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Hypothetical influence of non-indexed Spanish journals on the impact factor of radiological journals

Alberto Miguel-Dasit[a], Rafael Aleixandre[b], Juan C. Valderrama[b], Luis Martí-Bonmatí[c,*], Pilar Sanfeliu[d]

[a] *MR Section, La Plana de Vila-Real Hospital, Castellón, Spain*
[b] *Institute of History of Science and Documentation Lopez Piñero, University of Valencia-CSIC, Valencia, Spain*
[c] *Department of Radiology, MR Section, Dr. Peset University Hospital, Avenida Gaspar Aguilar 90, E-46017 Valencia, Spain*
[d] *Cardenal Herrera-CEU University, Alfara, Valencia, Spain*

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Abstract

Objective: The aim of this study was to analyze the hypothetical changes in the 2001 impact factor of 52 radiological journals included in the Science Citation Index–Journal Citation Reports by also counting cites proceeding from 73 Spanish journals on different medical specialties. Also, to estimate the possible impact factor of the official Spanish radiology journal, *Radiología*, not included in this database.
Materials and methods: A modified 2001 impact factor of 52 radiological journals and *Radiología* was obtained by adding the number of cites in 1999 and 2000 from the medical Spanish journals. Data were obtained by consulting the 2001 edition of the *Journal Citation Reports* in the 'Web of Science' database.
Results: The 16,985 bibliographical references were analysed (232 of them to radiological journals). The journal with the largest increase in its 2001 impact factor (from 1.83 to 1.90) was *Radiologic Clinics of North America*. *European Journal of Radiology* was the European journal with the highest increase (from 1.084 to 1.110) in the difference between the 2001 modified and original impact factor. The modified 2001 impact factor of the 34 American journals was statistically higher ($P = 0.016$) than that of the 18 European journals (1.64 versus 0.93). Differences between the 2001 modified and original impact factor were slightly higher in the American journals (no statistically significant difference). The 2001 impact factor of *Radiología* was 0.056.
Discussion: Differences between the 2001 original and modified impact factor were small, but larger in the American journals. The 2001 impact factor of *Radiología* was modest, although similar to other publications included in the Journal Citation Reports.

Keywords: Impact factor; Science Citation Index; Journal Citation Reports; Spanish journals; Radiological journals

1. Introduction

The impact factor is a bibliometric indicator obtained from a database produced by the Institute for Scientific Information (ISI) in Philadelphia (United States), which continuously records scientific citations by the reference lists of articles from a large number of the world's scientific journals. The references are rearranged in the database to show how many times each publication has been cited within a certain period, and by whom, and the results are published annually in Science Citation Index–Journal Citation Reports (SCI–JCR), being widely regarded as a quality ranking and used extensively by leading journals in their advertising [1,2]. One of the limitations of this indicator is the preference of the SCI–JCR database for English language journals [3,4] that contributes to the low impact factor for the few non-English journals that are included [5].

A method that can evaluate this deficit of representation is to hypothetically complement the SCI–JCR with journals coming from countries that do not have a suitable represen-

* Corresponding author. Fax: +34 963862534.
E-mail address: marti_lui@gva.es (L. Martí-Bonmatí).

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tation, as is the case of Spain [6]. For this reason, our objective was to determine the 2001 modified impact factor of the radiological journals that appear in the annual information of the SCI–JCR, by including in the database the Spanish medical journals of greater scientific quality. A second objective was to determine the hypothetical 2001 impact factor of *Radiología*, the official Spanish radiological journal, and its theoretical position in the ranking of journals included in the SCI–JCR.

2. Materials and methods

A total of 87 Spanish medical journals included in the database *Índice Médico Español* (IME) or in international databases (*Medline, Excerpta Medica, Current Contents and Science Citation Index*) were selected. From these, 14 Spanish journals also included in the 2000 edition of the SCI–JCR were excluded because their cites have already been included in the ISI list corresponding to the years 1999 and 2000. Finally, 73 journals were evaluated (Table 1).

From these 73 Spanish journals, all the published citable articles in 2001 were included for analysis, with the exclusion of those papers that were not original articles, review articles or case reports. In these recorded citable papers, bibliographical references corresponding to 1999 and 2000 were identified for the estimation of the 2001 modified impact factor of radiological journals included in the SCI–JCR. All the references were introduced in a Microsoft Access database to facilitate the analysis.

