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PHARMACEUTICAL SECTOR AND ECONOMY: A BIBLIOMETRIC ANALYSIS

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Abstract
The purpose of this research work is to evaluate the evolution of the economy in pharmaceutical companies; determine the thematic axes and identify the co-citation networks between authors, documents and sources of literature on the economy in intersection with the pharmaceutical industry. A descriptive study was carried out with bibliometric indicators and visualization maps, in which the Scopus database of the documents included from 2013 to 2023 was used. 129 records that met the inclusion criteria were considered, 89 research articles, 4 conference papers, 11 reviews and others, in addition to being filtered by the languages of English and Spanish. When talking about the results of the research carried out, the authors Harrison C stand out with 3 publications and Antunes Ams with 2. Although there are many to talk about in the journals and affiliations, only two of each have been highlighted. . On the journal side, Sustainability (Switzerland) and Systematic Reviews In Pharmacy were found with 4 and 3 publications, respectively. Finally, regarding affiliations, the University Of Chittagong with 9 and the Kafrelsheikh University with 8 publications each were obtained as references.

Key words: drug industry, article, human, economic aspect, pharmaceutical industry

Introduction

The pharmaceutical industry has seen significant transformation in recent years, driven by global economic factors. Among the many elements that have greatly impacted this business are globalization, technical advancements, differences in public health regulations, and swings in the financial markets (Buick, 2023). The way pharmaceutical businesses function and adjust to changing market conditions has been continuously evolving as a result of these developments, which has an impact on the supply and demand of pharmaceutical goods (Shukar et al., 2021). In this regard, it is critical to comprehend how the pharmaceutical industry is being shaped by these economic forces and how businesses may adapt to this ever-changing landscape.

Since the pharmaceutical industry is in charge of creating, manufacturing, and distributing medications that enhance and save lives, it plays a crucial role in the global economy. This business is distinguished from an economic perspective by large expenditures for research and development (R&D), protracted returns on investment, and a heavy reliance on government regulation (Wouters et al., 2020). The pharmaceutical industry is important to the world not only because it can provide large amounts of revenue and jobs, but also because it plays a vital role in social welfare and public health (Abraham, 2023). Pharmaceutical businesses work in a highly regulated, competitive industry where success depends on innovation and the protection of intellectual property. Globalization has

also made the pharmaceutical markets more interconnected, which has made it easier to enter new markets and collaborate internationally on the research and development of novel medications (Di Tommaso et al., 2020).

In recent years, the pharmaceutical industry has faced a number of difficulties and changes that have defined its worldwide economic status. Pharmaceutical businesses' approaches to research and development, manufacture, and distribution of pharmaceuticals have been impacted by shifting economic dynamics (Milanesi et al., 2020). On the one hand, the aging of the global population and the rising need for novel medications have propelled the sector's expansion. However, there are now major obstacles as a result of the push to lower the cost of medications and improve access to reasonably priced therapies. These difficulties have been made worse by the COVID-19 epidemic, underscoring the significance of flexibility and resilience in the industry (Ayati et al., 2020). Pharmaceutical firms now face both possibilities and challenges as a result of the economy, necessitating a reassessment of their operational and commercial plans as well as an adjustment to the reality of the new market.

The absence of a strong methodological foundation, broad acceptance, and coherence in the information acquired thus far account for much of the ongoing challenges in knowledge creation and comprehending the interaction between the pharmaceutical industry and the economy, even in light of the sector's advancements and evolution (McKinlay, 2022). A thorough and comprehensive understanding of this interaction is hampered by the variety of methodological methods and the variations in the quality and accessibility of the data that are currently accessible. Moreover, the dearth of agreement across the scientific community about optimal methodologies for assessing and interpreting this correlation exacerbates the difficulty in formulating efficacious approaches to confront the sector's economic obstacles (Marques et al., 2020). The relevant data must be gathered, analyzed, and synthesized using a more methodical and rigorous manner in order to improve our knowledge of how economic dynamics affect the pharmaceutical industry and vice versa.

