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Abstract

Purpose – The present study aims at determining the most accredited free English electronic journals (EJs) in Medical Sciences, as finding free scholarly EJs including medical ones is difficult in the web environment.

Design/methodology/approach – The research population consisted of 700 free EJs of Medical Sciences, which were collected from two reputable websites, namely, Directory of Open Access Journals and Free Medical Journals. After first screening, 269 free EJs including 76 journals in health, 4 journals in nursing, 175 journals in medicine and 14 free EJs in dentistry remained for final investigation […].

Findings – The most accredited journals in four medical disciplines studied here are health: *New South Wales Public Health Bulletin*, *PLoS Biology* and *Environmental Health Perspectives – National Institute of Environmental Health Sciences*; nursing: *Online Journal of Rural Nursing and Health Care* and *Online Journal of Nursing Informatics* […].

Originality/value – This research can be treated as an addition to the webometrics literature.

Keywords Open access, Webometrics

Paper type Research paper

Introduction

For more than three centuries, the journal has played a pivotal role in the creation and transmission of knowledge by serving as the primary medium of scholarly communication, and has remained essentially unchanged in form and function over its lifetime. Science as we know it is scarcely imaginable without the scholarly journal

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(Harter and Kim, 1996). In Toffler's (1984) book *The Third Wave*, information and communication technology with its transformative power has fired the digital revolution within which digital technologies are transforming a variety of fields (Kalantzis-Cope, 2011), including scholarly communication. Despite the undeniable explosion of the World Wide Web, Nicholas and Huntington's (2006, p. 50) declaration is true, namely:

> Many, many more people are accessing scholarly journals, and many of these people are novice, occasional users and do not have full text downloading rights (we call them the disenfranchised).

The authors add that the market for scholarly journals has been massively expanded as a result of the migration to digital form. The open access publishing model is attempting to cater to the needs of readers but there must also be opportunities for the document delivery community. Tenopir *et al.* (2009, p. 6) indicated:

> […] although academics continue to use print articles, their use of electronic journal articles has increased substantially over time, particularly as university libraries continue to transition their collections to electronic journals (EJs) available on the scholar's desktop and elsewhere.

As Kaur and Verma (2009, p. 611) wrote:

> […] owing to the emergence of information technology and its application in libraries, traditional print journals are being replaced by EJs with benefits for libraries and users apparent in many ways. Users can access, download and print out papers quite easily. The problems of missing issues, binding, subscription and damage of papers have also been solved.

It should be noted that libraries and information centres annually pay large sums to subscribe to electronic journals. When the subscription period ends, libraries are in a rush to renew their journal subscriptions. Universities and research centres have to spend substantial funding to purchase journals; however, it is not possible for all libraries to afford this cost. Providing accredited EJs through open and free access facilities could be a supplemental method to help meet information needs of students and researchers. Thus, open access, as a factor, helps to ensure long-term access to scientific articles.

Searching web portals for access to free EJs (no subscription fee needed) is a suitable method for finding EJs, but the main question is whether all free EJs are valid or not. There are many approaches for the assessment of such journals. In this study, using webometrics, which is defined as the study of the quantitative aspects of the construction and use of information resources, structures and technologies on the web, by drawing on bibliometric and informetric approaches (Björneborn, 2004), the most accredited free English EJs in medical sciences are identified. In fact, the main concern of this research is to determine the most accredited free EJs among the large numbers of this kind of journal on the basis of webometric principles.

Webometrics applications in brief

According to the related literature, there are ten webometric applications. They include: web impact factor (WIF) assessment (Ingwersen, 1998; Thelwall, 2001; Smith, 2004; Kousha, 2004; Danesh *et al.*, 2008); website visibility assessment (Vreeland, 2000;

