Evolution of the performance of the treatment and diagnosis of schizophrenia, an application of the bibliometric analysis technique

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ABSTRACT
The purpose of this study was to analyze the evolution of the performance of the treatment and diagnosis of schizophrenia, applying bibliometric techniques with a focus on temporal trends, leading countries, and institutions, among other indicators. The bibliometric analysis was performed using the Scopus database to identify scientific articles related to the diagnosis and treatment of schizophrenia between the years 2000 and 2023. The number of publications, temporal trends, leading countries and institutions, as well as the co-occurrence network were analyzed. A total of 9,411 scientific articles were identified. A significant increase in research production in this field was observed, and the United States stood out as the leading country in scientific production. This bibliometric analysis provides a clearer understanding of the current landscape of schizophrenia research, and also a way to guide future research and development efforts in this crucial field of psychiatry.

Keywords: mental health, psychiatry, psychosis, antipsychotics, bipolar disorder, diagnosis.

INTRODUCTION

Schizophrenia is a complex and chronic mental disorder (MD) that affects approximately 1% of people globally (Orrico-Sánchez et al., 2020). Characterized by symptoms such as hallucinations, delusions, and cognitive impairment, schizophrenia represents a significant challenge for both patients and health experts (Pardede et al. 2020). Effective diagnosis and treatment are necessary to improve the quality of life (QL) of affected individuals and reduce the economic and social burden of the MD.

Research on schizophrenia has advanced significantly since the term was coined by Eugen Bleuler in 1911 when it replaced the concept of "dementia praecox" proposed by Emil Kraepelin (Morgan, 2022), the discovery of dopamine as a relevant neurotransmitter in the 1950s and 1960s (Seeman, 2021), and then the development of first and second generation antipsychotics. The latter remain the mainstay of treatment, but attention has expanded to include psychosocial and rehabilitation approaches (Kharb, et al., 2021). Like cognitive-behavioral therapies, MD management programs and community-based interventions have also been shown to be effective in optimizing patients' functional outcomes and QL (Medalia et al., 2020).

Research on the treatment and diagnosis of schizophrenia is increasing and this is reflected in scientific production. However, the extent of the scientific literature can make it difficult to identify key trends and new areas in research. In this sense, by quantifying and analyzing various metrics related to scientific production, bibliometric analysis (BA) allows obtaining a panoramic view of the evolution and impact of research in a specific field (Galeano-Barrera et al., 2022).

Bibliometrics is a field of study that applies quantitative methods to the analysis of scientific literature (Kokol et al., 2021). In psychiatry and any other field, BA allows for the identification of patterns and trends in knowledge production, facilitating a better understanding of the evolution of research and priority areas. Previous bibliometric studies in psychiatry have examined topics such as depression (Li et

al., 2021), bipolar disorder (Grover et al., 2021), and anxiety disorders (Berta et al., 2022), providing valuable insights into the dynamics of research in these fields.

This study aims to conduct a comprehensive BA of research on the treatment and diagnosis of schizophrenia using Scopus data and analysis tools such as VOSviewer. Scopus is a leading database among the most robust for BA, offering a wide coverage of scientific journals, conferences, and patents in various disciplines (Baas et al., 2020). VOSviewer, on the other hand, is a tool specialized in the visualization of bibliometric networks (McAllister et al., 2022). This tool allows the creation of maps of co-authorship, citations, and terms, facilitating a visual interpretation of the relationships and trends in research.

METHODOLOGY

This article aims to describe the progress of research on the "treatment and diagnosis of schizophrenia" in the period from 2000 to 2023, using bibliometric data from a prominent database. It was a descriptive and retrospective study that uses a quantitative research design. The quantitative study design is chosen because it is based on the collection and analysis of numerical data (Duckett, 2021).

Trends in scientific production are identified and described (Grimes & Schulz, 2002), for that reason, this study is descriptive, and historical data is analyzed, that is, the data already exists (Talari & Goyal, 2020), which classifies it as retrospective. Data from the Scopus database was used due to its wide coverage of scientific literature and its reputation as a prominent database among the most robust and reliable in the academic field.