Because of the aforementioned factors, the research endeavors to assess the development of economics within the pharmaceutical sector, ascertain thematic axes, and detect networks of co-citations among authors, documents, and sources of economics literature intersecting with the field. We can recognize important patterns and new themes that are influencing this field of study by having a deeper grasp of how these interactions have changed over time (Ramírez-Durán et al., 2023). Moreover, by mapping the relationships between various players in pharmaceutical research and economics, co-citation network analysis will enable us to gain a better understanding of the impacts and partnerships in this area (Alnajem et al., 2021). By using a thorough approach, we will be able to evaluate the present level of knowledge as well as pinpoint any gaps and areas that require more research, which will help to build a stronger and more cohesive body of knowledge in this field.

Finally, in order to solve issues and take advantage of possibilities at the nexus of economics and the pharmaceutical sector, this research attempts to present a thorough understanding of the state and future developments of this field of study. It is intended that by promoting an interdisciplinary and international approach to research, novel and long-lasting solutions that assist the pharmaceutical industry would be developed. To design methods that can enhance the sector's sustainability, accessibility, and efficiency, economists, pharmaceutical researchers, and health professionals must work together. This research aims to further academic understanding while also providing useful advice for pharmaceutical industry stakeholders, assisting in navigating tricky financial situations and seizing chances for a more prosperous and healthful future.

Materials and methods

The current study falls under the documentary type, which is defined as, in the first instance, a set of procedures and methods for gathering, analyzing, and archiving the data found in documents; and, in the second instance, a methodical, cogent, and persuasively argued presentation of fresh data in a scientific document (Tennent & Gillett, 2023).

The biggest database of citations and abstracts of peer-reviewed literature and high-quality online sources, Scopus is a crucial component of SciVerse and offers sophisticated tools for tracking,

analyzing, and visualizing research in a quick, simple, multidisciplinary, and long-range collaborative platform; the simplest method for locating pertinent information is to use SciVerse Scopus (Niebles-Nunez et al., 2022). For the above reasons, this metasearch engine was selected to carry out this bibliometric analysis.

In the first part, the terms "pharmaceutical sector" OR "pharmacy sector" AND "economy" were searched within the summary option using the following search equation (TITLE-ABS-KEY ("pharmaceutical sector") OR TITLE-ABS- KEY ("pharmacy sector") AND TITLE-ABS-KEY (economy)) AND PUBYEAR > 2012 AND PUBYEAR < 2024 AND (LIMIT-TO (LANGUAGE , "English") OR LIMIT-TO (LANGUAGE , "Spanish")) and It was discovered that 161 research documents were published in different journals and in a wide variety of languages. Then, the search was limited to the last ten years and to the English and Spanish languages, with the aim of finding more recent information. that was easy to interpret for researchers on this topic, finding 129 documents of different types.

In the second phase, the annual scientific production, type of documents, leading institutions, authors with the highest H index and the most relevant countries were analyzed in detail to examine the progress of the field of study between the years 2013 to 2023; Other parameters, such as referral trends and collaboration trends (Ramírez et al., 2023), were also collected and analyzed. The biblioshiny visualization tool of the Bibliometrix package of Rstudio software was used to generate the cross-country collaboration map, the reference publication year spectroscopy, the author collaboration network, word growth, and the thematic map (Silva & Moreira, 2022).

Results

Table 1 Main information

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2013:2023
Sources (Journals, Books, etc)	116
Documents	129
Annual Growth Rate %	19.62
Document Average Age	4.88
Average citations per doc	9.465
References	6575
DOCUMENT CONTENTS	
Keywords Plus (ID)	654
Author's Keywords (DE)	513
AUTHORS	
Authors	402
Authors of single-authored docs	20
AUTHORS COLLABORATION	
Single-authored docs	20
Co-Authors per Doc	3.25
International co-authorships %	22.48
DOCUMENT TYPES	
article	89
book	1
book chapter	22
conference paper	4
editorial	1
note	1
review	11

Source: authors (2024)

129 documents were found that met the inclusion criteria from 2013 to 2023, of which 89 are scientific articles, 4 conference documents and 11 correspond to reviews. The number of individual authors

found in this research was 402 and on average 3.25 authors participated per document, the number of references found was 6575.