Vaughan and Thelwall, 2005; Gao and Vaughan, 2005; Asnafi and Osareh, 2006; Soheili *et al.*, 2008); investigation of website collaboration (Chu, 2001; Ingwersen and Larsen, 2001; Thelwall and Wilkinson, 2002; Osareh, 2003; Danesh *et al.*, 2008); identification of core websites (Soheili, 2006); mapping the structure of science (Kousha and Thelwall, 2007); search engines assessment (Isfandyari-Moghaddam and Parirokh, 2006; Isfandyari-Moghaddam, 2007; Isfandyari-Moghaddam and Ranjbar, 2008); web page contents analysis (Huizingh, 2000); investigation of users' information seeking behaviour (Sotoudeh, 2003; Thelwall *et al.*, 2005); investigation of the web presence of countries (Thelwall and Price, 2003; Noruzi, 2006b); and discovery of the link creation motivations (Wilkinson *et al.*, 2003; Chu, 2005; Thelwall *et al.*, 2005; Kousha and Thelwall, 2006). Hence, building this study on the related literature, a combination of webometric applications were utilized to determine the most accredited free English EJs in medical sciences.

Objectives of the study

The main purpose of this paper is to determine the most accredited free English EJs in medical sciences. To meet this general objective, it is necessary to find out:

- How is the ranking of free EJs in medical sciences based on their in-links?
- How is the ranking of free EJs in medical sciences based on WIF?
- What are the core free EJs in medical sciences?

Methodology

Because funding for higher education and universities has been reduced year after year (Babalhavaeji *et al.*, 2010), the increasing use of the electronic information-seeking environment (Talja and Maula, 2003), particularly free e-journals, is treated as a cost-effective way to follow up on and carry out scholarly efforts. According to the definition of "open access" from the Budapest Open Access Initiative (2012), these items are freely available on the public Internet, permitting users to read, download, copy, distribute, print, search or link to the full texts of these articles, crawl them for indexing, pass them as data to software or use them for any other lawful purpose, without financial, legal or technical barriers other than those inseparable from gaining access to the Internet itself. This holds true for free medical EJs. That is why the research population in this study is the medical journals in the Directory of Open Access Journals (DOAJ) and Free Medical Journals (FMJ).

The number of the studied journals in DOAJ is 335 journals, and 453 journals in FMJ. A quick survey showed that the two databases have an overlap in 88 cases, thus reducing the number of the research population to 700 journals. In other words, there were 700 unique journals across both databases surveyed in this research. The lack of any qualitative analysis limits the usefulness of this paper to health information professionals and reliance on in-linking to create a ranking of free titles is not a measure of the academic or scientific standard of a publication. Thus, to conduct this study, first, using the valid checklist used in Asnafi's (2005) study, all the web pages of medical journals in two databases were qualitatively studied. Then, the journals were accepted as the selected ones, provided that they met half the conditions outlined in the checklist and were also published in English. Accordingly, 269 free EJs – including 76 journals in health, 4 journals in nursing, 175 journals in medicine and 14 journals in dentistry – remained for final investigation. In the next stage, the web address (URL) of the selected

English medical free EJs was surveyed. In addition, the Yahoo Directory was used to determine the rate of in-links and the total links of these websites. Each of these links was extracted by webometric methods and the most accredited free EJs in medical field were determined. To determine the most accredited free EJs in any field, the core journal website formula has been utilized, as shown below.

Formula 1 (Danesh *et al.*, 2008):

$$Au = \frac{t}{n}$$

Au = core website.
t = total in-links to the studied website.
n = the number of studied websites.

Also, for journal ranking, the WIP Formula 2 was used:

Formula 2 (Ingwersen, 1998):

$$A_t = \frac{B'}{C'}$$

A_t = overall impact.
B' = links to web.
C' = the number of indexed web pages by search engine, not all of the web pages

Findings

Due to the high number of free EJs in some disciplines, such as health and medicine, only the top journals are provided in the ranking tables:

Q1. How is the ranking of free EJs in the medical sciences based on their in-links?

To rank the journals according to in-links, *Link domain: jcd.org.in-site: jcd.org.in* was utilized and the ranking results have been provided in the two tables below:

As Table I shows, the highest ranked journals were *New South Wales Public Health Bulletin*, *PLoS Biology* and *Environmental Health Perspectives – National Institute of Environmental Health Sciences*, having received the most in-links among all of health journals, with 10,200, 30,200 and 22,400 in-links, respectively.

According to Table II, the most highly ranked e-journals in nursing were *Online Journal of Rural Nursing and Health Care*, *Online Journal of Nursing Informatics*, *BMC Nursing* and *Open Nursing Journal* with 659, 350, 38 and 7 in-links, respectively.

