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Bibliometric analysis of the scientific production in the area of Optometry☆

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ABSTRACT

Objective: Using a bibliometric approach an analysis was made of the scientific publications of Spanish investigators in the area of optometry, from 1974 until 2013.
Methods: The EMBASE database was used for this study, employing optomtr*, optic*, visual, vision, eye*, and ophthalm* as search terms. The most common bibliometric indicators were applied for the selected publications.
Results: The number of published articles retrieved for Spain from 1974 to 2013 was 1,055. The growth of publications was more exponential ($R = 0.93$) than linear ($R = 0.71$). The doubling time of scientific production was 3.63 years. The level of productivity primarily corresponded to small producers (transience index of 64%). The collaboration index was 4.4 authors per paper. The majority of the output was generated in academic settings (62.27%). The Bradford core was formed by four journals, in which *Optometry and Vision Science* accounted for the majority of publications, with 11.85%.
Conclusions: Research in the area of optometry in Spain is in a phase of exponential growth, containing a high level of transient authors, which may indicate either a low productivity or the presence of investigators from other related fields that have published in a sporadic manner in this area. A small number of research groups are responsible for producing the majority of articles, primarily in an academic setting. There is a high concentration of publications in a few journals.

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Análisis bibliométrico de la producción científica española en el área de la Optometría

Palabras clave:
Bibliometría
Optometría
Ciencias de la visión
España
Artículos publicados

RESUMEN

Objetivo: En el presente trabajo hemos analizado, desde un enfoque bibliométrico, las publicaciones científicas de los investigadores españoles en el área de la Optometría, desde que se tienen datos de publicaciones (1974) hasta el año 2013.

Método: Para realizar el estudio se utilizó la base de datos EMBASE, y se utilizaron los descriptores «optomtr*», «optic*», «visual», «vision», «eye*» y «ophthalm*». Sobre los documentos seleccionados, hemos aplicado los indicadores bibliométricos más usuales.

Resultados: El número de documentos recopilados para España en el periodo 1974-2013 fue de 1.055. El crecimiento de las publicaciones se adapta más a un ajuste exponencial (R = 0,93) que del lineal (R = 0,71). El tiempo de duplicación de la producción científica es de 3,63 años. El nivel de productividad corresponde mayoritariamente a pequeños productores (índice de transitoriedad del 64%). El índice de coautoría es de 4,4 firmas por artículo. La mayoría de producción se produce en el ámbito de la universidad, con el 62,27%. El núcleo de Bradford lo forman 4 revistas, siendo la que cuenta con mayor número de publicaciones *Optometry and Vision Science*, que aglutina el 11,85% de los artículos.

Conclusiones: La situación de la investigación en Optometría en España se encuentra en una fase de crecimiento exponencial, con un alto grado de autores ocasionales, que puede indicar una baja productividad o la presencia de investigadores de otras especialidades relacionadas, que de forma esporádica han publicado en esta área. Un pequeño grupo de equipos e investigación es responsable de una gran parte de las aportaciones, produciéndose la mayoría de la investigación en la universidad. Existe una alta concentración de publicaciones en un número reducido de revistas.

Introduction

At the meeting of the World Council of Optometry at Kyongju, Korea, on April 25, 1997, optometry was defined as "an independent health profession with a teaching and regulated system which is legislated and collegiate, dedicated to visual health, that comprises refraction and adaptation of visual aids, detection/diagnostic and management of ocular diseases and the rehabilitation of various anomalous visual system conditions".[1]

The development of optometry as a scientific discipline has been very different in each country. In Spain, the academic status of optometry has gone through a number of phases. The first official studies are from 1956, with the Spectacles Optic Diploma under the Scientific Investigation Council. In 1972, the Optics University school was established in the Complutense University of Madrid, which gave the degree of Graduate in Optics. In 1992 a new study plan was approved under the title of Graduate in Optics and Optometrics. These studies were short University careers. The last reform, which was required for adapting to the Bolonia plan, took place in 2007 under the title of Degree in Optics and Optometrics. These studies were full length university studies. This model was based on the United Kingdom model, which has the longest tradition in Europe and comprises the highest level optometry studies.

The academic changes that have taken place and the consolidation of the profession have enabled the evolution of this discipline, leading to increased scientific activity. As material and financial resources allocated to scientific research were restricted together with public expenditure restrictions mainly after 2009[2] due to the crisis, it is necessary to establish the most rational method for allocating funds for these purposes. To this end, scientific activity is being evaluated in order to identify research centers, groups and researchers who carry out the best and most productive work. One of the aims of said evaluation is to promote scientific quality.[3] In this regard, several authors have focused on this due to the high impact its results have on society,[4] to earmarking resources for investment in research[5] and the adequate allocation thereof.[6]

The results of scientific research are difficult to assess. Analysis methods should analyze various aspects of research capabilities. The parameters utilized for assessing any activity can be defined as "indicators". A set of indicators are applied to emphasize one aspect of the objects being evaluated.[6] At present, it would not be possible to understand scientific policy reviews without the utilization of existing indicators.