The "Radiology, Nuclear Medicine and Medical Imaging" section of the 2001 JCR Science Edition included 81 journals. The number of cites received and published articles in these 81 journals were obtained from a Internet search in the *ISI Web of Knowledge* of the SCI–JCR, using the information server of the University of Valencia, Spain (http://go5.isiknowledge.com/portal.cgi). This section of the SCI–JCR includes several biomedical journals about radiology, nuclear medicine, radiotherapy, oncology, biology and biophysics, the aim of our study being to analyse only the radiological journals. An analysis of the bibliographical references included in the papers published between 1998 and 2003 in the Spanish journal *Radiología* was performed to record the international radiological journals cited. The results showed few references to nuclear medicine, radiotherapy and biophysics journals. Table 2 shows the journals excluded because their topic (attending to subject categories showed in the 2001 JCR Science Edition for each journal). Journals about the medical disciplines "radiotherapy" and "nuclear medicine" were excluded because in Spain they are independent disciplines according to the application of the Royal Order 127/1984 and the February 10 1988 Ministerial Order, as in other countries [7]. Therefore, 29 journals were excluded from the analysis and the 2001 modified impact factor was calculated with the 52 remaining journals.

The impact factor of a particular journal is mainly calculated by dividing the number of current year citations to the journal's articles that were published in the previous 2 years, by the total number of citable items (articles and reviews) published in the same 2-year period. The 2001 modified impact factor of the 52 radiological journals and the Spanish journal *Radiología* was estimated by adding, in the numerator, the number of cites from the papers published in 1999 and 2000 in the 73 Spanish medical journals analysed, the denominator remaining invariable. Finally, the 2001 modified impact factor and the published 2001 SCI–JCR impact factor were compared to establish differences between American with respect to European journals. The Student's *t*-test was used for the statistical analysis. A P-value < 0.05 was considered to be statistically significant.

3. Results

A total of 16,985 bibliographical references coming from 73 citing Spanish journals were analysed. Table 3 shows the annual distribution of cites from the 1999 to 2000 published papers by documentary types. There is a predominance of cites to journal articles (87.6%), followed by cites to book chapters and books (7.2%).

From the total number of cites, 232 (1.15%) were to the 52 selected radiological journals included in the SCI–JCR. Thirty-three of the radiological journals were from United States (64.1%), 6 from Germany (11.3%), 5 from Great Britain (9.4%), 2 from France (3.8%), 2 from Netherlands (3.8%), 2 from Italy (3.8%), 1 from Canada (1.9%) and 1 from Sweden (1.9%). Sixteen journals (8 American and 8 European) from the 52 analysed radiological journals did not receive any cite from the Spanish medical journals. Table 4 contains the data for the calculation of the 2001 original and modified impact factor considering the cites coming from the Spanish journals.

With respect to the 73 analysed Spanish journals, there were 36 (49.3%) that have been cited the selected radiological journals. Table 1 shows the thematic areas of these 36 Spanish biomedical journals. The journals with the highest number of cites (58.6% of the total cites) to SCI–JCR radiological journals were: *Radiologia* (84 cites), followed by *Neurología* (34 cites) and *Archivos Españoles de Urología* (18 cites).

The radiological journal with the highest number of cites received from the 73 Spanish journals in 1999 and 2000 was *Radiology*, with 47 cites, although the difference between their 2001 original and their 2001 modified impact factor (from 4.759 to 4.806, increased in 0.047 points) was lower than the journal *Radiologic Clinics of North America*. This journal, whit nine cites from Spanish journals, have a lower number of articles in the denominator (137 papers versus 1005 articles published in Radiology), and their modified impact factor raised from 1.832 to 1.898, increasing 0.066 points.