The search for publications was performed using keywords related to schizophrenia, treatment, and diagnosis. The search included research articles, reviews, and conference papers indexed in Scopus, publications in English, Spanish, German, and French, documents published between 2000 and 2023. Non-relevant articles, such as editorials and conference proceedings without full text available, were excluded. The search equation remains: TITLE-ABS-KEY ("schizophrenia", "treatment", "diagnosis") AND PUBYEAR > 1999 AND PUBYEAR < 2024 AND (EXCLUDE (DOCTYPE, "ed") OR EXCLUDE (DOCTYPE, "le") OR EXCLUDE (DOCTYPE, "er") OR EXCLUDE (DOCTYPE, "cr") OR EXCLUDE (DOCTYPE, "tb")) AND (LIMIT- TO (LANGUAGE, "English") OR LIMIT-TO (LANGUAGE, "Spanish") OR LIMIT-TO (LANGUAGE, "German") OR LIMIT-TO (LANGUAGE, "French")).

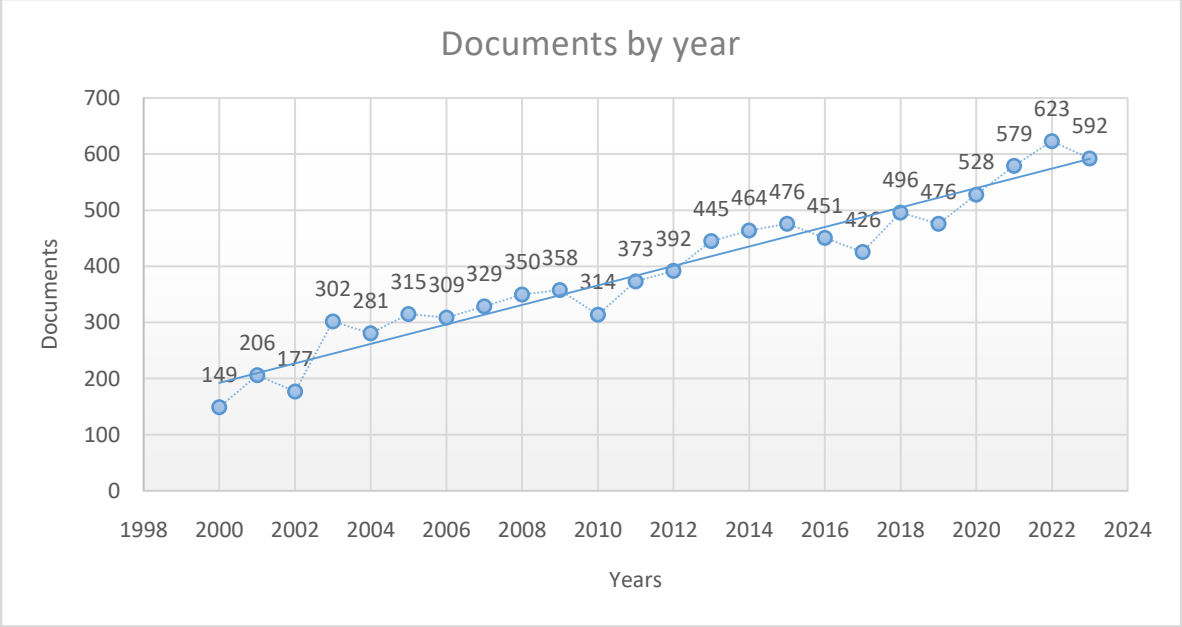
The bibliographic data of the selected publications were exported from Scopus in CSV format for analysis. The extracted information included: the title of the article, authors, affiliations, journal or conference, year of publication, number of citations, and keywords. The VOSviewer software (Ding & Yang, 2022) was used as an analysis and data visualization tool. The number of publications per year, authors and affiliations, co-authorship networks, citations, and the term map, among other indicators, were analyzed.

RESULTS

The findings of the BA on research into the treatment and diagnosis of schizophrenia are presented below. The results are organized into several subsections that address different aspects of scientific production, including the temporal distribution of publications, the most influential authors and institutions, collaboration networks, the impact of articles through citations, and the analysis of the most frequent terms in the literature. These results provide a comprehensive and detailed view of the trends and dynamics in this field of research.

Temporal distribution of publications

The result was a total of 9,411 documents. Chart 1 shows the distribution of publications between 2000 and 2023. A progressive increase can be observed over the years. In 2000, 149 documents were published (1.6%), increasing in 2001 to 206 (2.2%), in 2002 to 177 (1.9%), and in 2003 to 302 (3.2%). This trend continues with annual variations, reaching a total of 528 publications (5.6%) in 2020, 579 (6.2%), in 2022, 623 (6.6%), and in 2023, 592 (6.3%). The chart clearly reflects the sustained increase in scientific production during this period.