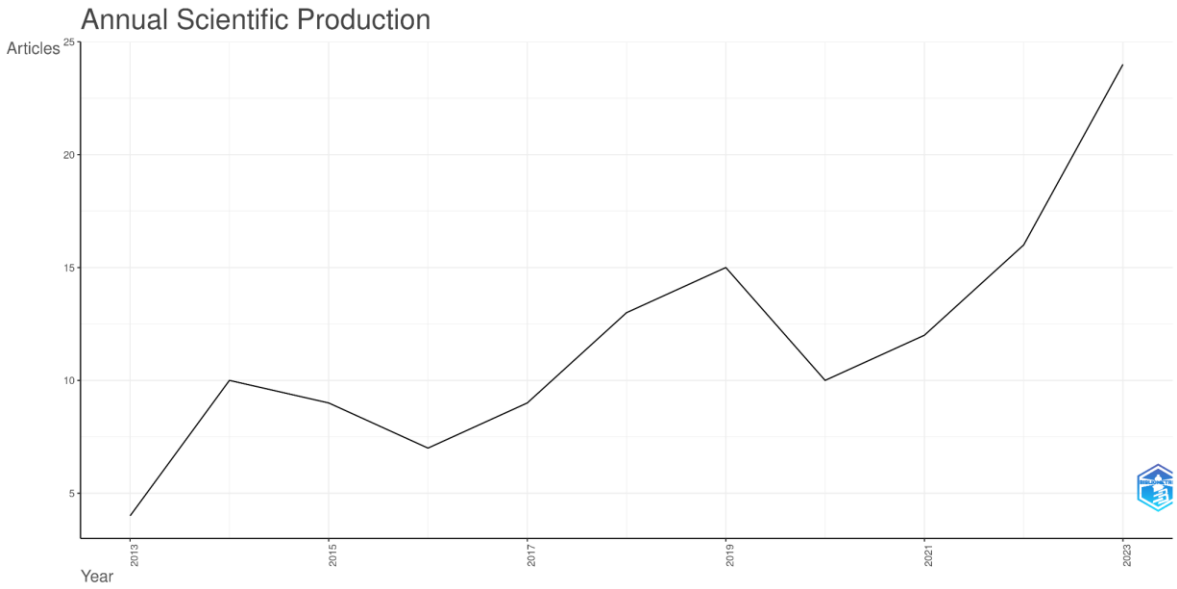

Figure 1. Annual scientific production.

Figure 1, called document production per year, shows the growth and decline of scientific production on the topic of economics and the pharmaceutical sector. The increase in research in 2023 is also evident, surpassing previous years with 24 publications. The most notable article also belongs to this last year. The authors of this article point out that the economy and the environment are affected by the careless disposal of the most common crustacean waste, particularly those from marine sources. Furthermore, they emphasize that the collection and strategic management of garbage is vital, highlighting the fundamental role that sustainable recovery systems have had both in solving these problems and in creating value from waste. According to the aforementioned study, sea waste is abundant in beneficial bioactive substances such as minerals, lipids, carotenoids, chitin and chitosan, among other amino acid derivatives. In short, it is determined that these value-added ingredients have a wide range of pleiotropic uses in the food, nutraceutical, cosmetic, agro-industrial, pharmaceutical and healthcare industries (Azelee, et al., 2023).

