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ORIGINAL

Scientometrics in Argentina from an analysis of scientific production: Who does it?

Cienciometría en Argentina desde un análisis de la producción científica. ¿Quién la hace?

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ABSTRACT

Introduction: in Argentina, bibliometrics and scientometrics have become crucial for evaluating scientific research. These disciplines use indicators and statistical tools to measure scientific production, identify trends and collaborations, and guide academic management. Despite their value, limitations and biases are recognized, emphasizing the need for ethical use.
Method: this bibliometric study analyzes the scientific production of authors affiliated to Argentine institutions in the field of bibliometrics and scientometrics using the Scopus database, covering a period from 2013 to 2022.
Results: we found 271 articles with 1175 authors, with an average of 4,33 authors per article and a total of 2995 citations. The most represented areas were social sciences (35,8 %), medicine (17,3 %), and computer science (15,9 %). International collaboration was common, with a positive impact on the number of citations. The University of Buenos Aires led the production, and a decrease in citations per article was observed, possibly related to the defunding of science in the region.
Conclusion: despite the reduction in the number of citations per publication, the impact of citations weighted by field has increased in the field of scientometrics in Argentina, especially in public universities. Although a collaborative network has not been confirmed, it stands out that social sciences is the most represented discipline and the most productive researchers belong to this field, highlighting the need to foster collaboration to boost scientometrics research in the country.

Keywords: Bibliometrics; Scientometrics; Bibliometric Analysis; Scientific Production Indicators; Argentine Authors; Argentina.

RESUMEN

Introducción: en Argentina, la bibliometría y la cienciometría se ha ganado importancia para evaluar la investigación científica. Estas disciplinas emplean indicadores y herramientas estadísticas para medir la producción científica, identificar tendencias y colaboraciones, y guiar la gestión académica. A pesar de su valor, se reconocen limitaciones y sesgos, enfatizando la necesidad de un uso ético.
Método: en este estudio bibliométrico se analiza la producción científica de autores afiliados a instituciones argentinas en el campo de la bibliometría y cienciometría utilizando la base de datos Scopus, abarcando el período de 2013 a 2022.

Resultados: se encontraron 271 artículos con 1175 autores, con un promedio de 4,33 autores por artículo y un total de 2995 citas. Las áreas más representadas fueron ciencias sociales (35,8 %), medicina (17,3 %), y ciencias de la computación (15,9 %). La colaboración internacional fue común, con un impacto positivo en el número de citas. La Universidad de Buenos Aires lideró la producción; y se observó una disminución en las citas por artículo, posiblemente relacionada con el desfinanciamiento de la ciencia en la región.
Conclusión: a pesar de la reducción en el número de citas por publicación, el impacto de las citas ponderadas por campo ha aumentado en el ámbito de la cienciometría en Argentina, especialmente en universidades públicas. Aunque no se ha confirmado una red de colaboración, destaca que las ciencias sociales son la disciplina más representada y los investigadores más productivos pertenecen a este campo, resaltando la necesidad de fomentar la colaboración para impulsar la investigación en cienciometría en el país.

Palabras clave: Bibliometría; Cienciometría; Análisis Bibliométrico; Indicadores de Producción Científica; Autores Argentinos; Argentina.

INTRODUCTION

Bibliometrics has become a fundamental field of research that evaluates science's quality, impact, and development in different areas of knowledge. It is responsible for measuring and analyzing scientific production through tools that quantify visibility, collaboration, authorship, etc. This type of study has gained relevance in the last decade, driven by the desire to understand and improve scientific production and seek to understand what is being researched from a holistic view.[1]

This discipline is responsible for applying statistical techniques to the study of the production, dissemination, and use of scientific and technical information to measure and evaluate scientific and academic activity and identify patterns and trends. [2,3,4,5]

It is known that the need to measure and evaluate scientific production has become imperative in the world. Bibliometric and scientometric indicators have become tools to measure the influence and impact of research. It is now almost impossible not to talk about the h-index or the impact factor of journals as a measure of the quality of science.[6]

Other terms, such as scientometrics, infometrics, or bibliotecometrics, are often used, but bibliometrics is widely used to define this discipline. It should be noted, however, that scientometrics is different from bibliometrics or even altmetrics.[7]

The almost exponential growth of available scientific information makes it necessary to evaluate and develop new ways of processing it. The advances in science and the digitization of information have conditioned the appearance of new ways of analyzing this information for bibliometric purposes. All this results in identifying trends to support decision-making in scientific and academic management through the evaluation of production, identification of such trends, impact assessment, management and international collaboration, and management of public policies, among others.[8]

In bibliometrics and scientometrics, several databases provide scientific and academic information for analysis. Each database has different characteristics suitable for different bibliometric analyses, but they have common features that include coverage of sources, thematic breadth, available indicators, user-friendly interface and functionality, etc. Scopus is widely used and respected in academic and scientific research. It has wide coverage and is internationally inclusive.[9,10,11]

Once the information is available, various techniques and methods are used to analyze and measure different aspects of scientific activity, such as citation analysis, analysis of co-authors and scientific networks, keyword analysis, collaboration, and the application of mathematical models or algorithms. Combining these models and techniques provides a complete view of scientific production and its impact. This information is then useful for scientific decision-making.[12]