Table I.
Free EJs ranking in health according to in-links

Rank	Journal title	URL	In-links
1	*New South Wales Public Health Bulletin*	www.publish.csiro.au/nid/226.htm	102,000
2	*PLoS Biology*	www.plosbiology.org/home.action	30,200
3	*Environmental Health Perspectives – National Institute Of Environmental Health Sciences*	http://ehp.niehs.nih.gov/	22,400
4	*International Journal Of Environmental Research And Public Health*	www.mdpi.com	18,900
5	*Mmwr: Morbidity & Mortality Weekly Report*	www.cdc.gov/mmwr/	15,000

In Table III, free EJs ranking in dentistry shows the three top journals are *BMC Oral Health*, *Brazilian Oral Research* and *Journal of the Indian Society of Pedodontics and Preventive Dentistry* with 683,000, 589,000 and 2,740 in-links, respectively.

Table IV indicates that the journals *Brazilian Journal of Medical and Biological Research*, *Clinics* and *Sao Paulo Medical Journal* were the three top journals in medicine with 593,000, 591,000 and 589,000 in-links, respectively:

Q2. How is the ranking of free EJs in the medical sciences based on WIF?

The WIF is based on the comparison of hyperlinks and citations and an adaptation of the journal's impact factor. In general, the "proportion of the links received by a website to the number of its pages is called the WIF" (Ingwersen, 1998). Noruzi (2006a) believes that as the WIF is a snapshot of its impact, it cannot be considered

Rank	Journal title	URL	In-links
1	*Online Journal Of Rural Nursing And Health Care*	www.rno.org/journal/index.php/online-journal	659
2	*Online Journal Of Nursing Informatics*	www.ojni.org/	350
3	*BMC Nursing*	www.biomedcentral.com/bmcnurs/	38
4	*Open Nursing Journal*	www.bentham.org/open/tonursj/	**7**

Table II. Free EJs ranking in nursing according to in-links

Rank	Journal title	URL	In-links
1	*BMC Oral Health*	www.biomedcentral.com/	683,000
2	*Brazilian Oral Research*	www.scielo.br/scielo.php?script=sci_serial&pid=1806-8324&lng=en&nrm=iso	589,000
3	*Journal of the Indian Society of Pedodontics and Preventive Dentistry*	www.jisppd.com/	2,740
4	*Indian Journal of Dental Research*	www.ijdr.in/	1,830
5	*Saudi Dental Journal*	www.sdsjournal.org/saudi-dental-journal.html	1,130

Table III. Free EJs ranking in dentistry according to in-links

Rank	Journal title	URL	In-links
1	*Brazilian Journal of Medical and Biological Research*	www.scielo.br/scielo.php?script=sci_serial&pid=0100-879X	593,000
2	*Clinics*	www.scielo.br/scielo.php?script=sci_serial&pid=1807-5932&lng=en&nrm=iso	591,000
3	*Sao Paulo Medical Journal*	www.scielo.br/scielo.php?script=sci_serial&pid=1516-3180&lng=en&nrm=iso	589,000
4	*Texas Heart Institute Journal*	www.pubmedcentral.nih.gov/tocrender.fcgi?journal=92&action=archive	422,000
5	*Journal of the Medical Library Association*	www.pubmedcentral.nih.gov/tocrender.fcgi?action=archive&journal=93	422,000
6	*Biological Research*	www.scielo.cl/scielo.php?script=sci_serial&pid=0716-9760&lng=en&nrm=iso	146,000

Table IV. Free EJs ranking in medicine according to in-links

a perfect tool to measure the quality of websites, but there is nothing better and it has the advantage of already being in existence. Accordingly, the impact factor of a website characterizes its reputation, viewing capability and its retrieval probability both on the national and international stage. The WIF increases with the number of links, and the higher this coefficient is, the higher is the impact of that website in the web environment. The impact factor of a website is a reflection of its universal reputation and to a great extent the quality of the information contained in it. Therefore, it is possible to compare and rank websites – and in this paper, free e-journals – on the basis of their WIF.

According to Figure 1, the *International Journal of Integrated Care*, *International Journal of Yoga* and *Australian Journal of Emergency Management* placed in the three top health journals with 7.004104, 7.345576 and 9.185804 for their WIF, respectively.