Table 1
Distribution of Spanish journals per thematic areas

Thematic areas	Spanish journals
Allergy, Immunology	Allergologia et immunopathología; Inmunología
Anesthesiology[a], Critical Care	Actualizaciones en Anestesiología y Reanimación; Revista de la Sociedad Española del Dolor; Revista Española de Anestesiología y Reanimación[a] (1); Medicina Intensiva; Enfermería Intensiva
Biology, Medical Microbiology[a]	Enfermedades Infecciosas y Microbiología Clínica[a] (1); Revista Iberoamericana de Micología; Revista de Diagnóstico Biológico
Cardiovascular Diseases[a]	Angiología[a] (7); Revista Latina de Cardiología[a] (3); Anales de Cirugía Cardíaca y Cirugía Vascular[a] (1)
Dermatology	Actas Dermo-Sifiliográficas; Fontilles. Revista de Leprología; Medicina Cutánea Ibero-Latino-Americana
Diagnostic Imaging[a]	Radiología[a] (84); Revista Española de Medicina Nuclear[a] (7)
Drug Theraphy, Pharmacology[a]	Atención Farmacéutica; Ciencia y Tecnología Pharmacéutica; Farmacia Hospitalaria[a] (1); Revista de Toxicología
Endocrinology[a], Nutrition[a], Reumatology[a]	Endocrinología y Nutrición[a] (1); Nutrición Clínica y Dietética Hospitalaria; Nutrición Hospitalaria; Revista Española de Enfermedades Metabólicas y Óseas[a] (3); Revista Española de Reumatología[a] (5)
Family Practice[a], Public Health	Anales del Sistema Sanitario de Navarra[a] (1); Atención Primaria; Enfermería Clínica; Gaceta Sanitaria; Investigación Clínica; Medifam. Revista Española de Medicina familiar y Comunitaria[a] (1); Revista Española de Salud Pública
Gastroenterology[a]	Gastroenterología y Hepatología[a] (9)
Geriatrics	Geriatrika. Revista Iberoamericana de Geriatría y Gerontología; Revista Española de Geriatría y Gerontología
Ginecology and Obstetrics[a]	Acta Ginecológica[a] (6); Ciencia Ginecológika[a] (3); Clínica e Investigación en Ginecología y Obstetricia[a] (2); Ginecología Clínica y Quirúrgica[a] (2); Progresos en Obstetricia y Ginecología[a] (8); Revista Iberoamericana de Fertilidad y Reproducción Humana; Toko-Ginecología Práctica
Internal Medicine[a]	Anales de Medicina Interna; Revista de Medicina de la Universidad de Navarra[a] (2).
Medical Oncology[a]	Oncología (Barcelona)[a] (2); Revisiones en Cáncer[a] (5); Revista de Oncología[a] (2); Revista Española de Quimioterapia
Neurology[a]	Neurología (Barcelona)[a] (34)
Orthopedics[a], Rehabilitation	Revista de Ortopedia y Traumatología[a] (1); Rehabilitación
Otolaringology[a], Ophthalmology	Acta Otorrinolaringológica Española[a] (2); ORL-DIPS[a] (1); Archivos de la Sociedad Española de Oftalmología
Pediatrics[a]	Acta Pediátrica Española[a] (4); Anales Españoles de Pediatría[a] (5); Pediatría Catalana[a] (4); Pediatrika[a] (1); Revista Española de Pediatría[a] (1); Cirugía Pediátrica
Psychiatry, Substance Dependence	Adicciones; Anales de Psiquiatría; Psiquis; Revista de Psiquiatría de la Facultad de Medicina de Barcelona; Revista Española de Drogodependencias
Pulmonary Disease[a]	Archivos de Bronconeumología[a] (1)
Urology[a]	Actas Urológicas españolas[a] (1); Archivos Españoles de Urología[a] (18)
Others	Archivos de la Medicina del Deporte[a] (2); Medicina Oral; SD. Revista Médica Internacional sobre el Síndrome de Down

[a] Journals (and their thematic areas) with one or more cites to SCI–JCR radiological journals (number of cites in parentheses).

Table 2
Journals included in the section "Radiology, Nuclear Medicine and Medical Imaging" of the JCR and excluded of the analysis because of their topic