Graph 1. Publications on the treatment and diagnosis of schizophrenia by year
Source: Authors

The growth trend observed is notable. In 2000, 149 documents were published (1.6% of the total), which is a relatively low base compared to subsequent years. This number increased to 206 in 2001 (2.2%), experiencing some fluctuations in the following years, with a significant increase in 2003, when 302 papers (3.2%) were published. The upward trend continued, and the increase is most pronounced in the last two decades. In particular, the number of publications peaked in 2022 with 623 papers (6.6%). This continued growth suggests an increase in research and publications in response to the growing importance of the topic within the scientific community (SC).

Analysis of the most productive countries

Analysis of the data set on countries that research the treatment and diagnosis of schizophrenia reveals that the ten countries with the highest productivity are: United States, Canada, United Kingdom, Italy, Germany, China, Australia, Spain, Netherlands, and France.

In Figure 1, it is observed that the United States leads the list with 3,254 documents, which is equivalent to 34.6% of the total publications. It is followed by the United Kingdom with 1,245 documents (13.2%), Germany with 787 documents (8.4%), Australia with 575 documents (6.1%), Canada with 552 documents (5.9%), Italy with 482 documents (5.1%), Spain with 423 documents (4.5%), China with 352 documents (3.7%), France with 312 documents (3.3%) and the Netherlands with 276 documents (2.9%). This analysis highlights the significant contribution of these countries to scientific production related to schizophrenia, reflecting both their research capacity and their commitment to progress in the diagnosis and treatment of this disorder.

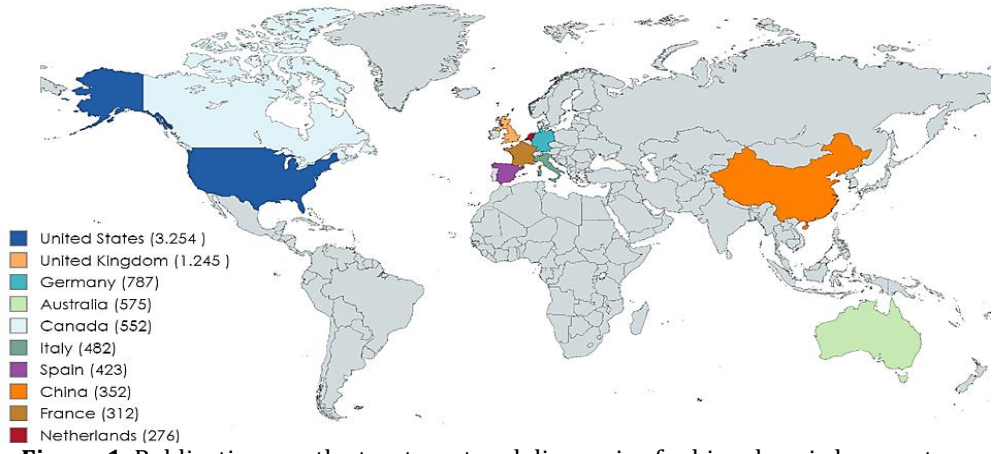


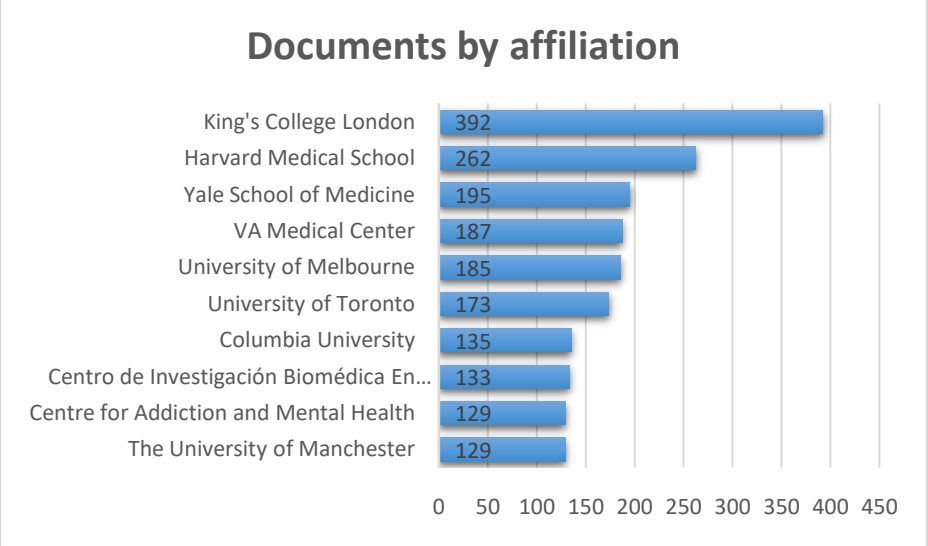
Figure 1. Publications on the treatment and diagnosis of schizophrenia by country
Source: Authors