Although bibliometric indicators are widely used, it should be recognized that they have limitations that have been the subject of fierce debate.[13] Some of these recognized limitations are biased towards certain disciplines (towards the most cited disciplines such as the natural sciences), lack of qualitative context, self-citations, citation inflation delay in indexing, the crisis of reproducibility of science, manipulation, and geographical inequalities. Despite these, these indicators remain a valuable tool but should be taken with caution when interpreting the results in order to consider them as a complement to a more qualitative approach to evaluation.[14]

Ethical implications for using metrics and accountability in reporting results are raised. Limitations and biases must be recognized and addressed in interpreting the results presented.[15,16]

As a partial conclusion, bibliometrics is a powerful tool supporting evidence-based scientific and political decision-making. However, it should be used responsibly, considering quantitative science analysis's ethical implications and limitations. The proper use of it promotes policies and strategies that drive the advancement

of scientific research for the benefit of society.

This article aims to review Argentine scientific production in bibliometrics and scientometrics. It will explore Argentine researchers' trends, advances, and contributions in quantitative science analysis and how this relates to their position in the world scientific community. To this end, a systematic analysis of the relevant scientific literature will be carried out, identifying the main research areas and the leading names in the field.

Bibliometric assessment can provide valuable information on the strengths and weaknesses of research in Argentina, allowing institutions and science policymakers to identify areas for improvement and promote inter-institutional collaboration.

This research aims to observe and describe the landscape of bibliometric research in Argentina based on the study of publications produced in the country from 2013 to 2022.

It is worth mentioning as a precedent to this study, which Miguel and Dimitri developed in 2013 on who conducts bibliometric studies in Argentina.[17]

METHOD

This paper uses the bibliometric method and conducts a quantitative study of the publications of authors affiliated with Argentine institutions in bibliometrics or scientometrics. The Scopus database was consulted for data collection. The search expression *"ALL (bibliometrics OR scientometrics) AND AFFILCOUNTRY(Argentina)"* was used.

The data analysis included the evaluation of the volume and evolution of production in 2013-2022. All documents were included regardless of language and typology. All the articles found were included for a total of 271.

All the articles were exported, and a dataset was created and analyzed using SciVal. The variables analyzed were research areas (according to the *All Science Journal Classification of Scopus*), thematic networks and co-citations in the specific research field, h-index analysis, number of citations, field-weighted citation impact (FWCI), researchers' institution, keywords, collaboration.

The information was processed and organized using Microsoft Excel (latest version available September 2021, Microsoft Corporation, Redmond, WA, USA). Graphs and figures were produced in SciVal (version [2023], Elsevier BV, Amsterdam, The Netherlands) and subsequently edited in Microsoft Word (latest version available September 2021, Microsoft Corporation, Redmond, WA, USA) for inclusion in the manuscript. The network of authors, countries, and cooccurrence was produced using the VOSviewer tool version 1.6.19.

Information on the names of the investigators was obtained from public online access sources incorporated into the SciVal tool of Scopus. The applicable ethical and legal regulations for data handling in research have been followed.

RESULTS

Of all the articles retrieved between 2013 and 2022, there are 271 articles with 1175 authors, with an average of 4,33 authors per article. This group of publications has 2995 citations, with 11,1 citations per article. The impact of citations weighted by field is 1,30 for those included between these years.

The most represented area is social sciences, with 35,8 % of the production, followed by medicine and computer sciences, with 17,3 % and 15,9 %, respectively.

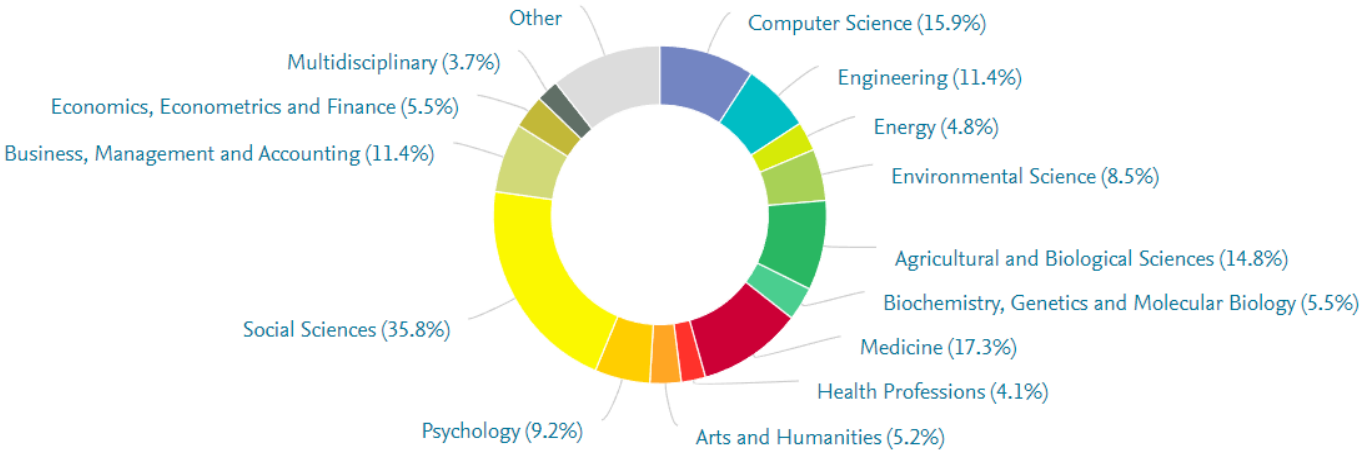

Figure 1. Distribution of scientific production on bibliometrics by Argentine authors between 2013 and 2022 by subject area

Figure 2 shows that the highest concentration of publications is found within the thematic area of social

sciences. The topics discussed in the articles studied, co-authorship, scientific collaboration, bibliometric analysis, h-index, self-citations, innovation, communication, etc., stand out.