Free e-journal ranking in nursing according to WIF can be seen in Figure 2. The results show that *BMC Nursing* with a WIF of 2.704819 places at the first rank and the last rank belongs to the *Open Nursing Journal* with a WIF of 0.824176.

The data included in Figure 3 show free EJs ranking in dentistry. There are 14 journals in this field which are ordered on the basis of WIF. The journals *Journal of Oral Science*, *The New York State Dental Journal* and *Angle Orthodontist* placed as the three top journals with WIFs of 3.578337, 2.753012 and 1.663366, respectively.

Figure 4 shows that *Journal of Oral Science*, *The New York State Dental Journal* and *Angle Orthodontist* with 3.578337, 2.753012 and 2.373096 for their WIF are determined as the three top journals:

Q3. What are the core free EJs in medical sciences?

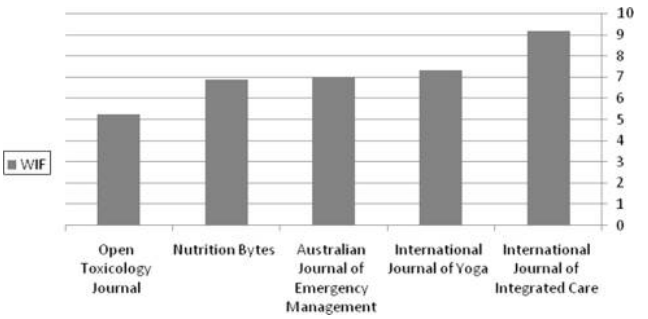

Figure 1.
Free EJs ranking in health according to WIF

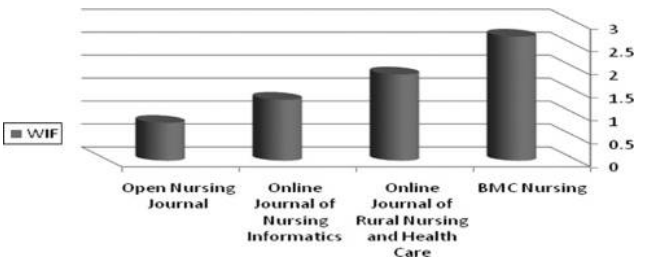

Figure 2.
Free EJs ranking in nursing according to WIF

To determine the most accredited free EJs in the medical disciplines, according to the number of journals and their in-links rate, the average in-links has been calculated to find the maximum of them. For this, the total of in-links of free EJs in any discipline was divided into the total number of free EJs in that discipline. By this calculation, a value was obtained through which the journals with in-links higher than the number were considered as the most highly in-linked journals.

Core journals in the health discipline are listed in Table V. In this field, there were a total of 76 free EJs. To calculate the maximum score (threshold) in this field, the total in-links of all journals was divided into the number of journals, which resulted in the number 4,356 and is the maximum score. In other words, the core journals in this field are those with in-links higher than 4,356. Based on Table V, journals *New South Wales Public Health Bulletin*, *PLoS Biology* and *Environmental Health Perspectives – National Institute of Environmental Health Sciences* have been determined to be the most highly in-linked EJs in the health field with 102,000, 30,200 and 22,400 in-links, respectively.

In the nursing field, there were only four free EJs and after calculating the maximum score for the core journals (263), and only the score of in-links of two journals were higher than the maximum score. These journals were the *Online Journal of Rural Nursing and Health Care* and the *Online Journal of Nursing Informatics*.

However, in the dentistry field, there were 14 free EJs and after the maximum score calculation using the core website formula, this number was reduced to two journals because only two obtained a score higher than the maximum score in this field (91,385). The journals were *BMC Oral Health* and *Brazilian Oral Research*.