Subject category (topic)	Journals excluded of the analysis
Chemistry, inorganic and nuclear science and technology	Applied Radiation and Isotopes
Clinical neurology	Brain Topography
Neurosciences	Human Brain Mapping
Biophysics, biology, miscellaneous, environmental sciences	Medical Physics; NMR in Biomedicine; International journal of Radiation Biology; Journal of Radiation Research; Radiation Protection and Dosimetry; Radiation and Environmental Biophysics; Radiation Research
Biochemical research methods, optics	Journal of Biomedical Optics
Engineering, biomedical	Physics in Medicine and Biology
Nuclear medicine	Annals of Nuclear Medicine; Clinical Nuclear Medicine; European Journal of Nuclear Medicine; Journal of Nuclear Cardiology; Journal of Nuclear Medicine; Nuclear Medicine and Biology; Nuclear Medicine Communications; Nuklearmedizin-Nuclear Medicine; Quarterly Journal of Nuclear Medicine; Seminars in Nuclear Medicine
Radiotherapy	Cancer Biotheraphy and Radiopharmaceuticals; International Journal of Hyperthermia; International Journal of Radiation Oncology; Radiation Oncology Investigations; Radiotherapy and Oncology; Seminars in Radiation Oncology; Strahlentherapie und Onkologie

Table 3
Distribution of the cites by documental types

Documental types	1999	2000	Total	Percentage
Journal articles	9526	6671	14884	87.64
Book chapters	397	273	618	3.64
Books	398	256	605	3.56
Abstracts from meetings	226	229	420	2.47
Doctoral thesis	24	19	35	0.20
Other[a]	258	312	423	2.49
Total	10829	7760	16985	100

[a] Includes cites to newspapers, courses, dissertations, web pages, guideness and memories.

The European journal with the largest number of cites (11 cites) was *European Radiology* (their 2001 impact factor increased in 0.015 points), although the journal *European Journal of Radiology* increased their impact factor from 1.084 to 1.110 (a difference of 0.026 points), being the European journal with the highest increase in the difference between the 2001 original and the 2001 modified impact factor.

The mean ± standard deviation (S.D.) of the original impact factor of the American journals was statistically higher ($P = 0.017$) than which of the European journals (1.62 ± 1.51 versus 0.92 ± 0.46). The mean ± S.D. of the modified impact factor was also statistically higher ($P = 0.016$) in the American journals in relation to the European journals (1.64 ± 1.51 versus 0.93 ± 0.46). Although differences between the modified and the original impact factor were slightly higher in the American with respect the European journals, no statistical differences were found ($P = 0.80$).

The Spanish journal *Radiología* received only three cites from the journals included in the 2001 edition of the SCI–JCR, whereas it obtained 10 cites from other Spanish journals. Since it published 230 citable articles in the 2-year period 1999–2000, its theoretical 2001 impact factor was estimated in 0.013, being 0.056 its theoretical 2001 modified impact factor (including the cites from the Spanish journals).

4. Discussion

At present, investigators try to gain prestige in the scientific world publishing their papers in the journals in which they can reach an ample diffusion and impact. Rankings of the most important journals of each discipline or scientific area is acquiring a growing importance in the evaluation of research output. This is needed for the academic promotion of the investigators and to acquire economic resources [8]. In order to obtain the necessary diffusion and impact, the investigators usually go to the lists of journals included in the SCI–JCR. With the advent of the Internet, this database have become widely available to individuals and institutions, and allows researchers to consult diverse bibliometric indicators, such as the impact factor, the immediacy index and the number of cites received by a paper in 1 year [1,9,10].

Nevertheless, there are several biases in the calculation of the impact factor: the choice of the citations is subjective and the non-pertinence of the citations is well known. Several variables may intervene, such as the type of journal and its size, domain concerned, language of the publication, self-citations, coding of the articles depending on their nature, and the choice of the manuscripts published ("hot papers") [10]. Therefore, indicators of citations as well as the impact factor obtained from the SCI–JCR indexes are object of numerous critics, mainly due to preference of this database for the English language journals.

In this respect, Anglo-American publishers countries and English language journals prevail in SCI–JCR with respect to numbers and impact factor levels. English publication language favours citation frequency. Moreover, of the more important international databases, SCI–JCR shows a maximum preference for English language sources, thereby causing an English language bias during impact factor derivation [11]. On the matter, the 2001 edition of the SCI–JCR included 2,220 journals from the United States and 1,171 from Great Britain, in contrast to non-Anglo-American countries (148 journals from France, 69 from Italy and 26 from Spain).