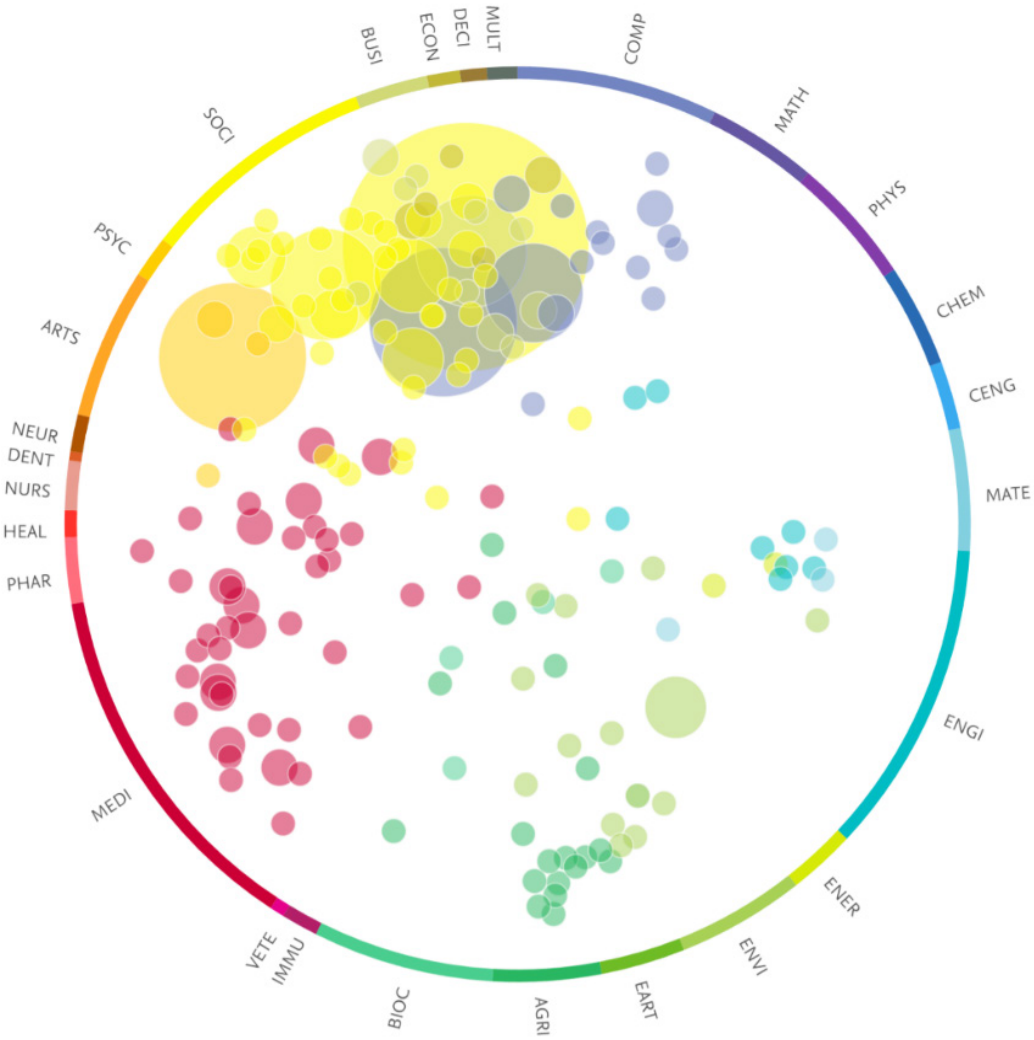

Figure 2. Thematic wheel. Distribution of topics according to scientific area and size of production. SciVal, 2013-2022

An analysis of that theme shows that more than half of the publications are under international collaboration with a higher impact of field-weighted citations followed in the latter index by single authorship.

Table 1. Collaboration in scientometrics publications by Argentines between 2013-2022

index	Percentage	Number of documents	Number of cites	Citations by publication	Impact of field-weighted citations
International collaboration	54,9 %	161	2308	14,3	1,71
National collaboration	19,9 %	54	406	7,5	0,74
Institutional collaboration	7,4 %	20	78	3,9	0,39
Sole authorship	13,3 %	36	203	5,6	0,84

In the present study, only 2,6 % of the research is developed in a framework of academic-business collaboration; 97,4 % is only academic collaboration. Publication in high-impact factor journals makes scientific production visible. During the studied period, 37,8 % were published in Q1 journals, and 84,6 % of the total articles were published in Q1-Q3 journals. The main authors by academic production and their affiliation are presented in table 2.

Among the universities with the highest production is the University of Buenos Aires, which makes up 18,5 % of the total. Table 3 shows the institutions with the highest scientific production in the area studied and the bibliometric indexes of their production.