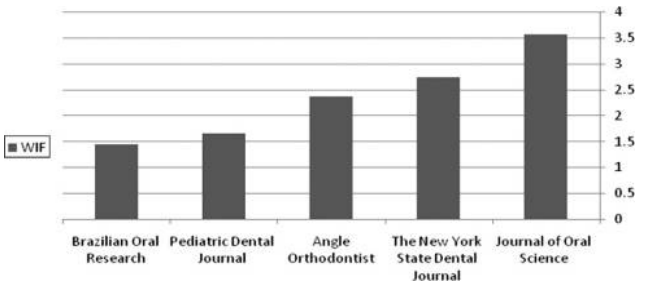

Figure 3.
Free EJs ranking in dentistry according to WIF

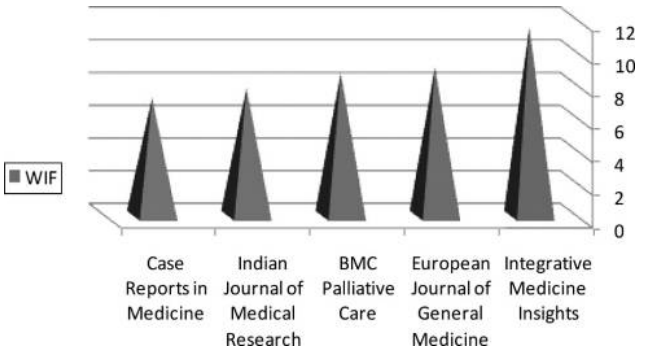

Figure 4.
Free EJs ranking in medicine according to WIF

Table V.
Core free EJs in health

Rank	Journal title	URL	In-links
1	*New South Wales Public Health Bulletin*	www.publish.csiro.au/nid/226.htm	102,000
2	*PLos Biology*	www.plosbiology.org/home.action	30,200
3	*Environmental Health Perspectives–National Institute Of Environmental Health Sciences*	ehp.niehs.nih.gov/	22,400
4	*International journal of environmental research and public health*	www.mdpi.com	18,900
5	*MMWR: Morbidity & Mortality Weekly Report*	www.cdc.gov/mmwr/	15,000
6	*Health and Quality of Life Outcomes*	www.hqlo.com/	9,210
7	*Iranian Journal of Public Health*	journals.tums.ac.ir/description.aspx?org_id=59&culture_var=en&journal_id=5&issue_id=1784&segment=en	7,630
8	*Iranian Journal of Environmental Health Science & Engineering*	journals.tums.ac.ir/description.aspx?org_id=59&culture_var=en&journal_id=13&issue_id=1781&segment=en	7,620
9	*Eurosurveillance*	www.eurosurveillance.org/	7,090
10	*International Journal of Health Geographics*	www.ij-healthgeographics.com/	6,610
11	*Australian Journal of Emergency Management*	www.ema.gov.au/	6,090
12	*Substance Abuse: Research and Treatment*	www.la-press.com/journal.php?journal_id=80&issue_id=106	6,060
13	*Bulletin of the World Health Organization: Bulletin de L'organisation mondiale de la santé*	www.who.int/bulletin	5,570
14	*The Internet journal of nutrition and wellness*	www.ispub.com/ostia/index.php?xmlFilePath=journals/ijnw/front.xml	5,100
14	*The Internet journal of healthcare administration*	www.ispub.com/ostia/index.php?xmlFilePath=journals/ijhca/front.xml	5,100
15	*The Internet Journal of Toxicology*	www.ispub.com/ostia/index.php?xmlFilePath=journals/ijto/front.xml	5,080
15	*The Internet Journal of Epidemiology*	www.ispub.com/ostia/index.php?xmlFilePath=journals/ije/front.xml	5,080
15	*The Internet Journal of Forensic Science*	www.ispub.com/ostia/index.php?xmlFilePath=journals/ijfs/front.xml	5,080
16	*Journal of Health, Population and Nutrition*	www.icddrb.org/publication.cfm?classificationID=30	5,000
17	*Biology Direct*	www.biology-direct.com/	4,630

Overall, 175 free EJs in medicine were surveyed and after implementing the core website formula for this field, the number 20,072 was obtained as the maximum score. Considering the number, the most highly in-linked journals are those of in-links higher than this number. These journals are provided in Table VI. As shown, *Brazilian Journal of Medical and Biological Research*, *Clinics* and *Sao Paulo Medical Journal* were considered as the highly in-linked journals with 593,000, 591,000 and 589,000 in-links respectively.