It is noteworthy that, of the 19 biomedical Spanish journals analysed in the 2000 edition of the JCR by Bordons et al. [12], the two journals with the highest impact factor (*International Journal of Developmental Biology* and *Histology and Histopathology*) are published exclusively in the English language. Moreover, in the present study the 13 European radiological journals non-edited in the Great Britain, from several countries (France, The Netherlands, Italy, Germany and Sweden) are published in English, besides the German journal *Rofo*, the French *Journal de Radiologie*, and the German *Radiologe* contains predominantly non-English publications.

The hypothetical 2001 impact factor of the Spanish journal *Radiología* is modest, being similar to the lowest of the SCI–JCR ranking, which corresponds to the journal *Critical Reviews in Diagnostic Imaging*. Nevertheless, it must be considered that, being outside the cover of the SCI–JCR, its diffusion between investigators who consult this source in its bibliographical searches is small.

Hypothetical impact factor in Spanish journals not included in the SCI–JCR have been previously studied [13–15]. These predicted indicator was calculated as 0.105 for *Archivos de Bronconeumología* for the 1997–2000 period [13]; 0.077 for *Anales Españoles de Pediatría* for the 1997–2001 period [14]; and 0.034 for *Revista Española de Anestesiologia y Reanimación* in the 2-year period 1997–1998 [15]. Therefore, the calculated impact factor of these three Spanish journals on different medical specialties was slightly highest [13,14] and even lower [15] than the 2001 impact factor of *Radiología* (0.056) in our study.

The inclusion of a journal in the SCI–JCR will surely increase its impact factor, as it has happened with some Spanish journals; e.g. the journal *Revista Española de Cardiología* changed its impact factor from 1999, when it was included in the SCI–JCR, from 0.46 [16] to 0.70 in 2000 [12].

Table 4
Modified impact factor (MIF) of radiological journals included in the JCR and *Radiología* Spanish journal