Table 2. Main authors, academic production and affiliation (ordered by scientific production in the area of bibliometrics). 2013-2022

Order	Author	Affiliation/ University	Thematic areas	Total bibliometric articles	Total items	Total cites	Cites per article	Index h
1	Gantman, Ernesto R.	University of Buenos Aires, University of Belgrano	Library and information, strategy and management	8	33	364	11,0	10
2	Miguel, Sandra	National University of La Plata	Library and information, applications of computer science.	8	23	467	20,3	11
3	Kreimer, Pablo	Maimonides University, University of Quilmes	History and philosophy, education	7	31	387	12,5	10
4	Fierro, Catriel	National University of Mar del Plata	History, psychology	6	16	27	1,7	3
5	Beigel, Fernanda	National University of Cuyo	Social sciences, sociology and political science	5	19	284	14,9	8
6	Romero Quete, Andrés Arturo	National University of San Juan	Energy engineering, energy technologies	5	51	333	6,5	11
7	Gallegos, Miguel	National University of Rosario	Psychology, general medicine	4	93	506	5,4	13
8	Ferrero, Fernando C.	University of Buenos Aires	Pediatrics, general medicine	4	129	1682	13,0	18
9	Martínovich, Viviana	National University of Lanús	Health policies, public health	4	9	18	2,0	3
10	Levin, Luciano Guillermo	National University of Río Negro, National University of La Pampa	Communication, social sciences	4	7	78	11,1	5

Table 3. Institutions, production and bibliometric indexes. 2013-2022

University	Total items	Impact of field-weighted cites	Number of cites	Cites by publication
University of Buenos Aires	50	1,05	517	10,3
National University of La Plata	29	0,91	253	8,7
National University of Mar del Plata	17	0,62	78	4,6
National University of Cuyo	16	1,17	133	8,3
National University of Litoral	13	2,54	522	40,2
National University of the South	11	1,35	103	9,4
Maimonides University	10	1,53	114	11,4
National University of Quilmes	9	1,64	149	16,6
National University of San Luis	8	1,21	78	9,8
National University of San Martín	8	0,52	29	3,6

A comparison was made between the citations per article of the university with the most publications on the subject, the University of Buenos Aires; the National Council of Scientific and Technical Research as the main organization dedicated to the promotion of science and technology in Argentina and the set of publications in the area of study of this research. The number of citations per publication and the weighted citation impact per field in the last ten years were evaluated (figures 3.1 and 3.2). These institutions were selected because they are referents in research in Argentina.

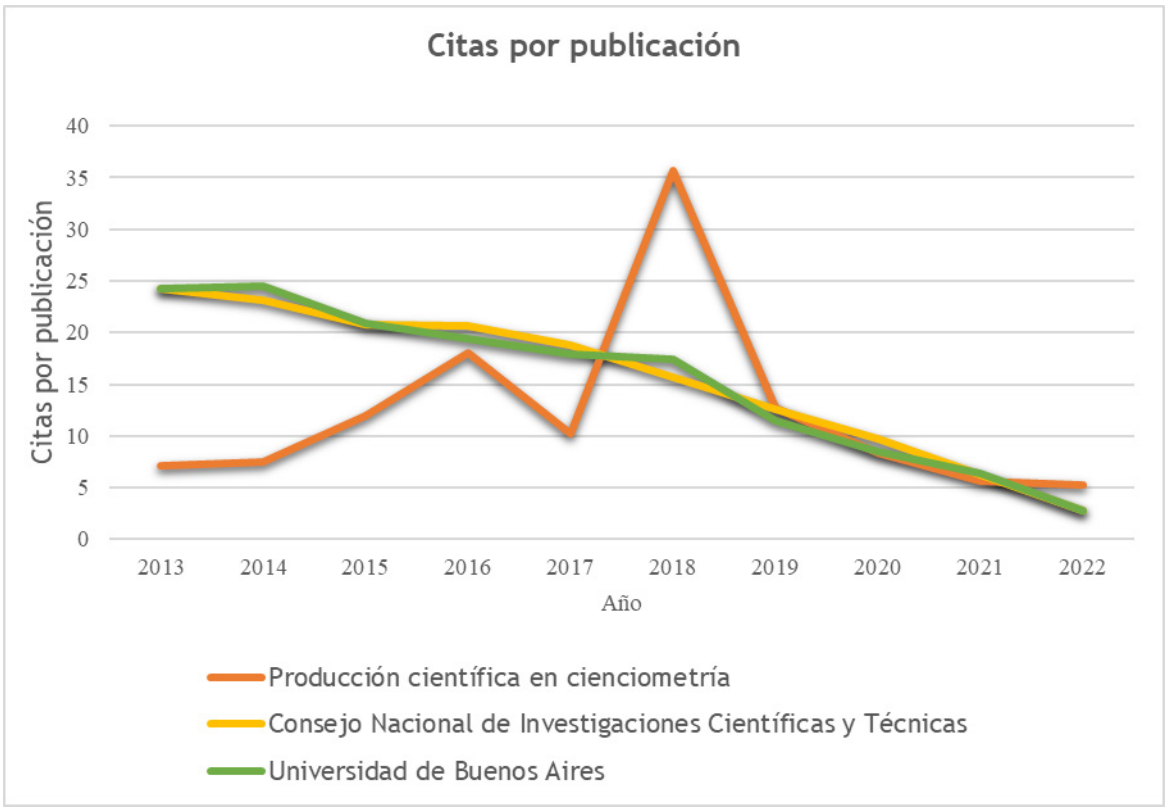

Figure 3.1. Citations by publication. Universidad de Buenos Aires, Consejo Nacional de Investigaciones Científicas y Técnicas, Scientific production in scientometrics in Argentina. Scopus, 2013-2022