The results of this analysis show a clear predominance of the United States, which contributes 34.6% of the total publications. This leadership can be attributed to its robust research system, extensive funding, and the existence of numerous institutions dedicated to mental health (MH). For their part, the United Kingdom and Germany also have a significant participation, representing 13.2% and 8.4% of the total documents, respectively. These countries, along with the United States, are recognized for their advanced research programs and international collaboration.

The presence of countries such as Australia, Canada, Italy, Spain, China, France, and the Netherlands in the top 10 underlines the global nature of schizophrenia research. The geographical distribution of scientific production highlights not only the relevance of international collaboration but also how MH research is a priority in various regions of the world. In particular, China's growth in scientific production, although still behind more traditional Western countries, suggests an expansion and strengthening of its research capacity in psychiatry.

Analysis of the most productive institutions

Approximately 160 institutions have contributed to research on the treatment and diagnosis of schizophrenia. Graph 2 presents the 10 most productive institutions in this field. King's College London tops the list with 392 papers, followed by Harvard Medical School with 262 publications. Yale School of Medicine ranks third with 195 papers, while the VA Medical Center has contributed 187 publications. The University of Melbourne and the University of Toronto also stand out with 185 and 173 papers, respectively. Columbia University has produced 135 publications and the Centro de InvestigaciónBiomédicaen Red de Mental health has contributed 133 papers. The University of Manchester and the Center for Addictions and Mental Health complete the list with 129 publications each.



Graph 2. Publications on the treatment and diagnosis of schizophrenia by institutions
Source: Authors

The graph shows that King's College London leads the list with 392 papers, which underlines its prominent position in psychiatry and MH research. This result can be attributed to the institution's research programs, international collaborations, and multidisciplinary approach.

Harvard Medical School and Yale School of Medicine, with 262 and 195 papers respectively, reflect the strength of American institutions in this field. These universities not only have access to extensive financial and technological resources, but are also located at the epicenter of innovation in MH.

The VA Medical Center, with 187 publications, highlights the importance of institutions focused on veteran care in schizophrenia research. This underscores the commitment to understanding and treating schizophrenia in specific populations that may be at higher risk. Meanwhile, the University of Melbourne and the University of Toronto, with 185 and 173 papers respectively, represent the strong contribution of Australian and Canadian institutions, demonstrating a growing commitment to research, in addition to national policy support and funding. On the other hand, Columbia University and the MH Biomedical Research Network Center in Spain also show relevance with 135 and 133 publications, respectively.

Finally, The University of Manchester and the Centre for Addiction and Mental Health, each with 129 papers, reinforce the idea that schizophrenia research is a priority on multiple fronts, ranging from treatment and diagnosis to prevention and rehabilitation. These results indicate a strong international

collaboration and knowledge exchange between these institutions, demonstrating that they are essential for continued progress in the understanding and treatment of schizophrenia.

Analysis of the most influential authors

As shown in Table 1, among the top five, Nordentoft, M.'s team was the most productive with 58 articles published (h-index = 104), followed by Correll, C.U. with 54 articles (h-index = 113), Melle, I. with 50 articles (h-index = 91), Gaebel, W. with 39 articles (h-index = 76), and Rosenheck, R.A. with 37 articles (h-index = 105).

Table 1. Most prolific authors in research on the treatment and diagnosis of schizophrenia

Ranking	Authors	Documents	h_index
1	Nordentoft, M.	58	104
2	Correll, C.U.	54	113
3	Melle, I.	50	91
4	Gaebel, W.	39	76
5	Rosenheck, R.A.	37	105
6	McGorry, P.D.	35	135
7	Mueser, K.T.	35	101
8	Wykes, T.	33	75
9	Tiihonen, J.	31	76
10	Kane, J.M.	30	80

Source: Authors

Table 1 shows that the five most prominent authors who have contributed significantly to the advancement of knowledge in this field are: in position number one is Nordentoft, M with 58 published articles and an h-index of 104, not only evidencing high productivity but also a considerable impact in the field since the h-index indicates that at least 104 of his publications have received 104 citations each. Likewise, Correll, C.U. occupies the second place with 54 articles and an h-index of 113, the highest among the five authors mentioned. This h-index highlights Correll, C.U.'s ability to produce highly cited and recognized research, underlining his prominence in the scientific field.