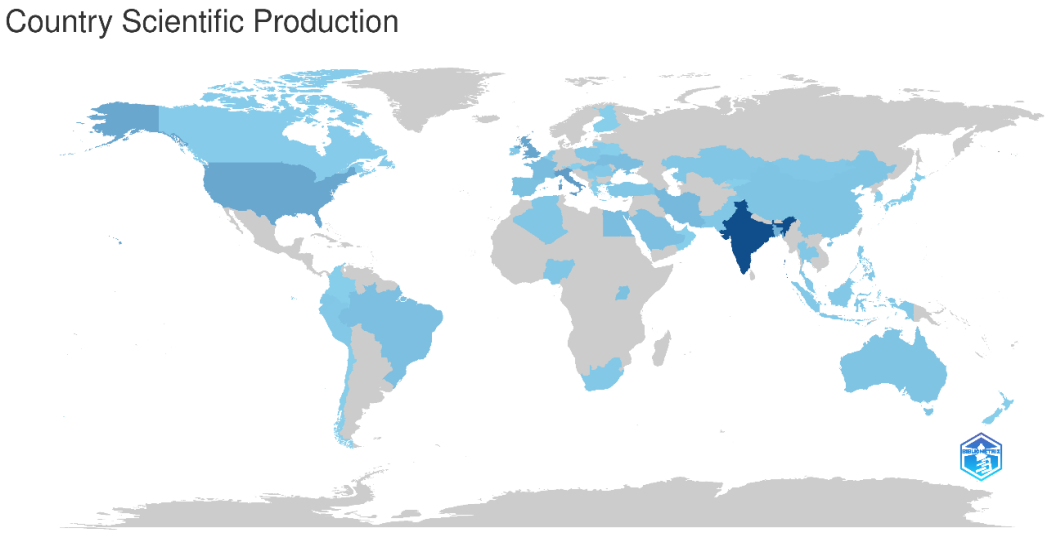

Figure 2. Scientific production by country.

The regions with the greatest scientific production in this period were analyzed. As shown visually in the map in figure 2, the 10 countries that stand out the most for their contribution in this field are:

India with 84 contributions (which stands out in the figure for having the strongest blue color), followed by Italy , with 32, and the United Kingdom, with 26 articles contributed to the topic. The most relevant article on the most productive country (India) explains how the pharmaceutical industry plays a vital role in providing life-saving goods and services to society and how materials, goods and services related to pharmaceuticals have a variety of environmental effects. The authors list, among the elements of the pharmaceutical industry that cause these environmental effects, patients who dispose of pills or tablets inappropriately, pharmacies that release pharmaceutical products inappropriately, expired and unused prescriptions, and wastewater. domestic waste that contains excess medication. The results of the aforementioned research suggest that maximum importance should be given to technological risk categories and cold chain supplies. The researchers insist that the purpose of the cited work was to help government officials and practicing managers develop and oversee GSC programs in a way that aligns with sustainable development goals within the pharmaceutical business (Kumar et al., 2018).

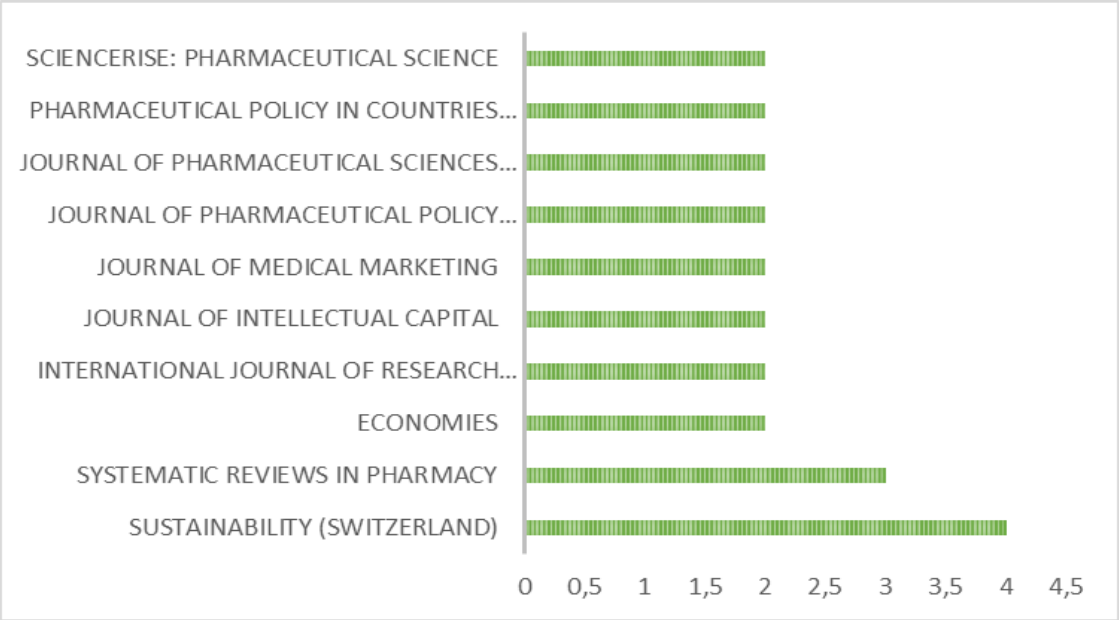

Figure 3. Most relevant sources.