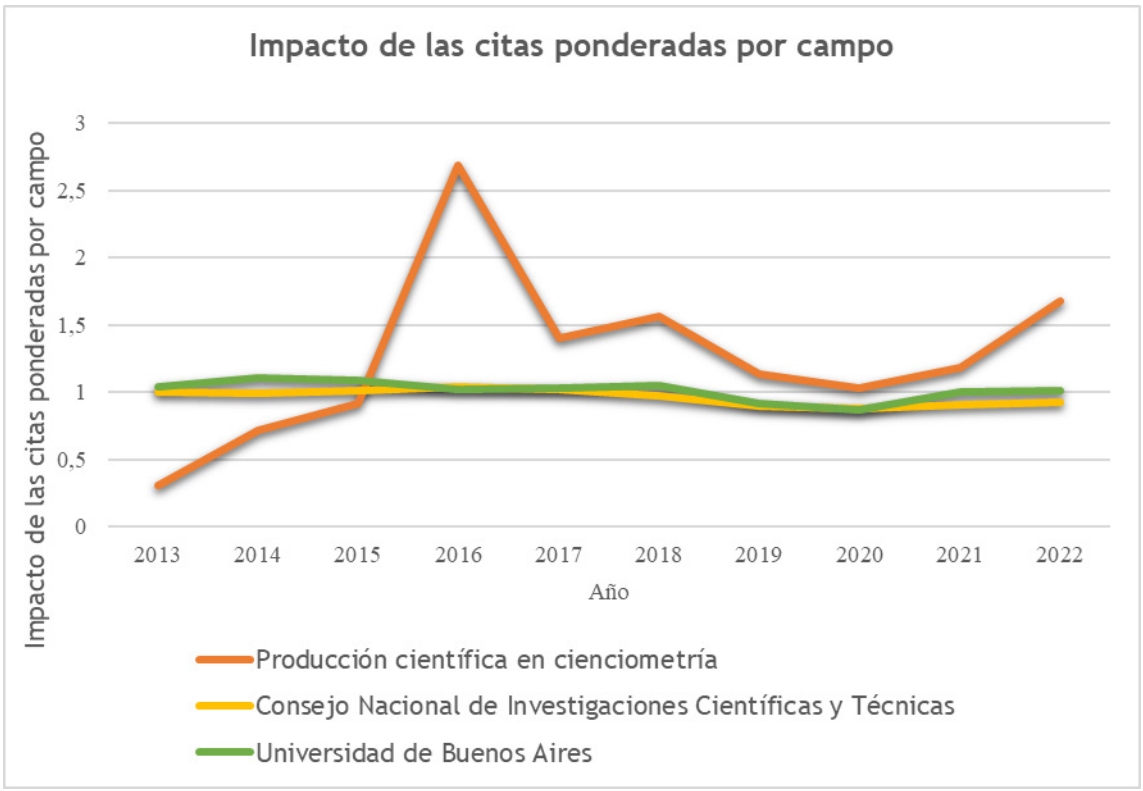

Figure 3.2. Weighted citation impact by field. Universidad de Buenos Aires, Consejo Nacional de Investigaciones Científicas y Técnicas, Scientific production in scientometrics in Argentina. Scopus, 2013-2022

An analysis of the authors' affiliation reveals collaboration with countries in the region and, to a greater extent, European countries. The figure does not show all the countries since only those with at least five papers in the area studied are represented (figure 4).

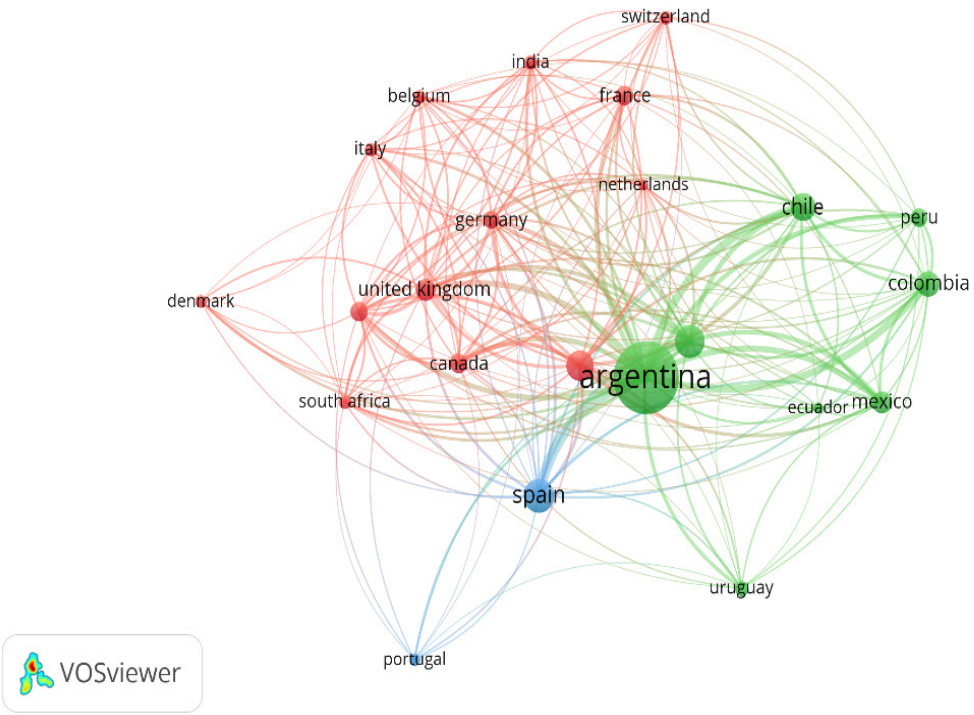

Figure 4. International collaboration of scientific production on scientometrics by Argentine authors. 2013-2022