Bibliometry and its indicators focus on calculus and analysis of quantifiable values of scientific production and consumption.[7,8] It can be defined as the science that studies the nature and cause of a discipline and the publications derived from it by means of calculating and analyzing various aspects of written communication.[9] Bibliometry involves collecting, processing and managing quantitative ideographic

data obtained from scientific publications.[10] The Organization for Economic Cooperation and Development described bibliometry as a tool that enables the observation of the status of science and technology by means of the global production of scientific literature at a given specialization level.[11]

The authors have studied the evolution of scientific literature from a bibliometric viewpoint for psychiatry, neurology, gynecology, phytotherapy, which involve various disorders, and specific therapeutic techniques.[12–18] In the present study the authors analyze the evolution of Spanish scientific production in the area of optometry. Other objectives include studying the productivity of authors, their degree of cooperation and the most productive institutions, as well as identifying the journals selected for publications.

Material and method

The databases utilized in this bibliometric study comprise MEDLINE (Index Medicus, US National Library of Medicine, Bethesda, Maryland, USA) and Excerpta Medica (Elsevier Science Publishers, Amsterdam, Holland), regarded as the most comprehensive databases in biomedics, both included in the EMBASE Biomedical Answer web (Elsevier BV). Said database comprises over 25 million indexed records since 1947 obtained from articles, reviews, conferences, notes, letters and communications, and covers over 8400 biomedical journals of 90 countries.

By means of remote downloading techniques the authors selected documents containing the following descriptors in the author data (AD): España, Spain or Espana; in any field of the records the optometr* descriptor, and the following terms directly referred to the area of the study; visual, vision, eye* or ophthalm*; in the AD field: óptic*. In this manner it was possible to obtain the documents published in the period comprised between 1974 (first publications in Spanish) and 2013.

All original articles were included for the purposes of this study, omitting duplicated documents. In this regard, the utilized database enables the elimination of files which could be duplicated in each database (MEDLINE and EMBASE).

The bibliometric analysis included the following indicators: Price index, duplication time and annual growth rate, Lotka productivity level (PL), Price transience index, Bradford zones and c0-authorship index.

Price law[19] was chosen for production bibliometric indicators. This law is the most widely used indicator for analyzing the productivity of a specific discipline or a country to show a fundamental feature of scientific production, i.e., exponential growth.

Duplication time and annual growth rates are indicators related to growth. The former is the time in years that must elapse for a subject matter to duplicate its production, while the annual growth rate illustrates the percentage amount of growth compared to the previous year. The equation that calculates the duplication time (D) is illustrated by the following expression:

$$D = \frac{Ln2}{b}$$

In which b is the constant that relates the growth rate with the already acquired size of the discipline. For calculating the annual growth rate, the following equation is applied:

$$R = 100(e^{b} - 1)$$

Lotka enunciated the author distribution law on the basis of the number of published articles, also known as "quadratic inverse of scientific production".[20] Said author studied the volume of publication of authors and observed that there is a larger amount of authors who publish few articles than the amount that publish many.[21] Said law establishes that throughout the scientific community, the number (A) of authors who have published a given amount (n) of articles during a period of several years of activity, that is, $A(n)$ authors equals the amount of those who have published a single article, $A(1)$ in the same period, divided by the square of n. In mathematical terms, the original law is expressed with the following formula:

$$A(n) = \frac{A(1)}{n^2}$$

According to said index, authors are distributed in 3 levels of productivity, i.e., small producers who publish a single paper, mid-range producers who publish between 2 and 9 papers and large producers who publish 10 or more articles. The productivity index, also known as PL, is one of the fundamental indicators corresponding to the logarithm of the number of contributions made by an author.

It is also interesting to determine the number of authors with a single publication, known as the transience or Price index. This calculation is given as a percentage of the quotient of authors with a single publication among all authors. Mathematically, the expression is as follows:

$$IT = \frac{authors\ \ with\ \ a\ \ single\ \ publication}{All\ \ \ authors} * 100$$

The last indicator to be utilized is the dispersion index, the Bradford zones. Samuel C. Bradford evidenced the concentration of the largest percentage of pertinent citations in a subject matter in a small number of journals, and this entailed a rapid reduction of the performance of expanding the search of references beyond a reduced core.[22] The most usual manner of representing this law is by means of a semilogarithmic diagram representing the aggregate number of articles, $R(r)$, against the aggregate number of journals, r. In said diagram, the abscissa is the logarithm representing the aggregate number of journals, while the ordinate represents the aggregate number of articles. In this way, once the data are represented, it can be seen that the number of articles is divided in 3 parts having approximately the same size, one being the core and the other 2 the peripheral zones which correspond to the straight zone where it is possible to find in the posterior zone that the number of articles increases at a lower rate. This new curvature is known as the Gross inflection.[23] This model enables the identification of the journals with greater weight or use in a given field of scientific production.

