
<td>54</td>
<td>36</td>
<td>45 (5.4)</td>
<td>90</td>
</tr>
<tr>
<td>6</td>
<td>IPM*</td>
<td>35</td>
<td>6 (3.61)</td>
<td>166</td>
<td>44</td>
<td>41 (4.91)</td>
<td>210</td>
</tr>
<tr>
<td>7</td>
<td>Tabriz University of Medical Sciences</td>
<td>5</td>
<td>33 (19.87)</td>
<td>17</td>
<td>45</td>
<td>38 (4.5)</td>
<td>62</td>
</tr>
<tr>
<td>8</td>
<td>Isfahan University of Medical Sciences</td>
<td>23</td>
<td>2 (1.2)</td>
<td>73</td>
<td>12</td>
<td>25 (3)</td>
<td>85</td>
</tr>
<tr>
<td>9</td>
<td>Pasteur Institute</td>
<td>19</td>
<td>5 (3.01)</td>
<td>156</td>
<td>28</td>
<td>24 (2.88)</td>
<td>184</td>
</tr>
<tr>
<td>10</td>
<td>ICCS**</td>
<td>18</td>
<td>1 (0.6)</td>
<td>96</td>
<td>2</td>
<td>19 (2.28)</td>
<td>98</td>
</tr>
<tr>
<td>11</td>
<td>Iran University of Medical Sciences</td>
<td>17</td>
<td>2 (1.2)</td>
<td>53</td>
<td>9</td>
<td>19 (2.28)</td>
<td>62</td>
</tr>
<tr>
<td>12</td>
<td>Azad University</td>
<td>17</td>
<td>–</td>
<td>83</td>
<td>–</td>
<td>17 (2.04)</td>
<td>83</td>
</tr>
<tr>
<td>13</td>
<td>Tarbiat Moallem University</td>
<td>12</td>
<td>2 (1.2)</td>
<td>89</td>
<td>42</td>
<td>14 (1.68)</td>
<td>131</td>
</tr>
<tr>
<td>14</td>
<td>Semnan University of Medical Sciences</td>
<td>11</td>
<td>2 (1.2)</td>
<td>43</td>
<td>18</td>
<td>13 (1.56)</td>
<td>61</td>
</tr>
<tr>
<td>15</td>
<td>Welfare and Rehabilitation Science University</td>
<td>5</td>
<td>7 (4.21)</td>
<td>24</td>
<td>11</td>
<td>12 (1.44)</td>
<td>35</td>
</tr>
<tr>
<td>16</td>
<td>Others</td>
<td>116</td>
<td>51 (30.72)</td>
<td>500</td>
<td>180</td>
<td>167 (20.04)</td>
<td>680</td>
</tr>
<tr>
<td>Total</td>
<td>–</td>
<td>667</td>
<td>166 (100)</td>
<td>3140</td>
<td>736</td>
<td>833 (100)</td>
<td>3876</td>
</tr>
</tbody>
</table>

*Institute for Studies in Theoretical Physics and Mathematics.
**Institute for Cognitive Science Studies.
by Iranian researchers, only four papers had an impact factor above 10. This included 0.5% of the published papers in this field. Most of the papers were published in journals with an impact factor of <4, and about 5.5% of them were published in journals with an impact factor above 4. This may be due to the rejection of papers from developing countries by valid international journals. A high impact factor could indicate international visibility and readability of journals. As an effort, medical librarians who are ‘journal selection experts’ could give advice on appropriate journals for researchers’ who are considering publishing research reports. This could be an emerging role for medical librarians in developing countries. Also, native researchers publish their research in particular journals. A list of these journals could be seen as a helpful tool in collection development of research libraries.

On the basis of the results of the present study, most of the neuroscience researchers have been joint authors. Only 5% of papers were written by a single author. This shows the relation of neuroscience to other scientific fields and the collaboration of different scientific research groups. From a total of 734 indexed neuroscience papers in the database, 168 papers have written jointly with authors from other countries.