Conclusions

It is hoped that this research, as an addition to the webometrics literature, can help researchers and academics identify the most accredited free English EJs in medical sciences. The top-ranked free EJs in the medical sciences studied in the present study according to their in-links are as follows:

- *Health: New South Wales Public Health Bulletin*, *PLoS Biology* and *Environmental Health Perspectives – National Institute of Environmental Health Sciences*.
- *Nursing: Online Journal of Rural Nursing and Health Care*, *Online Journal of Nursing Informatics* and *BMC Nursing*.
- *Dentistry: BMC Oral Health*, *Brazilian Oral Research*, and *Journal of the Indian Society of Pedodontics and Preventive Dentistry*.
- *Medicine: Brazilian Journal of Medical and Biological Research*, *Clinics* and *Sao Paulo Medical Journal*.

Rank	Journal title	URL	In-links
1	*Brazilian Journal of Medical and Biological Research*	www.scielo.br/scielo.php?script=sci_serial&pid=0100-879X	593,000
2	*Clinics*	www.scielo.br/scielo.php?script=sci_serial&pid=1807-5932&lng=en&nrm=iso	591,000
3	*Sao Paulo Medical Journal*	www.scielo.br/scielo.php?script=sci_serial&pid=1516-3180&lng=en&nrm=iso	589,000
4	*Texas Heart Institute Journal*	www.pubmedcentral.nih.gov/tocrender.fcgi?journal=92&action=archive	422,000
5	*Journal of the Medical Library Association*	www.pubmedcentral.nih.gov/tocrender.fcgi?action=archive&journal=93	422,000
6	*Biological Research*	www.scielo.cl/scielo.php?script=sci_serial&pid=0716-9760&lng=en&nrm=iso	146,000
7	*African Health Sciences*	www.bioline.org.br/toc?id=hs	71,700
8	*PLoS Genetics*	www.plosgenetics.org/home Action	60,500
9	*PLoS Pathogens*	www.plospathogens.org/home Action	54,000
10	*Journal of Epidemiology*	www.jstage.jst.go.jp	47,800
11	*Critical care*	http://ccforum.com/	39,200
12	*Chinese Medical Journal*	www.cmj.org/	36,300
13	*Eubios Journal Of Asian And International Bioethics*	www.unescobkk.org/index.php?id=2434	26,900

Table VI. Core free EJs in medicine

Additionally, the top ranked free EJs in medical sciences according to WIF are:

- *Health: International Journal of Integrated Care*, *International Journal of Yoga* and *Australian Journal of Emergency Management*.
- *Nursing: BMC Nursing*.
- *Dentistry: The New York State Dental Journal* and *Angle Orthodontist*.
- *Medicine: Journal of Oral Science*, *The New York State Dental Journal* and *Angle Orthodontist*.

Altogether, the most accredited journals as the best performers are listed below:

- *Health: New South Wales Public Health Bulletin*, *PLoS Biology* and *Environmental Health Perspectives – National Institute of Environmental Health Sciences*.
- *Nursing: Online Journal of Rural Nursing and Health Care* and *Online Journal of Nursing Informatics*.
- *Dentistry: BMC Oral Health* and *Brazilian Oral Research*.
- *Medicine: Brazilian Journal of Medical and Biological Research*, *Clinics* and *Sao Paulo Medical Journal*.

As Fosmire and Yu (2000, p. ? [direct quote]) emphasized, "overall, it appears, that several high-quality, productive free scholarly electronic journals exist currently", this paper serves to re-emphasize that the number of free EJs in the web are increasing but only a few are high accredited. Thus, the results mentioned in this article can help researchers and academic authorities, particularly in medical universities, identify reliable free EJs. In addition, the journal ranking could steer the experts to use these resources more effectively and precisely, and identify the most accredited ones. It is suggested that the journals included in Medindia.net will be studied by future research as this lists open access journals in the medical field.

It should be noted that this study was limited in terms of using a selection of webometric applications to identify the core free EJs. Consequently, other applications, such as "website visibility assessment", "web page contents analysis", and so on, were not considered here, but could be of value for further studies. On the other hand, this was a machine or system-oriented investigation. Thus, as one of the webometric applications, "investigation of users' information seeking behaviour", from a user study perspective, can be used to study users' views concerning core EJs identified via the methodology of the present study. As for the future, it is also suggested that the framework of this research be applied for identifying the most accredited free electronic journals in other scholarly domains.

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