The analysis of cooccurrence of terms or keywords (Figure 5.1 and 5.2) identifies the thematic areas and their study over time. Three groupings of terms are identified.

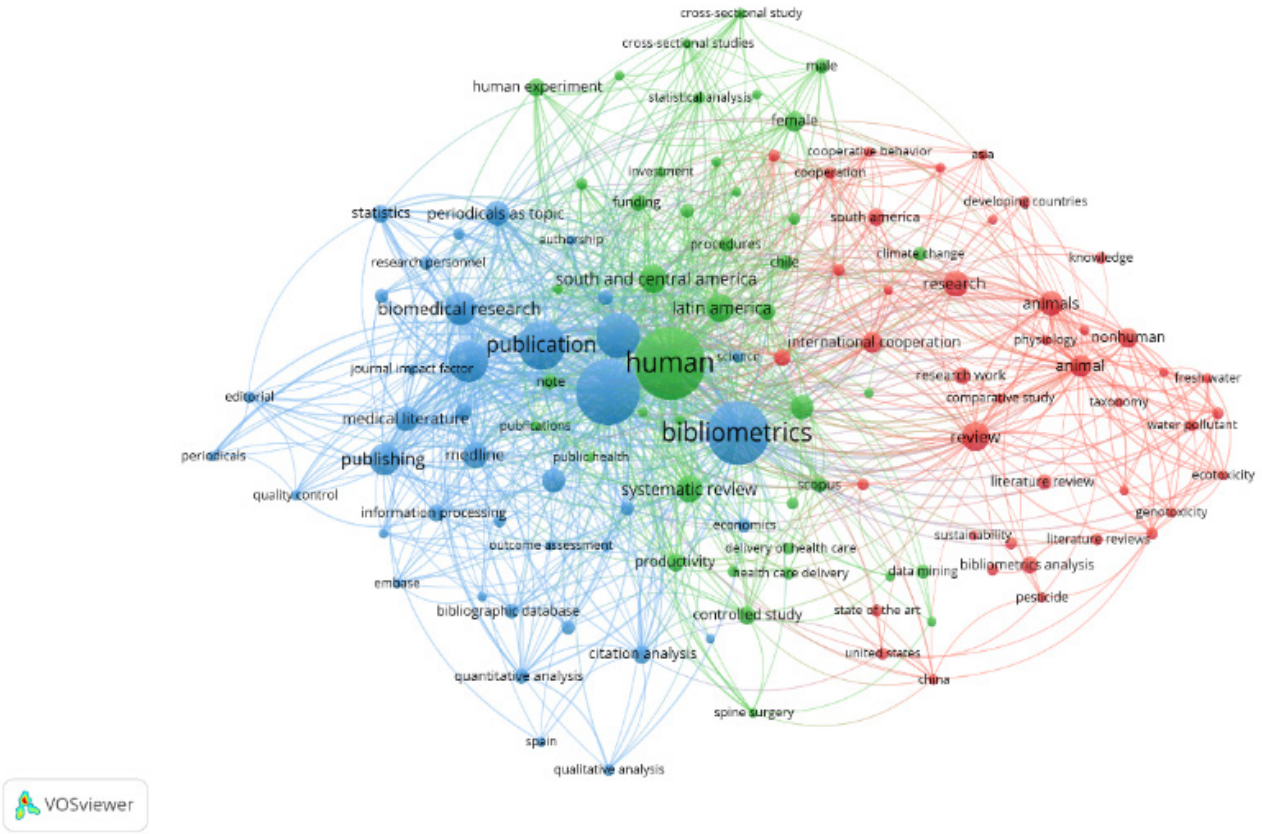

Figure 5.1. Keyword network of the scientific production on scientometrics of Argentine authors. Scopus, 2013-2022