The journals that have contributed the most research to the field of study over the last ten years are analyzed in Figure 3, being Sustainability (Switzerland) with four, Systematic reviews in pharmacy with three publications, Economies with two and International journal of research in pharmaceutical sciences with two others, standing out as the most productive.

Table 2 H Index of Authors

Element	h_index	g_index	m_index	TC	NP	PY_start
BURNARD K	2	2	0.222	94	2	2016
CAMPO M	2	2	0.286	120	2	2018
HARRISON C	2	3	0.222	95	3	2016
PAUL S	2	2	0.222	94	2	2016
ROMANI A	2	2	0.286	120	2	2018
ABBASIAN E	1	1	0.143	1	1	2018
ABDELAZIZ K	1	1	0.25	1	1	2021
ABHAYAWANSA S	1	1	0.091	37	1	2014
ABOOD A	1	1	0.5	7	1	2023
AF RAGAB M	1	1	0.333	3	1	2022

Source: authors (2024)

As maintained by multiple authors, one of the most popular bibliometric measures to evaluate the quality of research projects and project the long-term effects of the findings is the H index, given two main reasons. First of all, it is simple; Any researcher can quickly identify it as a unique indication that combines production and impact. Second, it eliminates systematic inaccuracies originating from the extremes of the citation distribution. This score penalizes the most selective researchers who are distinguished from traditional manufacturers not by the number of publications they have published, but by the number of citations they have received. This means that the index is not very good at differentiating between researchers with varying editing practices (Dorta-González, P., & Dorta-González, M. I. 2010).

Among the articles revealed by the H-index analysis was a study that used the retail pharmaceutical industry in Nigeria to examine the difficulties faced by entrepreneurs in underdeveloped countries. This study highlighted the business leadership qualities that have been useful in overcoming the obstacles that this industry has faced. Semi-structured interviews with retail pharmacy owners and their staff served as the basis for data collection. The stated study, according to the authors, was the first qualitative investigation into how corporate governance affects pharmaceutical retailing in Nigeria. They saw the need for business training in this particular environment. The research pretended to inspire other retail pharmacy entrepreneurs by highlighting the conditions necessary for success as participants shared their experiences (Harrison et al., 2016).