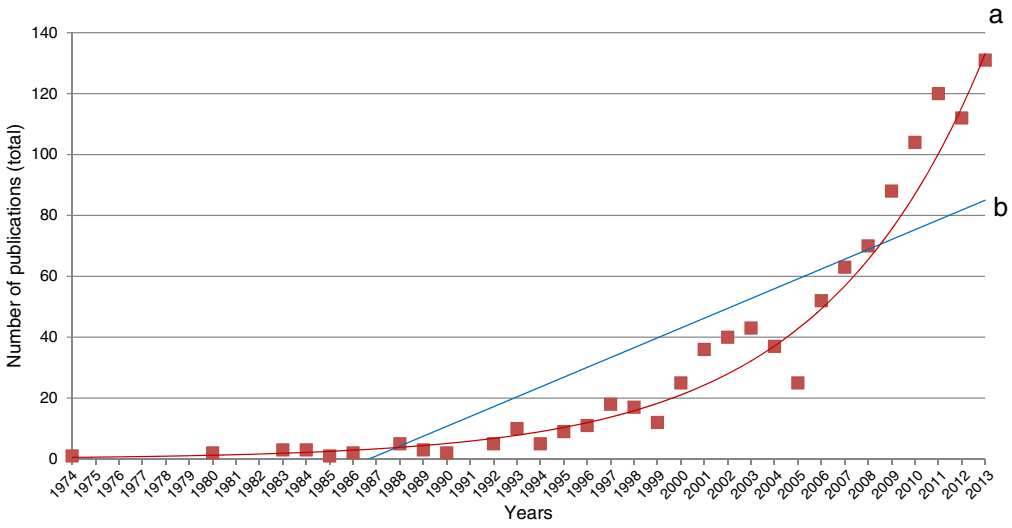

Fig. 1 – Chronological distribution of publications in Spain. (a) Exponential trendline. (b) Linear trendline.

Results

Applying the search criteria, the authors have recovered for the 1974–2013 period 1117 contributions (articles, reviews, letters to the editor, etc.). Manual screening excluded 62 results for not fulfilling inclusion criteria, an elimination of 5.55% of documents. In this way, the number of documents for study purposes was of 1055. The chronological distribution thereof can be appreciated in Fig. 1.

To determine whether the increase of scientific production follows Price's exponential growth law, the obtained data were linearly adjusted (Fig. 1) in accordance with the $y = 2.67x - 28.32$ equation, and another adjustment in the exponential curve in accordance with the $y = 0.0903e^{0.1923x}$ equation. According to this mathematical expression, the value of R^2 (determination coefficient) is higher for the exponential curve with a value of 0.93 that illustrates the quality of the representative power of the function against the linear function, which is of 0.71. Accordingly, it can be stated that optometry research in Spain is in the exponential growth stage. The mean annual growth rate for the entire period of the study is of 9.83%.

For calculating the duplication time, the dispersion graph represents the temporal production of contributions with the trendline (Fig. 2), adjusted to the equation $y = 0.8639e^{0.1906x}$, and a determination coefficient of 0.99. Said production covers 40 years. Applying the equation for calculating the duplication time, the result is 3.63 years.

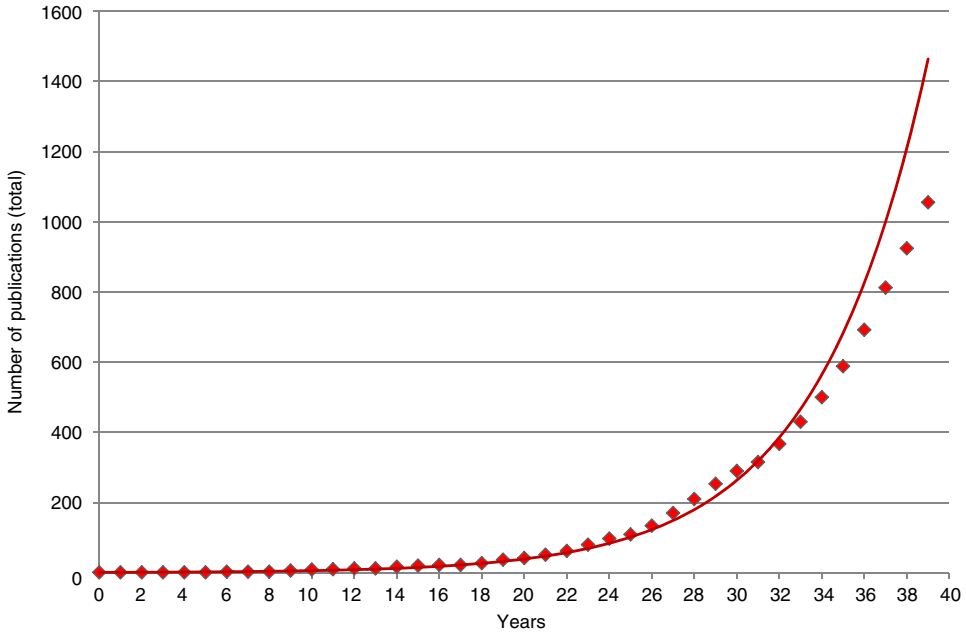

Fig. 2 – Temporal evolution of Spanish scientific production in optometry.

Table 1 – Productivity of Spanish authors.