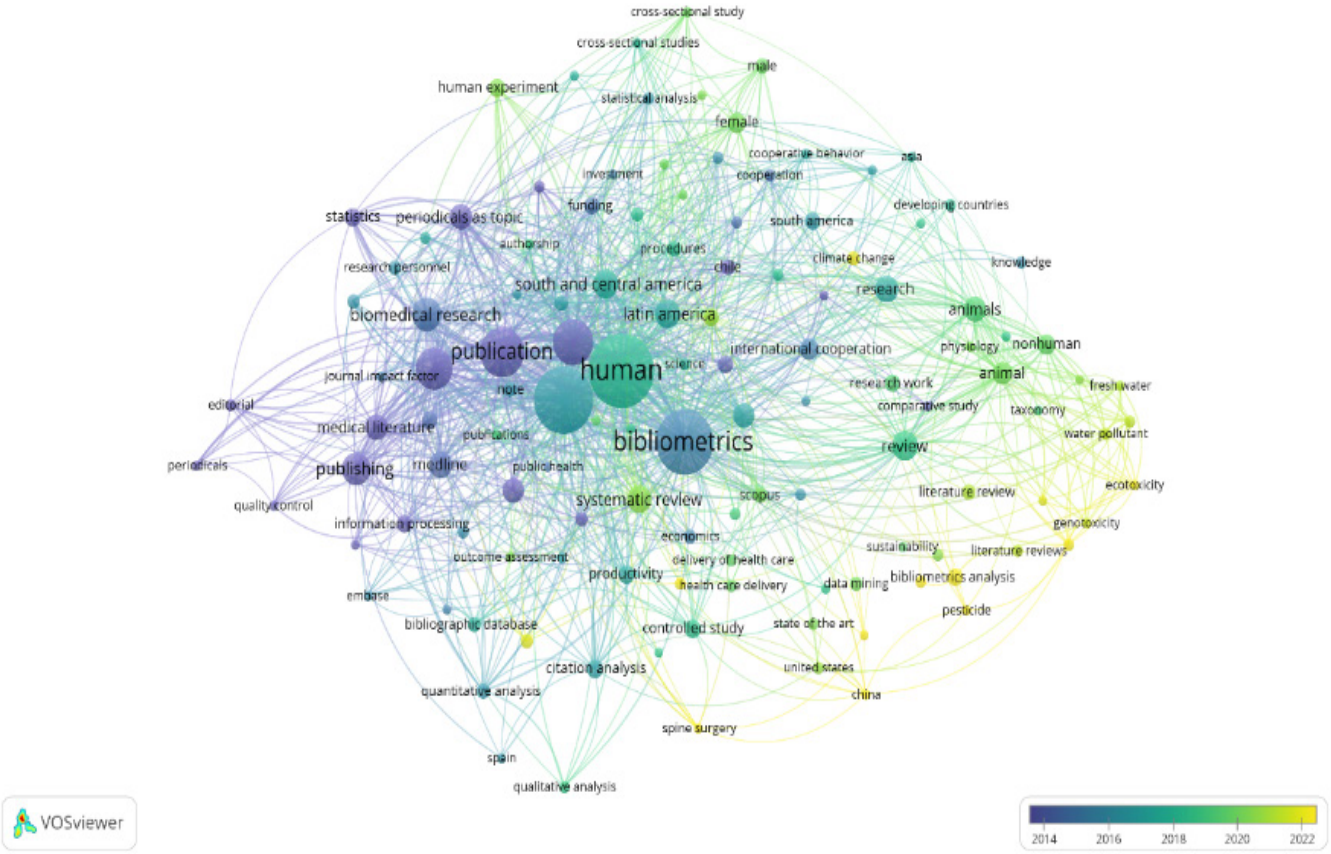

Figure 5.2. Overlay of the keyword network and year of publication of the scientific production on scientometrics of Argentine authors. Scopus, 2013-2022

DISCUSSION

Bibliometrics plays an important role in the evaluation of research and is a tool that can be enhanced in the field of academic research in Argentina. Bibliometric studies provide metrics to evaluate the quality of scientific production and help in decision-making in research and development. Despite the lack of a clear relationship between citations and quality, bibliometric indicators are widely used. In addition, bibliometrics provides information on trends in research and disciplines.[18,19,20,21,22] However, the use of bibliometric indicators has its critics. International initiatives advocate for a fairer and more comprehensive research assessment in response to the challenges and limitations associated with over-reliance on these indicators. Among these, the Leiden Manifesto[23] and the San Francisco Declaration on Research Assessment (DORA)[24] promote assessment practices that transcend traditional quantitative metrics. The Leiden Manifesto, for example, proposes ten principles for the responsible use of metrics in research evaluation, emphasizing the importance of contextualizing data and considering the diversity of scientific results. For its part, the DORA Declaration urges evaluators not to rely exclusively on the impact index of journals and to value other forms of scholarly contribution, including social impact and the quality of the peer review process. Adopting these principles in Argentina could be an important step towards a more balanced and representative research evaluation system.

When evaluating the impact of citations weighted by field, it stands out that scientometrics articles are cited 30 % above the global average for their area. Since this is a methodology and not the article's subject, it may be that the subject addressed is the cause of the citation.[25] It is known that review articles and bibliometric articles, in particular, receive more citations than "original articles," but in this case, we are talking about citations compared to the average for the same subject; hence, the importance of the bibliometric index mentioned above is.[26]

The most represented area is social sciences. It should be noted that the ten most productive researchers in the area addressed library and information, strategy and management, social sciences, sociology, and political science as the main topics. Then we see in second and third place, but with much less representation, the areas of medicine and computer science.