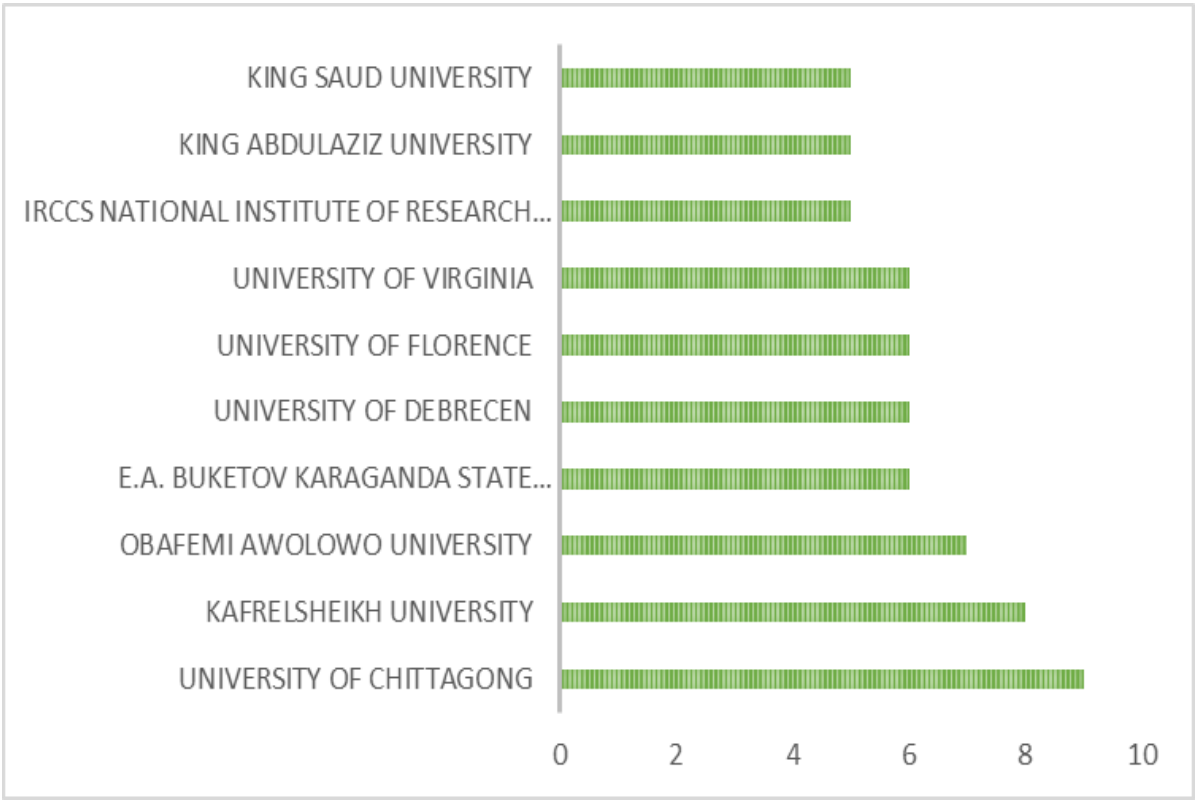

Figure 4. Most relevant affiliations.

The previous graph shows the ten institutions that have carried out the most research regarding economics in pharmaceuticals, highlighting the University of Chittagong with a total of 9 publications, the University of Kafrelshikh with 8 and the University of Obafami Awolowo with 7. In the most important paper from Chittagong University, authors AlRutia et al. (2018) comment that significant changes in Saudi Arabia's economy have an impact on jobs in the medical field. However, the authors go on to note that there is currently no quantitative information available on the medical workforce in the Kingdom of Saudi Arabia. Therefore, the objective of the aforementioned study was to know the current situation of medical personnel in Saudi Arabia. To this end, the authors conducted descriptive statistics based on data from the Saudi Council for Medical Qualifications (SCFHS) in

March 2017. Less than 20% of Saudi doctors are employed in the Kingdom of Saudi Arabia, according to one of the results of the study, which also claims that foreigners dominate the Saudi labor market for medical professionals. The three main segments of the medical industry – pharmacies, community pharmacies and private hospitals – are where Saudi Arabia fares worst. Therefore, the researchers emphasize that one of the main objectives of Saudi Arabia's Vision 2030 should be to address the unmet demand for staff retention and pharmacy training among Saudi residents.

Table 3 Most global cited documents

Paper	DOI	Total Citations
KUMAR A, 2019, INT J PROD RES	10.1080/00207543.2018.1543969	114
LUCARINI M, 2018, MOLECULES	10.3390/molecules23081888	87
CHOWDHURY LAM, 2019, J INTELLECT CAP	10.1108/JIC-10-2018-0171	86
HARRISON C, 2018, J SMALL BUS ENTERP DEV	10.1108/JSBED-05-2017-0160	63
ALRUTHIA Y, 2018, HUM RESOUR HEALTH	10.1186/s12960-018-0294-8	63
SUSSEX J, 2016, BMC MED	10.1186/s12916-016-0564-z	46
BIRCH K, 2014, J KNOWL ECON	10.1007/s13132-012-0117-4	40
PAI S, 2022, ENVIRON SCI POLLUT RES	10.1007/s11356-022-19423-4	39
ABHAYAWANSA S, 2014, ASIAN REV ACCOUNT	10.1108/ARA-10-2013-0067	37
HOSSEINI-MOTLAGH S-M, 2020, J CLEAN PROD	10.1016/j.jclepro.2020.124173	36
ROMANI A, 2020, FRONT NUTR	10.3389/fnut.2020.00120	33
HARRISON C, 2016, J WORKPLACE LEARN	10.1108/JWL-01-2015-0004	31
SHARMA S, 2017, J INTELLECT CAP	10.1108/JIC-09-2016-0092	30
HOSSAIN MS, 2021, MAR POLICY	10.1016/j.marpol.2021.104469	26
SUN P, 2018, IEEE TRANS ENG MANAGE	10.1109/TEM.2018.2793215	26
CHAHAL H, 2014, J GLOB RESPONSIB	10.1108/JGR-02-2014-0005	25
HU Y, 2013, PLOS ONE	10.1371/journal.pone.0077247	24
GRIMES S, 2015, EUR PLANN STUD	10.1080/09654313.2015.1029442	23

Source: authors (2024)

The top 20 of the works with the most references, shown in table 3, is ranked first with 114 citations by the document KUMAR A, 2019, INT J PROD RES, whose research indicates that, when it comes to giving society access to goods and services that can save lives, the pharmaceutical business is crucial; The environment and goods, products and services are related to medicine in various ways.