The highest and lowest rates of international collaborations were in 2008 and 2002, respectively. This shows scientific collaboration of Iranian researchers with researchers from other countries and, as a result, the significant progress of international collaboration in recent years. In other words, co-authorship at this level results in the formation of international social networks, science expansion and the achievement of greater knowledge.

Based on the distribution of papers, 15 research centres, 13 universities and three research institutes have had the highest number of neuroscience papers, among these, Tehran University of Medical Sciences and IPM institute with 208 and 35 papers, respectively. These are the most active institutes in this area.

Comparing the progression of neuroscience in Iran with other countries active in the field indicates that before carrying out research in this subject, it is necessary to plan and consider forthcoming findings. In these countries, they had well thought out plans to train students at schools and universities. In addition, to introduce neuroscience to students, they arrange and hold scientific expeditions, periodically. All these together show the effect of scientific training and talent recognition as a path to scientific advancement in neuroscience. These countries, in collaboration with educational experts, endeavour to find the best methods for improving training methods in neuroscience for students, these results in progress of this science in the educational departments of these countries.

Neuropharmacology and neurology have been shown as the most progressive fields of neuroscience in Iran. Therefore, the study of other neuroscience subfields should be considered as a priority for health and research policymakers. Although Tabriz University established ‘cognitive neuroscience’ in 2002, however, we found more neuropharmacology researches rather than ‘cognitive neuroscience’. It could be a major conflict between policies and outcomes that should be considered for future decisions.

Tehran University of Medical Sciences, owing to its powerful infrastructures, can be considered as a suitable national pattern for other hard-working and active research institutes and universities in neuroscience research.

There are also lessons for medical librarians in developing countries for future research. Medical librarians should play the major roles:

- As research assistants of scientometric studies.
- In providing evidence for policymakers.
- In strategic searching, data gathering, organisation of information about neuroscience indexed papers and compiling final research reports.

It could be a pattern for librarians in developing countries. Most of the time, this type of research is the prerequisite for future plans in research development decisions.

Conclusion

Neuroscience is a growing research area among Iranians. It comprises many subfields each of which needs a plan for future development. Our study showed an unbalanced research trend among different subfields of neuroscience. Despite establishment of cognitive neuroscience as an academic field, we still have not reached the research objectives of this area. Such a gap between academic
education and research trends necessitate evidence provision for policymakers. For this, it is necessary to have a team including neuroscientists, policymakers and medical/clinical librarians. Also, classification of neuroscience and even subfields of other scientific fields using experts’ opinions, scientometricians and tools such as thesauri and taxonomies is recommended in the future studies and developments. These perquisites may lead to added value in:

- prioritising research areas;
- creating more subject-oriented databases;
- modifying subject fields of existing databases;
- developing MeSH and other classification systems; and
- providing journals selection guides for librarians to develop library collection and suggest appropriate journals for submission and publication purposes.

Iran is a rare case in which medical librarians and neuroscientists work together to reach results for decision-making. This can be seen as a new role of librarians in evidence-based practice beyond the clinical settings.

Limitations

We did not search Social Science Citation Index in this study. Maybe, there were some other records in this database related to neuroscience as a multidisciplinary scientific filed; however, we acted as previous similar researches that considered SCIE as the only source of records for neuroscience.

Acknowledgements

We specially thank assistant editor of HILJ Penny Bonnett, who spent valuable time editing the paper’s language in order to meet the criteria for publication in the journal. Also, we would like to thank the referees for their comments on the paper.

Source of funding

This paper reports the main findings of the project supported financially by Tabriz University and Tabriz University of Medical Sciences located in Eastern Azerbaijan, Tabriz, Iran.

Conflict of interest

No conflicts of interest have been declared.

References

14 Narin, F., Computer Horizons, I. & Foundation, N. S. Evaluative Bibliometrics: The Use of Publication and


Received 27 January 2011; Accepted 11 March 2012