Contributions	Spanish authors	Percentage of authors	Lotka PL (lg 10 n)	Aggregate of authors
1	1065	64.00%	0.000	1664
2	243	14.60%	0.301	599
3	100	6.01%	0.477	356
4	58	3.49%	0.602	256
5	40	2.40%	0.699	198
6	21	1.26%	0.778	158
7	26	1.56%	0.845	137
8	24	1.44%	0.903	111
9	13	0.78%	0.954	87
10	13	0.78%	1.000	74
11	7	0.42%	1.041	61
12	5	0.30%	1.079	54
13	2	0.12%	1.114	49
14	11	0.66%	1.146	47
16	4	0.24%	1.204	36
17	1	0.06%	1.230	32
18	5	0.30%	1.255	31
19	1	0.06%	1.279	26
20	1	0.06%	1.301	25
21	3	0.18%	1.322	24
22	1	0.06%	1.342	21
23	2	0.12%	1.362	20
24	1	0.06%	1.380	18
26	1	0.06%	1.415	17
27	1	0.06%	1.431	16
28	1	0.06%	1.447	15
31	1	0.06%	1.491	14
34	2	0.12%	1.531	13
39	1	0.06%	1.591	11
40	1	0.06%	1.602	10
46	1	0.06%	1.663	9
51	1	0.06%	1.708	8
66	1	0.06%	1.820	7
71	2	0.12%	1.851	6
78	2	0.12%	1.892	4
79	1	0.06%	1.898	2
128	1	0.06%	2.107	1

Table 2 – Classification of authors based on productivity.

Productivity index	Number of authors	Authors	Number of articles	Articles
PL = 0 (1 article)	1065	64.00%	1065	22.94%
0 < PL < 1 (2–9 Articles)	525	31.55%	1835	39.52%
PL ≥ 1 (10 or more articles)	74	4.45%	1743	37.54%
Total	1664		4643	

Table 1 shows the Lotka PL of authors. The most productive author comprises 128 contributions, that is 0.06% of all authors, whereas 1065 authors, i.e., 64%, contributed a single paper.

Table 2 classifies the authors in groups according to PL. The production index, that is authors that account for 50% of contributions, is of (9.13%). As observed, the largest group is made up of authors with a single publication (PL = 0), small producers, with 64%, whereas large producers (PL ≥ 1) with over 10 published papers account for the smaller group with 4.45%. Accordingly, Price's transience index, that corresponds to occasional authors who have only produced one paper, is of 64.

A logarithmic graph is utilized to represent the number of authors and their published papers (Fig. 3).

The 1055 articles in the study correspond to 1664 authors with 4663 signatures, a mean of 4.4 signatures per document (coauthorship index). The details are shown in Table 3.

The distribution based on institutions corresponds mostly to universities, as shown in Fig. 4. The category "Others" includes institutions that are difficult to classify such as private clinics, independent authors, etc.

The overall number of journals in which Spanish researchers have published articles is of 157. Table 4 details the division per Bradford zones. The mean number of articles per area is of 351.66. The multiplication factor is also shown.

The graphic distribution of Bradford for all journals is shown in Fig. 5. It must be considered that it is a semi-logarithmic diagram showing the aggregate number of

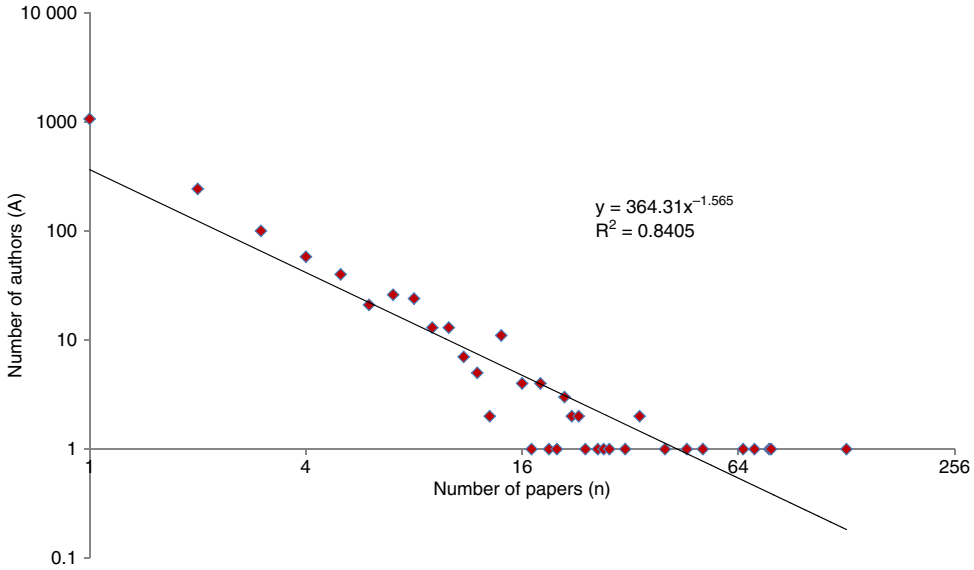

Fig. 3 – Number of publications by Spanish authors.

Table 3 – Number of signing authors per document.

Number of signing authors	Number of documents	Aggregate	Documents
42	1	42	0.09%
24	1	24	0.09%
21	1	21	0.09%
15	1	15	0.09%
13	2	26	0.19%
12	2	24	0.19%
11	6	66	0.57%
10	3	30	0.28%
9	12	108	1.14%
8	14	112	1.33%
7	53	371	5.02%
6	109	654	10.33%
5	257	1285	24.36%
4	256	1024	24.27%
3	195	585	18.48%
2	117	234	11.09%
1	25	25	2.37%
Total	1055	4646	100.00%

articles against the aggregate number of journals (r). The straight zone has been considered for $r = 5$, adjusted to the $y = 214.95\ln(x) + 110.11$ equation with a high value of the determination coefficient (0.9967), demonstrating the quality of the function. The Gross inflection is observed for $r = 49$.