This includes patients inappropriately disposing of pills or tablets, pharmacies inappropriately disposing of expired or unused prescriptions, and household wastewater containing radical pharmaceuticals, among others (Kumar et al., 2019).

Figure 5. Wordcloud.

Figure 5 indicates the words that appeared most frequently in the study carried out on the topic "economics in the pharmaceutical industries", as can be seen just by taking a look at the graph, the author's keywords are closely related to the topic, and Terms such as "Drug industry" (33), "Article" (27), "Human" (21) and "Economic aspect" (10) stand out.

Subsequently, in co-citation networks, a node corresponds to a CR (Cited Reference) record and a link is created if two CRs are co-cited by the same source record. The number of times two CRs are indicated together determines the weight of the tie. The weight can be seen as a measure of node similarity, since it is expected that the more times two CRs are cooked, the more similar their content will be. The other metrics of the analysis are described below (Chi & Young, 2013):

- Degree centrality is the number of direct connections to other nodes; Weighted grades are used to indicate relationships with strength attributes.
- The degree to which a node mediates or is between two other nodes on the shortest path connecting those nodes is known as betweenness centrality.
- A cluster is a collection of nodes in a network that are linked to each other more closely than to other nodes in the network.
- A bridge in a network is a node that joins two different clusters.

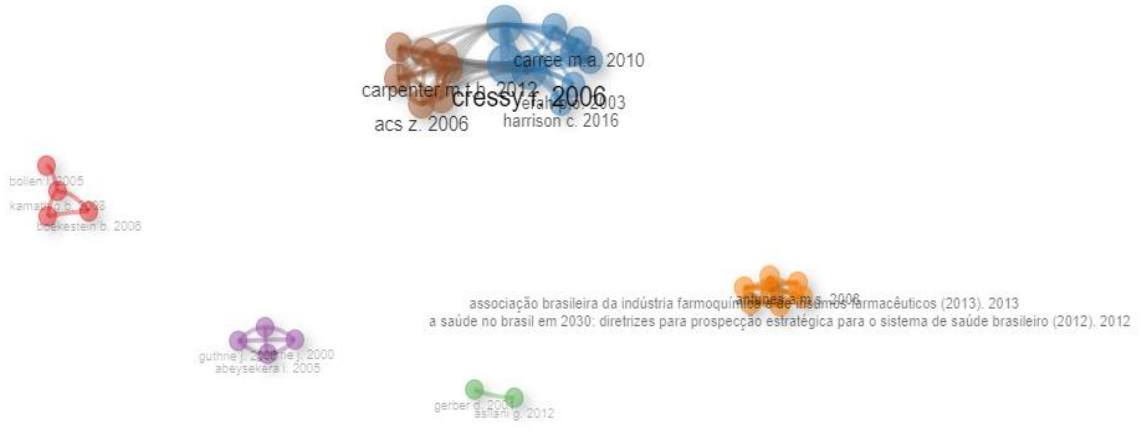

Figure 6. Co-citation for documents.

Taking into account the previous paragraph and figure 6 of the co-citation of documents, it can be said that there are 6 groups related each to a line of research, and they are formed as follows:

- Red color: it is made up of 4 authors, which are: Bollen l (2005), Kamath G.B (2008), Boekestein B (2006) and Ghosh S (2009).
- Blue cluster: made up of 16 researchers, of which Cressy R (2006), Vecchio R.P (2003) and Yin R.K (2003) among others stand out.
- Orange cluster: there are 7 authors, including Antunes A. (2000), Cartaxo R.J.A. (2011) and Gadelha C.A.G. (2007).
- Purple cluster: it is made up of 4 researchers such as: Abeysekera I (2005), Bozzolan S (2003) Guthrie J (2000 and 2006).
- Green cluster: authors such as Asllani G. (2012) and Gerber D. (2001) have the same line of work.