Similarly, Melle, I. with 50 articles and an h-index of 91, demonstrates a solid combination of productivity and relevance in research. Gaebel, W. on the other hand, with 39 articles and an h-index of 76, shows a notable impact despite having a lower number of publications compared to the leaders. The h-index of 76 indicates a substantial influence in the field of schizophrenia. While Rosenheck, R.A. with 37 articles and an h-index of 105, stands out for having one of the highest h-indices, suggesting that his works are widely cited and have a significant impact on SC.

Analysis of the journals with the greatest impact

Table 2 presents the top 10 journals with the highest number of publications and their recent impact factor (IF). In terms of Journal Citation Reports (JCR), the majority of journals were classified in Q1 (70%), and 90% of journals were classified as psychiatry journals. These results underline the relevance of journals in the dissemination of research on schizophrenia. Journals with a higher number of publications and high impact factors, especially those classified in Q1, are crucial for the advancement of knowledge in this context.

Table 2. Journals with the greatest impact on research on the treatment and diagnosis of schizophrenia

Ranking	Sources	Documents	IF	JCR
1	Schizophrenia Research	324	4,453	Q1
2	Journal Of Clinical Psychiatry	180	5,408	Q1
3	Frontiers In Psychiatry	177	3,2	Q1
4	BMC Psychiatry	152	2,576	Q2
5	Schizophrenia Bulletin	143	7,757	Q1
6	Psychiatric Services	142	2,335	Q1
7	Psychiatry Research	128	2,466	Q2
8	Encephale	102	0,675	Q4
9	Acta Psychiatrica Scandinavica	76	6,128	Q1
10	American Journal Of Psychiatry	76	13,505	Q1

Source: Authors

Q1-ranked journals with high impact factors, such as Schizophrenia Bulletin and American Journal of Psychiatry, are crucial for the advancement of knowledge in this context. The diversity in the number of publications and impact factors across sources reflects the breadth and depth of schizophrenia research and underlines the importance of these journals in the dissemination and application of new scientific discoveries.

Analysis of the most used keywords

Figure 2 shows the network map of keywords, where the size of nodes reflects the frequency of occurrence of each keyword, while the distance between two nodes represents the strength of their association. Keywords with shorter distances were grouped into the same category, roughly reflecting the main topics in research on the treatment and diagnosis of schizophrenia.

Group 1, in red, with a total of 119 items groups together terms related to psychiatric disorders and MH, such as "psychotic disorder", "psychiatric patients", "comorbidity" and "dual diagnosis". Group 2, in green with 74 items, focuses on psychiatry, with keywords such as “dementia”, “cognitive dysfunction” and “delirium”, also including terms such as “encephalitis” and “genetics”. Group 3, in blue, points to antipsychotics, with keywords such as “clozapine”, “minocycline” and “olanzapine”. Group 4, in yellow with 47 items, focuses on schizophrenia, including terms such as “schizophrenic spectrum,” “schizophrenic personality disorder,” “psychotic,” “psychopathology,” and “psychotic symptoms.” Group 5, in purple with 45 items, is focused on “diagnosis”, “treatment”, “neurology” and “symptoms”.