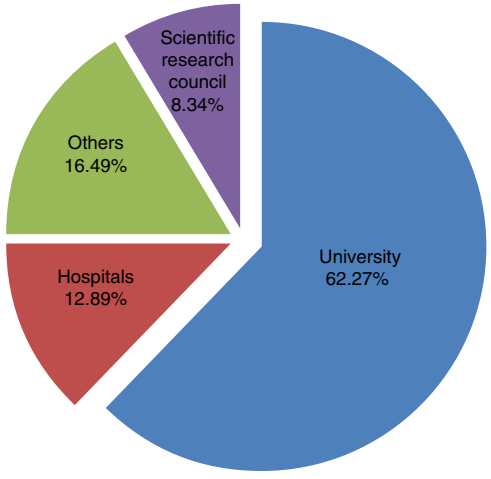

Fig. 4 – Distribution per institution.

Table 5 shows the core of journals as well as the abbreviated name and country of origin. As can be seen 3 out of 4 are published in the United States and one in the United Kingdom, with *Optometry and Vision Science* concentrating the highest number of contributions.

Fig. 6 clearly shows that articles are the publication format of choice in this area of research.

Table 4 – Distribution of journals in Bradford zones.

Zones	No. of journals	% of journals	No. of articles	% of articles	Bradford multiplier
Core	4	2.55	383	36.30	
Zone 1	14	8.92	350	33.18	3.5
Zone 2	139	88.54	322	30.52	10
Total	157	100	1055	100	6.75

Table 5 – Main journals within the Bradford distribution core zone.

Journal	Publications	Percentage	FI	Abbreviated name	Country of origin
Optometry and Vision Science	125	11.85	2.038	Optom Vis Sci.	United States
Ophthalmic and Physiological Optics	98	9.29	2.664	Ophthalmic Physiol Opt.	United Kingdom
Journal of Cataract and Refractive Surgery	90	8.53	2.552	J Cataract Refractive Surg.	United States
Journal of Refractive Surgery	70	6.64	2.781	J Refractive Surg.	United States

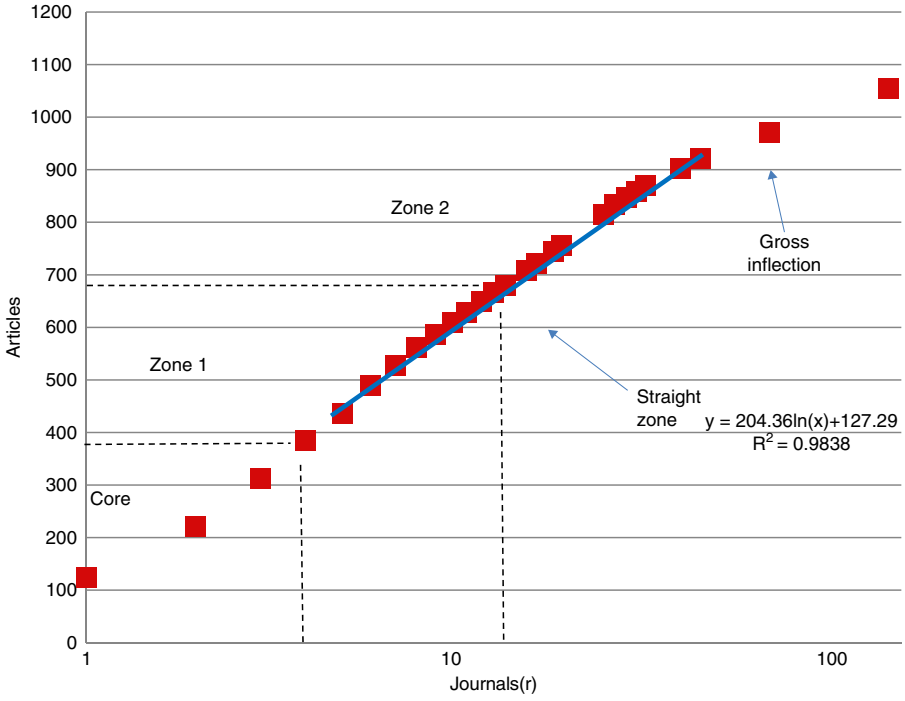

Fig. 5 – Bradford distribution, global data.