Figure 7. Co-citation for authors.

The researcher co-citation map seen in Figure 7 indicates that the research field is made up of six lines with thematic similarity. The red cluster is made up of 5 authors, which are: Gadelha CAG, Lundvall BA, Magalhaes JL, Malerba F and Nelson RR; The blue cluster is made up of 2 researchers, Cheb YS and Hair JF; the green cluster is made up of 4 researchers: Mehralian G, Guthrie J, Abeysekera I and Abhayawansa S; the purple cluster is made up of: Zhang Y, Wang Y, and Li J; The orange cluster is made up of 5 researchers who are: Harrison C, Morgan N, Barney J, Bryman A and Johanson J., while the last cluster that is represented with the color brown is only made up of two authors who are: Khana T and Peng MW. Each of these groups represents a similarity in the topic investigated by these authors, which will serve as a guide to identify the researchers who most influence the area of study.

Conclusions

A substantial and expanding global trend in research on the subject of "economics in the pharmaceutical sector" has been identified by bibliometric analysis of the field of study between 2013 and 2023. An extensive synopsis of the analysis's key conclusions is given below, offering a strong basis for further studies and methods in this area.

A total of 129 papers pertaining to the pharmaceutical industry's economics were found during the course of the analysis, indicating a 19.62% yearly increase. This rise indicates a rise in interest and a

need for more study in this area. Specifically, 2023 was the most productive year in terms of scientific output, with 24 articles demonstrating a considerable rise in output. This growth may be the result of the pharmaceutical industry's increasing significance in the world economy, particularly in light of the COVID-19 epidemic, which has brought attention to the vital role that medications play in society and the economic impact they have.

Scientific papers make up the majority of the detected materials (89), followed by book chapters (22) and reviews (11). A broad range of techniques and procedures have been used in study on the pharmaceutical industry and its link to the economy, as evidenced by the diversity of document formats. Moreover, international cooperation is noteworthy, as seen by the 22.48% of the documents that are the product of author collaborations from other nations. This high rate of collaboration highlights the value of international cooperation in scientific research and reflects the global character of the possibilities and problems facing the pharmaceutical industry.

With 9, 8, and 7 publications, respectively, the University of Chittagong, Kafrelsheikh University, and Obafemi Awolowo University are the most productive universities in this discipline. These organizations have shown leadership and research capability in this field, greatly adding to our understanding of the pharmaceutical industry's economics. With an H-index of 2, Burnard K, Campo M, and Harrison C are the researchers with the highest H-index among writers. These writers have made substantial contributions to the advancement of knowledge in this discipline via their noteworthy research.

With 84 articles, India leads the world in scientific productivity in this area, followed by the UK (26 publications) and Italy (32 publications). India is a leading country in this field of study because of its large pharmaceutical sector, which is important on a national and worldwide scale. Sustainability, Systematic Reviews in Pharmacy, Economies, and International Journal of Research in Pharmaceutical Sciences are some of the most prestigious publications in pharmaceutical economics and research. These journals have played a crucial role in disseminating pertinent, excellent research and in creating forums for discussion and the emergence of novel concepts in this area.

Ultimately, word cloud visualization and keyword analysis reveal that "Drug industry," "Article," "Human," and "Economic aspect" are the most commonly used phrases in this field of study. The main ideas and issues of study in the nexus of economics and the pharmaceutical industry are reflected in these phrases. Six theme clusters, each denoting distinct study trajectories and areas of collaboration between academics, are shown by the co-citation of authors. The selected clusters address a wide range of subjects, including the management of pharmaceutical waste and the effects of the pharmaceutical sector on local economies.

As previously said, a thorough understanding of the present and potential directions of this area of research is offered by the bibliometric analysis of the pharmaceutical industry's economics. The results highlight the value of ongoing study and cross-border cooperation in addressing issues and grabbing opportunities at the nexus of economics and the pharmaceutical sector. Encouraging an interdisciplinary and international approach to research will enable the creation of creative and long-lasting solutions that will benefit the pharmaceutical industry as well as society at large.

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