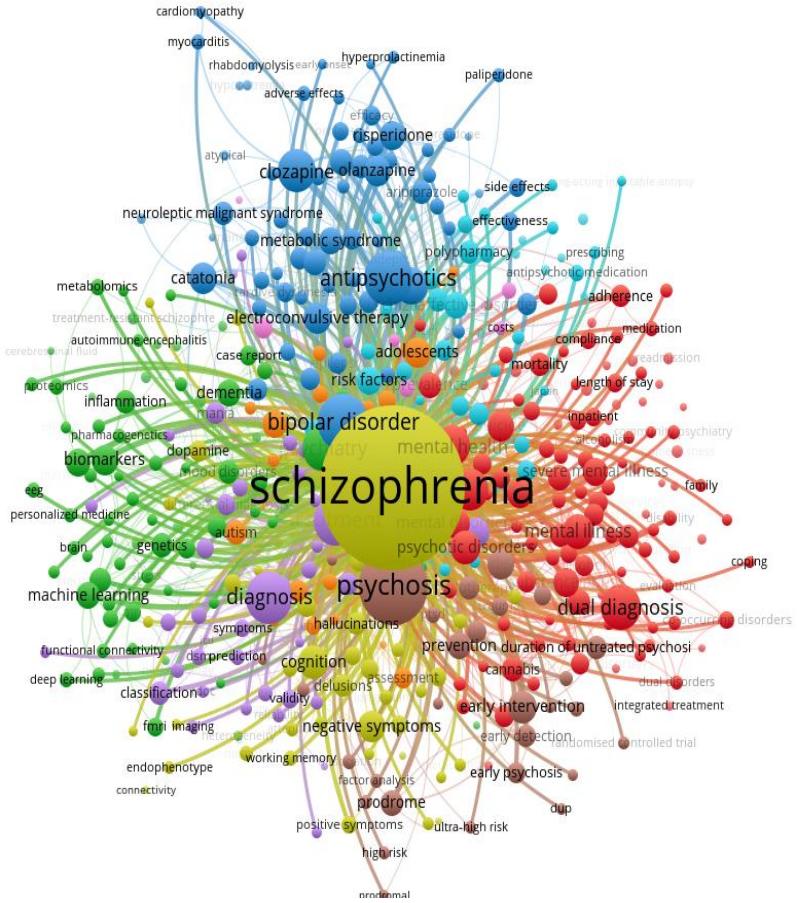


Figure 2. Network map of the most used keywords
Source: Authors

Figure 3 shows the 10 most frequent keywords, with “schizophrenia” being the most used keyword with 3104 occurrences, followed by “psychosis” (N = 696), “depression” (N = 375), “bipolar disorder” (N = 367), “antipsychotics” (N=332), “diagnosis” (N=306).

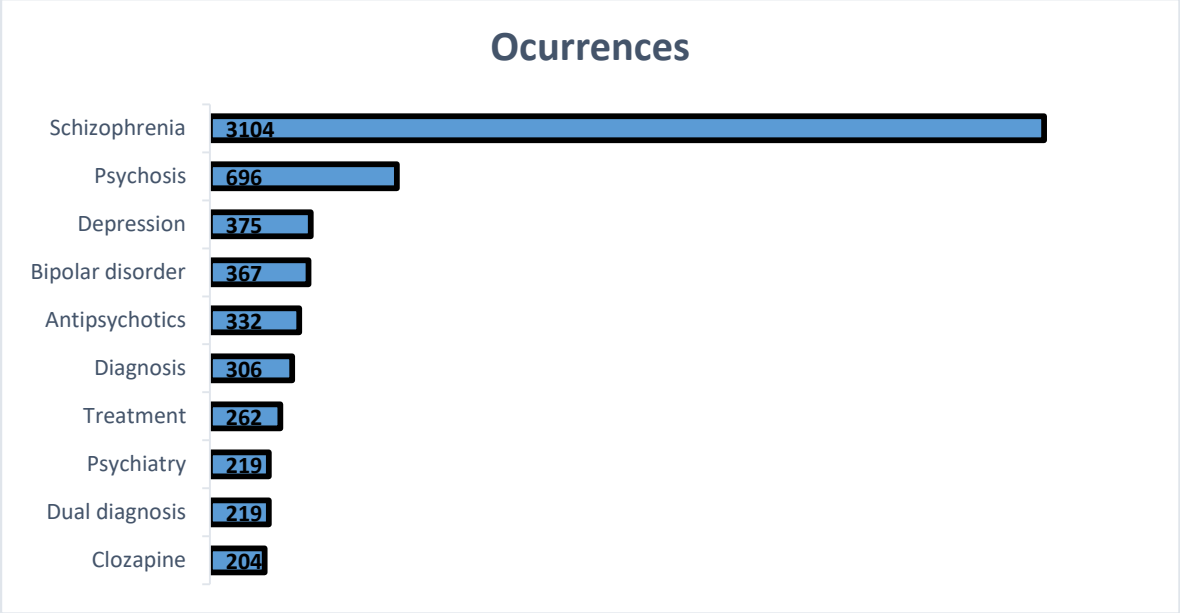


Figure 3. Occurrence of the 10 most frequent keywords
Source: Authors

These results indicate that research on schizophrenia is not only focused on the disorder itself but also on its relationship with other mental disorders and on pharmacological interventions. Furthermore, the high frequency of keywords such as "psychosis", "depression", "bipolar disorder" and "antipsychotics" suggests that the study of schizophrenia focuses on both comorbidities and treatments. These findings highlight the relevance of research in the treatment of schizophrenia, which includes understanding its interaction with other mental disorders and improving available therapeutic strategies.