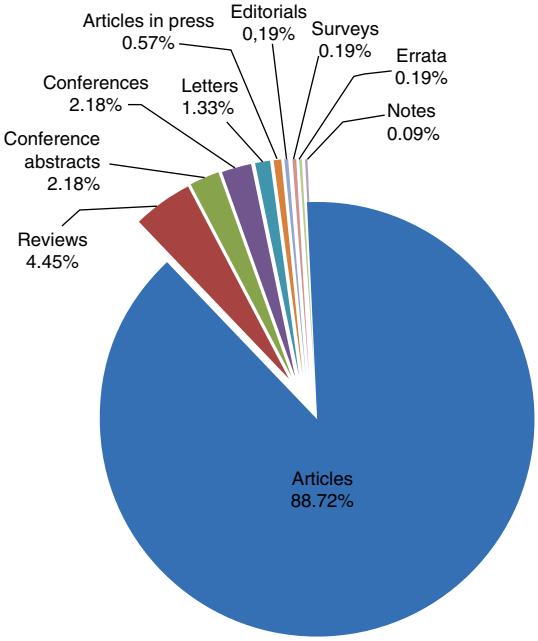

Fig. 6 – Typology of contributions.

Discussion

Despite the typical limitations of bibliometric studies,[24,25] said indicators have become an essential tool for evaluating the results of scientific activity by providing an overall view of growth, size and distribution of scientific literature related to a discipline. The fact of being a reliable and universal method for measuring the productivity of a sector has increased its demand in countries with significant scientific development.[26]

Taking all these precedents into account, the design of the present study enables an assessment of some aspects of Spanish optometry research. One of the strong points of this analysis is the utilization of a very comprehensive database, which minimizes the methodological limitations derived from the analysis of records and enables the best utilization of bibliometric indicators, reducing the relativity of data as much as possible.[27,28]

The first relevant data observed was that scientific literature has exhibited a positive evolution in Spain. In fact, said growth has been exponential as can be seen in the mathematical adjustment of the trend curve of Fig. 1 but without reaching

the saturation point described by Price.[19] This evolution could be due to academic changes because, as some authors have pointed out, the growth of optometric practice is a consequence of increased training quality.[29] This increase has increased in momentum as of 2006, with an average increase of 26.23%. The number of contributions for the 2004–2013 period has multiplied almost 4 times (exactly 3.6 times), going from 209 to 1055. This demonstrates the growth of this scientific field and a positive outlook for the future. Overall, Spain has exhibited an unprecedented increase of research in the past 25 years,[30] reaching in 2007 the 9th position in worldwide production.[31] Likewise, a similar increase has taken place in biomedicine and health-related sciences[32–35] with an increase of 8.9%,[36] which indicates a positive evolution of optometry vis-à-vis other areas.

Bibliometric productivity indicators can be utilized for characterizing the scientific production of specialized periodical publications[37] made by professional groups[38] or areas of research.[39] In this case, said indicators have been utilized for analyzing the production habits of Spanish authors with the results that most authors are occasional publishers as demonstrated by the high transience rate (64%). This can be interpreted as low productivity or as indicating the presence of researchers of other related specialties which have sporadically published in this field. However, comparing said indicators with other biomedical studies in Spain, the rate is lower, in the area of 80% depending on different studies.[39–42] The fact that only 4.45% of authors considered as large producers account for 37.54% of articles means that a large part of scientific production originates from a small number of research groups.

The amount of cooperation, i.e., papers signed by more than one author, is of 99.62%. This demonstrates a high degree of cooperation between researchers. Collaboration between authors is an indicator that demonstrates the importance of teamwork, with a trend toward an increase in the number of authors in experimental sciences due to the fact that research is increasingly expensive, complex and specialized.[43] The mean value obtained for this index is 4.4, slightly lower than that indicated by Spanish authors in other biomedical disciplines, which is in the area of 5.[44–47]

The majority of professionals in Spain work in the private area, which means that their research activity is very limited. In fact, a significant percentage of research takes place in the framework of universities, which account for 62.27% of production, a similar percentage found in other biomedical domains.[48]

In what concerns the journals selected for publishing documents, this study has verified that 4 journals concentrate 36.30% of contributions. This demonstrates a high rate of concentration of articles published by a small amount of journals. On the other hand, *Optometry and Vision Science* (the official publication of the American Academy of Optometry) gathers the largest amount of contributions (125 articles) accounting for 11.85% of all publications. The choice of publishing in said journal corresponds to the indications made by other authors.[49]

The type of document utilized by authors is mostly original articles, which account for nearly 90% of all publications, indicating that the subject matter is experimental or clinical research.

The authors point out that the results of the present study should be adequately interpreted, considering the limitations inherent to its bibliometric nature.[50] First, not all the optometry publications in Spain have been included since the search was restricted to those included in the EMBASE database. The criteria established by said databases determine the development of study materials.[26,51] The publications in national or local journalists that are not included in MEDLINE and Excerpta Medica were excluded, together with contributions in scientific meetings.

Despite the limitations of the above-mentioned studies, bibliometric studies are useful for assessing the social and scientific pertinence of a given discipline or field.[52] Said studies constitute an efficient supplement for the opinions and judgments of the experts in each field, providing useful and objective tools for assessing the results of scientific activity, offering a more realistic image and indication about tendencies as well as predicting the potential evolution thereof.

Taking into account the limitations and strengths described above and utilizing the most widely used international bibliometric indicators, the authors have been able to provide an image of the representativeness and evolution of international research on optometry in Spain. The present study aims at confirming that optometry research in Spain is at present at a very good level, featuring positive evolution in the path for decades, similarly to the evolution observed in other fields of biomedical research.