International collaboration was exhibited in this study with a higher field-weighted citation impact (FWCI of 1,71). International collaboration in research and academia contributes to greater global visibility in several

ways: it promotes the performance of research organizations, it manages to break down barriers such as lack of funding and data sharing, it allows achieving better results based on specialization, interdisciplinarity, and transdisciplinarity, it is a research trend towards collaboration.[27,28,29]

Regarding the affiliation of the most productive authors in the area, we found that all have at least one affiliation with public universities, with only two cases of affiliation with private universities. The work topics of the different authors are mostly related to the social sciences. Of these, the University of Buenos Aires is the institution with the highest number of documents, and this may be because public universities encourage research and allocate resources to it, which may be one of the reasons for the higher level of academic production.[30,31]

A comparison was made between the indicators of the Argentine group of scientometric publications, the University of Buenos Aires, and the National Council for Scientific and Technical Research. The university was chosen because it is the one that accumulates the greatest production on the subject under investigation, as well as having the best position in international rankings.[32] Secondly, the National Council for Scientific and Technical Research was selected because it is the organization that brings together most of the country's researchers.[33]

For this comparison, two indicators, mathematical ratios, were used: citations per document and citation impact weighted by field. Between 2019 and 2022, the citations per document indicator falls in all three cases. This does not indicate a drop in productivity but rather that research is being cited less and less. Indirectly, it may be a symptom of a greater evil, such as the general lack of funding for science in the region.[34,35] However, despite receiving fewer citations, scientific production in scientometrics shows better citation impact weighted by field. While the University of Buenos Aires and the National Council for Scientific and Technical Research remain around one during the entire study period (2013-2022), bibliometric articles show better results in the last two years by 68 % above the average for their field.

As mentioned above, international collaboration is crucial for the visibility of academic article. [36] Three groups of countries that collaborate with researchers with Argentine affiliation were identified: firstly, Spain and Portugal; then, in several countries, those of the Latin American region (Chile et al.); and finally, and most importantly, those that make up the European area (Great et al.) and North America.

When performing the co-occurrence analysis, three groupings of terms were identified. These are identified from the sub-networks in Figures 5.1 and 5.2 grouped by color. The first cluster highlights several central themes related to biology, environment, and academic research. These terms suggest a focus on animal life and conservation. The inclusion of "bibliography," "bibliometric," "literature review," and "review" point toward bibliometric analysis or literature reviews, implying a focus on synthesizing and evaluating existing research papers. Other terms suggest an intersection between economic development, sustainability, and international or interdisciplinary collaboration. The presence of "developing countries" indicates a special focus on developing regions. The mention of "pesticide," "toxicity," "ecotoxicity," and "genotoxicity" suggests a concern for the effects of certain chemicals on the environment and species, possibly within a sustainability and conservation framework.

Within the second grouping of terms, several key themes revolve around clinical and medical research, health education, public health decision-making, and socioeconomic and geographic perspectives, especially in Latin America. The terms indicate a focus on human clinical and experimental studies. The inclusion of "Brazil," "Chile," "Latin America," "Mexico," and "South and Central America" suggests that much of the research focuses on these geographic regions, possibly providing a unique perspective on health and medicine in these contexts. The mention of some terms suggests a focus on the practical application of medical research, the education of medical professionals, and the delivery of health services. "Climate change" and 'socioeconomic factors' indicate a consideration of environmental and socioeconomic factors in health research, suggesting a holistic approach. "Funding," 'investment,' and 'productivity' may relate to the financing and effectiveness of health research or health service delivery.

The third grouping of terms reflects a strong bias toward biomedical research, focusing on scientific publication, bibliometrics, and quality assessment in biomedicine and cardiology. "Argentina" and "Spain" suggest that studies or publications may have geographic relevance or originate from these regions. "Article," 'authorship," 'bibliographic database," 'bibliometrics," 'citation analysis," 'editorial," 'journal impact factor," 'medical literature," 'publication," 'publishing," and 'scientific literature' point to an interest in the scientific publication process and the evaluation of research through bibliometric methods. The mention of specific databases such as "Embase," "Medline," and "web of Science" reflects the use of key resources for the retrieval and analysis of scientific information. The inclusion of terms such as "methodology," "outcome assessment," "peer review," "qualitative analysis," "quantitative analysis," and "statistics" suggests a focus on research methodology and rigorous evaluation of results. "Quality control" indicates a concern for research and scientific publication quality. The terms "language," information processing," information retrieval," and "writing" reflect aspects of scientific information communication and management. "Economics" and

'personnel' could indicate consideration of research or scientific publication management's economic and human resources aspects.

The most recent keywords are those contained in the first grouping of terms, highlighting "pesticide," "toxicity," "ecotoxicity," and "genotoxicity," showing a particular interest in these topics towards the year 2022, marking the current trend of work in this area of knowledge.

CONCLUSIONS

The analysis of scientific production in scientometrics in Argentina between 2013 and 2022 reveals that the social sciences dominate this field, underlining the importance of this discipline in the country. International collaboration has proven to be key to increasing the impact of publications, with more citations in work carried out in cooperation with researchers from other countries. This highlights the need to foster more global alliances to strengthen the visibility and relevance of Argentine science in the international context.

Although the number of citations per publication has decreased, the impact of citations weighted by field has increased, especially in the last two years studied. This growth in impact suggests that, despite challenges such as the de-funding of science, the quality of scientific production in scientometrics has improved. The University of Buenos Aires stands out as the leading institution in this field, indicating that research policies and resources allocated in public universities are yielding positive results.

Using bibliometric indicators ethically and responsibly is necessary, recognizing their limitations. Adopting international principles for a fairer and more complete evaluation of research could improve the scientific system in Argentina, promoting a more equitable and effective approach to decision-making in research and development.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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