Radiological journal (ISO abbreviated journal title)	Country of edition	JCR cites (2000)	JCR cites (1999)	Spanish cites (1999)	Spanish cites (2000)	JCR articles (2000)	JCR articles (1999)	Impact Factor (IF)	Modified IF (MIF)	Difference MIF-IF
Abdom. Imaging	United States	78	138	2	2	126	126	0.857	0.873	0.016
Acad. Radiol.	United States	116	134	0	1	106	97	1.232	1.236	0.004
Acta Radiol.	Sweden	91	131	4	2	132	111	0.914	0.938	0.024
Am. J. Neuroradiol.	United States	476	915	18	7	304	317	2.240	2.280	0.040
Am. J. Roentgenol.	United States	1025	1510	21	21	611	658	1.998	2.031	0.033
Br. J. Radiol.	Great Britain	181	242	2	1	220	221	0.959	0.966	0.007
Can. Assoc. Radiol. J.	Canada	10	24	0	1	58	83	0.241	0.248	0.007
Cardiovasc. Interv. Radiol.	United States	58	127	3	0	100	104	0.907	0.922	0.015
Clin. Imaging	United States	4	40	2	0	71	69	0.314	0.329	0.015
Clin. Radiol.	Great Britain	161	235	0	4	197	177	1.059	1.069	0.010
Comput. Med. Imaging. Graph.	United States	20	41	0	0	46	43	0.685	0.685	0
Crit. Rev. Diagn. Imaging	United States	0	1	0	0	10	8	0.056	0.056	0
Dentomaxillofac. Radiol.	Great Britain	44	53	0	0	58	67	0.776	0.776	0
Eur. Radiol.	Germany	383	580	9	2	384	345	1.321	1.336	0.015
Eur. J. Radiol.	Germany	85	161	3	3	115	112	1.084	1.110	0.026
IEEE Trans. Med. Imaging	United States	204	459	0	0	112	99	3.142	3.142	0
Int. J. Card. Imaging	Netherlands	15	42	0	0	44	54	0.582	0.582	0
Int. J. Neuroradiol.	United States	0	10	1	0	0	42	0.238	0.262	0.024
Interv. Neuroradiol.	Italy	13	39	0	0	80	38	0.441	0.441	0
Invest. Radiol.	United States	297	181	2	0	96	112	2.298	2.308	0.010
J. Cardiov. Magn. Reson.	United States	26	65	0	1	31	23	1.685	1.704	0.019
J. Clin. Ultrasound	United States	56	123	3	2	89	91	0.994	1.022	0.028
J. Comput. Assist. Tomogr.	United States	165	339	4	4	174	213	1.302	1.323	0.021
J. Digit. Imaging	United States	58	97	0	0	92	92	0.842	0.842	0
J. Magn. Reson. Imaging	United States	329	818	3	0	222	254	2.410	2.416	0.006
J. Neuroimaging	United States	38	49	0	0	48	46	0.926	0.968	0.042
J. Neuroradiol.	France	9	44	0	0	41	47	0.602	0.625	0.023
J. Radiol.	France	36	59	4	2	158	147	0.311	0.331	0.020
J. Thorac. Imaging	United States	32	42	2	1	49	48	0.763	0.794	0.031
J. Ultrasound Med.	United States	122	205	1	6	129	131	1.258	1.285	0.027
J. Vasc. Interv. Radiol.	United States	327	466	0	0	180	181	2.197	2.197	0
Magn. Reson. Imaging	United States	207	461	4	1	153	175	2.037	2.052	0.015
Magn. Reson. Med.	United States	673	1331	0	1	265	318	3.437	3.439	0.002
Neuroimaging Clin. N. Am.	United States	19	69	0	0	45	47	0.957	0.957	0
Neuroimage	United States	886	1139	0	0	136	121	7.879	7.879	0
Neuroradiology	Germany	141	256	5	3	184	178	1.097	1.119	0.022
Pediatr. Radiol.	United States	86	188	1	5	182	184	0.749	0.765	0.016
Radiographics	United States	229	311	8	3	135	150	1.895	1.933	0.038
Radiología	Spain	3	0	3	7	102	128	–	0.056	–
Radiol. Clin. N. Am.	United States	114	137	5	4	74	63	1.832	1.898	0.066
Radiologe	Germany	50	123	3	0	151	143	0.588	0.598	0.010
Radiology	United States	1925	2858	30	17	501	504	4.759	4.806	0.047
Riv. Neuroradiol.	Italy	13	29	0	0	146	181	0.128	0.128	0
Rofo-Fortschr.	Germany	250	224	0	0	155	171	1.454	1.454	0
Semin. Roentgenology	United States	10	16	0	2	34	28	0.419	0.452	0.033
Semin. Ultrasound CT MRI	United States	32	42	2	1	33	36	1.072	1.116	0.044
Skeletal Radiol.	United States	70	136	1	2	128	122	0.824	0.836	0.012
Surg. Radiol. Anat.	United states	15	45	1	0	53	73	0.476	0.484	0.008
Ultraschall Med.	Germany	35	75	0	0	47	46	1.183	1.183	0
Ultrason. Imaging	United States	8	34	0	0	15	17	1.312	1.312	0
Ultrasonics	Netherlands	102	69	0	0	213	59	0.629	0.629	0
Ultrasound Med. Biol.	Great Britain	248	314	0	0	203	145	1.615	1.615	0
Ultrasound Obstet. Gynecol.	Great Britain	316	371	5	3	220	149	1.862	1.883	0.021

Furthermore, from the inclusion the journal benefits of their self-citation. Self-citation index in radiology journals has been previously studied [17,18], and contributes to increase the impact factor of the journals including in the SCI–JCR as opposed to non-included journals. It is noteworthy that attempts to force authors to self-citing are not well considered [19–21].

We have demonstrated that the inclusion of cites from a selection of Spanish medical journals in SCI–JCR indexed radiological journals produced a slight increase in their impact factor. An increase in the journal coverage with extension to other countries within the European Union will probably produced a higher increase of the European radiological journals' impact factor. Nevertheless, a limitation of our study is the difficulty of inclusion of a high sample of non-indexed journals from other European countries with the goal to analyse possible major changes in the modified impact factor of the European radiological journals included in the SCI–JCR, due to access limitations of the different databases and searching process. Future research should evaluate the influence of both European as well as other non-indexed worldwide journals in the impact factor of the radiological journals.

In summary, the differences between 2001 SCI–JCR impact factors and 2001 modified impact factors were small, but highest in the 34 American with respect the 18 European journals. Less than half of the Spanish journals, on several different medical specialties, have been cited the selected 52 radiological journals. Hypothetical 2001 impact factor of Spanish journal *Radiología* was modest, similar to the lowest of the ranking of the 81 journals included in the "Radiology, Nuclear Medicine and Medical Imaging" Section of the SCI–JCR.

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