The originality of the present study is that there is no previously published research on the subject. Accordingly, this analysis is useful for comparing its results with future studies to verify whether recent academic changes in Spain (Degree in Optics and Optometry) provide the necessary drive for consolidating research activities.

Conflict of interests

No conflict of interests has been declared by the authors.

REFERENCES

1. Eleventh Asia-Pacific Optometric Congress. 1997; Kyoungju, Korea. Available from: http://www.worldoptometry.org/filemanager/root/site_assets/governance_documents/global_competencies_model.pdf [accessed 08.01.14].
2. Pain E. Research cuts will cause “exodus” from Spain. Science. 2012;336:139–40.
3. Van Raan AFJ. Advance bibliometric methods as quantitative core of peer review based evaluation and foresight exercises; 1996. p. 397–420.
4. Moravcsik MJ. ¿Como evaluar a la ciencia y a los científicos? Rev Esp Doc Cient. 1989;12:313–25.
5. Sanz Menéndez L, Castells M. Presente y perspectivas de la investigación en los organismos públicos de investigación en España, con especial referencia al CSIC. Arbor. 1991;546:75–87.
6. Sancho R. Indicadores bibliométricos utilizados en la evaluación de la ciencia y la tecnología. Rev Esp Doc Cient. 1990;13:842–65.