DISCUSSIONS

The results showed an increasing trend since 2022 as in the bibliometric study developed by Kiraz& Demir (2021), where it was observed that the number of publications also increased substantially since 2011. This expansion of research can be attributed to several key factors, including increased funding and focus on MH by governmental and private organizations, advances in neuroimaging, genetics, and molecular biology technologies that allow for a better understanding of schizophrenia, an increase in public awareness and efforts to destigmatize MD, and an increase in global collaboration and the formation of research networks, facilitating multicenter studies.

On the other hand, more than 90% of the articles were published in English, which is not surprising since the database used consisted mainly of English-language journal articles. Furthermore, English is the predominant academic language worldwide as Rao (2019) explains.

In this BA, most of the relevant articles were published by corresponding authors from various countries such as the United States, the United Kingdom, Germany, Australia, and Canada. Similar patterns have been found in bibliometric studies on other topics in psychiatry such as depression in Wang et al. (2021), and bipolar disorders in Grover et al. (2021). Most collaborations in the treatment and diagnosis of schizophrenia are concentrated in the United States, reflecting its outstanding contribution to this academic field. This suggests the need to strengthen collaborations between other countries and territories.

The findings on the characteristics of international peer-reviewed journals are useful for understanding current trends (Wu et al., 2021). Among the 10 most active journals in research on the treatment and diagnosis of schizophrenia, the majority of editors are located in the United States. Schizophrenia Research was the most productive journal in this field, also standing out in other academic fields related to schizophrenia, such as origins (Kahn, 2020), cognitive impairment in schizophrenia (McCutcheon et al., 2023), and magnetic resonance imaging studies of schizophrenia (Duan & Zhu, 2020). On the other hand, no publisher is based in East Asia, even though China and Japan are major contributors to research on the treatment and diagnosis of schizophrenia. This underlines the need to develop influential international journals in Asia.

The keyword is a relevant indicator in scientific research since it reflects the central content of the relevant article. Keyword co-occurrence analysis could show the closeness and prevalence of research

topics in scientific areas (Deng et al., 2020). In addition to "schizophrenia" and "diagnosis", the most frequently used keywords focus on the possible mechanisms involved in both the diagnosis and treatment of this MD. Bipolar disorder is another frequently used keyword; Schizophrenia and bipolar disorder often present similar clinical characteristics (Grande et al., 2016) and shared genetic factors, making them subjects of joint research (Smeland et al., 2020).

The co-occurrence clustering function roughly divided the entire network into 9 clusters, with each cluster as the main topic. Group 3 in green included keywords about antipsychotic medications. Some studies found that certain antipsychotic drugs may have immunomodulatory effects by targeting cytokines (Zajkowska&Mondelli, 2014). Additionally, other studies found that certain anti-inflammatory medications (e.g., aspirin) could be used as an adjunct to antipsychotic medications, and their safety and effectiveness in treating schizophrenia may be better than antipsychotics alone (Berk et al., 2013).

This study has several limitations. First, data were acquired solely from the SCOPUS database. Although it has been recommended as a leading database among the most reliable for bibliometric studies, some articles may still be overlooked. Second, most of the articles were available in English, which may lead to selection bias in terms of the language of publication. Thirdly, there may be certain inconsistencies in various aspects; for example, an institution may use different names in different periods.

CONCLUSION

In conclusion, research on the treatment and diagnosis of schizophrenia has received increasing attention. The substantial growth in the number of annual publications suggests that this field of research has gained importance globally, with the United States having the largest number of publications. This study has identified key researchers and institutions involved in research related to the treatment and diagnosis of schizophrenia globally. Schizophrenia Research was the most productive journal in this field of research, while American Journal Of Psychiatry has the highest impact factor in this field. The results of this analysis not only provide a more detailed perspective on the current state of schizophrenia research but may also guide future research and development efforts within this important field of psychiatry.

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