7. Spina KE. Diccionario enciclopédico de Bibliometría, Cienciometría e Informetría. Caracas: Unesco; 1996.
8. Lopez Piñero JM, Terrada ML. Los indicadores bibliométricos y la evaluación de la actividad médicocientífica (III). Los indicadores de producción, circulación y dispersión, consumo de la información y repercusión. Med Clin (Barc). 1996;98:142–8.
9. Pritchard A. Statistical bibliograhy on bibliometrics. J Doc. 1969;4:348–9.
10. Moed HF, Burger WJM, Frankfort JG, Van Raan AFJ. A comparative study of bibliometric past performance analysis and judgement. Scienciometrics. 1985:149–59.
11. Okubo Y. Bibliometric indicators and analysis of research systems: methods and examples. París: OECD Publishing; 1997. p. 8.
12. López-Muñoz, Rubio G. La producción científica española en psiquiatría: estudio bibliométrico de las publicaciones de circulación internacional durante el periodo 1980–1993. An Psiquiatr. 1995;11:68–75.
13. López-Muñoz F, Marín F, Boya J. Evaluación bibliométrica de la producción científica española en neurociencia. Análisis de las publicaciones de difusión internacional durante el periodo 1984–1993. Rev Neurol. 1996;24:417–26.
14. López-Muñoz F, Álamo C, Rubio G, García-García P, Martin Ageda B, Cuenca E. Bibliometric analysis of biomedical publications on SSRIs during the period 1980–2000. Depress Anxiety. 2003;18:95–103.
15. López-Muñoz F, Vieta E, Rubio G, García-García P, Álamo G. Bipolar disorder as an emerging pathology in the scientific literature: a bibliometric approach. J Affect Disord. 2006;92:161–70.
16. López-Muñoz F, Álamo C, Quintero-Gutiérrez FJ, García-García P. A bibliometric study of international scientific productivity in attention-deficit hyperactivity disorder covering the period 1980–2005. Eur Child Adolesc Pyschiatry. 2008;17:381–91.
17. López-Muñoz F, García-García P, Saiz-Ruiz J, Mezzich JE, Rubio G, Vieta E, et al. A bibliometric study of the use of the classification and diagnostic systems in psychiatry over the last 25 years. Psychopathology. 2008;11:214–25.
18. López-Muñoz F, She W, Shinfuku N, Pae CV, Castle DL, Chung AK, et al. A bibliometric study on second-generation antipsychotic drugs in the Asia-Pacific. Region. 2014;6:111–7.
19. Price DJS. Little science, big science. New York: Columbia University Press; 1963.
20. Lotka AJ. The frequency distribution of scientific productivity. J Wash Acad Sci. 1926;12:317–23.
21. Pérez Andrés C, Estrada Lorenzo JM, Villar Álvarez F, Rebollo Rodríguez MJ. Estudio bibliométrico de los artículos originales de la Revista Española de Salud Pública (1991–2000). Parte primera: indicadores generales. Rev Esp Salud Pública. 2002;76:659–72.
22. Bradford SC. Sources of informations on specific subjects. Engineering. 1934;137:85–6.
23. Gross OV. Bradford's law and the Keenam-Atherton data. Am Doc. 1967;18:46.
24. King JA. A review of bibliometric and other science indicators and their role in research evaluation. J Inf Sci. 1987;13: 261–76.
25. Nigel Gilbert G. Measuring the growth of science. A review of indicators of scientific growth. Scientometrics. 1978;1:9–34.
26. Bordons M, Zulueta MA. Evaluación de la actividad científica a través de indicadores bibliométricos. Rev Esp Cardiol. 1999;52:790–800.
27. López Piñero JM, Terrada ML. Los indicadores bibliométricos y la evaluación de la actividad médicocientífica (III). Los indicadores de producción, circulación y dispersión, consumo de la información y repercusión. Med Clin (Barc). 1996;98:142–8.
28. López Piñero JM, Terrada ML. Los indicadores bibliométricos y la evaluación de la actividad médico-científica. IV. La aplicación de los indicadores. Med Clin (Barc). 1992;98:384–8.
29. Badwin WR. An international perspective on optometric education. Optom Vis Sci. 1993;70:634–6.
30. Jiménez Contreras E, de Moya Anegón F, Delgado López-Cózar E. The evolution of research activity in Spain. The impact of the National Commission for the evaluation of research activity (CNEAI). Res Policy. 2003;32:123–42.
31. López Cózar E, Jiménez Contreras E, Ruiz Pérez R. España y los grandes de la ciencia mundial en cifras (1992–2008). Reflexiones a partir de la última actualización de ScienceWactch. El Profesional de la Información. 2009;18:81–6.
32. Camí J, Fernández MT, Gómez Caridad I. La producción científica española en biomedicina y salud. Un estudio a través del Science Citation Index (1986–1989). Med Clin (Barc). 1993;101:721–31.
33. Camí J, Zulueta MA, Fernández MT, Gómez I. Producción científica española en biomedicina y ciencias de la salud durante el periodo 1990–1993 (Science Citation Index y Social Science Citation Index) y comparación con el periodo 1986–1989. Med Clin (Barc). 1997;109:487–96.
34. Camí J, Suñen Pinyol E, Méndez Vásquez RL. Mapa bibliométrico de España 1994–2002: biomedicina y ciencias de la salud. Med Clin (Barc). 2005;124:93–101.
35. Camí J, Méndez Vásquez RL, Suñén Pinyol E. Evolucion de la productividad científica de España en Biomedicina (1981–2006). Redes. 2008;10:24–9.
36. Méndez Vázquez R, Suñén Pinyol E, Cervello R, Cami J. Mapa bibliométrico de España 1996–2004: biomedicina y ciencias de la salud. Med Clin (Barc). 2008;130:246–53.
37. López Cózar ED, Ruiz Pérez R, Jiménez Contreras E. Calidad editorial, difusión e indicadores bibliométricos. Rev Esp Enferm Dig. 1999;91:1–32.
38. Simó Miñana J, Gaztambide Ganuza M, Latour Pérez J. Producción científica de los profesionales españoles de atención primaria (1990–1997). Un análisis bibliométrico a partir de Medline. Aten Primaria. 1999;23:14–28.
39. Álvarez Solar M, López González ML, Cueto Espinar A. Indicadores bibliométricos, análisis temático y metodológico de la investigación publicada en España sobre epidemiología y salud pública (1988–1992). Med Clin (Barc). 1998;111:529–35.
40. López Muñoz F, Marín F, Boya J. Evaluación bibliométrica de la producción científica española en Neurociencia. Análisis de las publicaciones de difusión internacional durante el periodo 1984–1993. Rev Neurol. 1996;24:417–26.
41. Álvarez Solar M, López González ML, Cueto Espinar A. Indicadores bibliométricos de la investigación en atención primaria (1988–1992). Aten Primaria. 1996;18:229–36.
42. Estrada Lorenzo JM, Villar Álvarez F, Pérez Andrés C, Rebollo Rodríguez MJ. Estudio bibliométrico de los artículos originales de la Revista Española de Salud Pública (1991–2000). Parte segunda: productividad de los autores y procedencia institucional y geográfica. Rev Esp Salud Publica. 2003;77:333–46.
43. Lopez Piñero JM, Terrada ML. Los indicadores bibliométricos y la evaluación de la actividad médico-científica. Usos y abusos de la bibliométria. Med Clin (Barc). 1992;98:64–8.
44. Camp D. Estudio bibliométrico general de colaboración y consumo de la información en artículos originales de la revista Universitas Medica, periodo 2002 a 2006. Univ Med. 2007;48:358–65.
45. García García P, López Muñoz F, Callejo J, Martín Águeda B, Álamo C. Evolution of Spanish scientific production in international obstetrics and gynecology journals during the period 1986–2002. Eur J Obstet Gyn R B. 2005;123:150–6.
46. Bojo Canales C, Carabaotes D, Veiga de Cabo J, Martínez Hernández D. Análisis bibliométrico de la Revista Española

de Quimioterapia (1996–2002). Rev Esp Quimioterap. 2004;17:161–8.
47. Fernández Baena M, García Pérez AM. Estudio bibliométrico de los artículos publicados en la Revista Española de Anestesiología y Reanimación en el periodo 1996–2001. Rev Esp Anestiol Reanim. 2003;50:4–12.
48. Labarta González-Vallarino AA. Actividad científica española en el área de la Podología: estudio bibliométrico. Madrid: Departamento de Medicina Preventiva y Salud Pública, Universidad Complutense; 2011.
49. Gross DA. Citation patterns in the optometric and ophthalmologic clinical binocular visión literature. Optom Vis Sci. 2006;83:895–902.
50. Johson M, Cohen J, Grudzinakas G. The uses and abuses of bibliometrics. Rep BioMed Online. 2012;24:485–6.
51. Gómez I, Bordons M. The uses and abuses of bibliometrics. Polit Cient. 1996;46:21–6.
52. White H, McCain K. Bibliometric. Ann Rev Inf Sci Technol. 1989;24:119–86.