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Review article

A bibliometric analysis of research on psychedelics for depression treatment

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ABSTRACT

Psychedelics, as a class of potent psychoactive substances, significantly alter sensory perception and mood, thereby profoundly impacting cognition. Increasing evidence indicates that psychedelics can facilitate individual social function and rapidly and sustainably improve symptoms of moderate and severe depression. The growing interest in psychedelics as potential treatments for depression has led to a substantial increase in related publications; however, the overall quantity and quality of these works remain unclear. To address this issue, we conducted a bibliometric analysis of literature on psychedelic drugs for depression published between 2004 and October 2023. Our study meticulously collected 710 publications, allowing for a comprehensive analysis of bibliographic elements such as annual publication trends, authorship, country of origin, institutional affiliations, journals, and keywords. By visualizing trends, emerging frontiers, popular topics, author collaborations, and influential factors in the field of psychedelics for depression, we have enhanced our understanding of advancements in this area. On this basis, we assert that the regulation of psychedelic drugs is necessary, but it should not hinder the scientific research progress.

1. Introduction

Psychedelics, one of the oldest psychoactive substances discovered by humans, can alter sensory perception, mood, and cognition [1]. Historical records indicate that tribes have used these substances for religious, entertainment, or healing purposes for thousands of years. These substances can induce hallucinations, and are categorized into classical and non-classical psychedelics [2]. Classical psychedelics, such as mescaline, psilocybin, lysergic acid diethylamide (LSD), and dimethyltryptamine (DMT), exemplify a blend of natural and synthetic chemistry. Some can be directly extracted from nature, while others require further chemical reactions [1,3]. In contrast, non-classical psychedelics like methylenedioxymethamphetamine (MDMA) and ketamine are primarily synthetic analogues

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or derivatives [4]. Most psychedelics are 5-hydroxytryptamine receptor 2A (5-HT2A) agonists, which can replace 5-hydroxytryptamine to activate this receptor, causing extensive changes in perception, thinking, emotion, and consciousness [5]. Although the exact mechanism of their therapeutic effects is still being explored, psychedelics targeting the 5-HT system have shown pharmacological benefits in treating various mental disorders, such as depression. 5-HT2A receptors are believed to function as antidepressants by repairing impaired synaptic plasticity in depression models [6,7]. Additionally, the 5-HT2A receptor may alleviate depression symptoms through its impact on neuronal firing and neurotransmitter activity in the brain [8–10]. While the 5-HT2A receptor is implicated in mediating the antidepressant effects of psychedelics, its precise mechanism of action remains unclear, necessitating further research.

Depression, a complex mental health disorder, is primarily characterized by a pervasive low mood and anhedonia [11]. Individuals with depression often exhibit symptoms such as profound sadness, pervasive apathy, and significant difficulty concentrating, which can hinder daily functioning. The loss of interest in previously enjoyed activities exacerbates feelings of isolation and despair [12,13]. In severe cases, these symptoms may lead to suicidal tendencies [14–17]. Currently, several traditional antidepressants are available, including norepinephrine reuptake inhibitors (SNRIs) and serotonin and selective serotonin reuptake inhibitors (SSRIs). Despite the availability of multiple treatment options, traditional antidepressants remain the primary choice for managing depression. However, these medications are often associated with delayed therapeutic effects and high non-response rates, resulting in treatment failure for many patients [18,19]. Surprisingly, approximately one-third of patients do not adequately ameliorate depressive symptoms [20]. Over 300 million people worldwide suffer from depression, with about 15 % of them being severely suicidal [21,22]. This slow onset of action poses a higher suicidal risk in patients with depression, emphasizing the urgent need for rapid relief of suicidal ideation in treatment and drug development [23].

Bibliometrics has a long history and has evolved into an independent discipline since 1969. It has gained widespread recognition and is now a commonly used method for document analysis [24]. This discipline is characterized by the application of quantitative methods to analyze publications within specific fields [25]. Computer technology enables the presentation of visual analysis results through clear and straightforward graphs, facilitating the description and analysis of progress in specific research topics [26]. Additionally, bibliometrics offers several advantages in evaluating academic productivity, summarizing emerging academic frontiers, and predicting research hotspots. This method allows for a comprehensive analysis of information related to countries, institutions, authors, journals, and keywords, offering valuable insights into academic activities from multiple perspectives. In contrast, methods like meta-analyses, reviews, or even experimental studies often fall short in delivering the same level of analytical depth [27].

Despite numerous bibliometric analyses of psychedelics, none have specifically focused on depression [28–31]. While many literature reviews have provided comprehensive and detailed descriptions of the treatment of depression with psychedelic drugs [32–34], a high-quality bibliometric study on this topic is still needed. To gain insights into the research hotspots of psychedelics in depression treatment and to anticipate future trends, we conducted a bibliometric analysis of relevant publications from the past two decades.

2. Materials and methods

2.1. Data Sources and collection methods

For bibliometric analysis, the Web of Science was chosen as the primary digital literature source [35,36]. Consequently, the core collection data from the Web of Science served as the primary data source for this study. The "Science Citation Index Expanded (SCI-EXPANDED)" was utilized for citation indexing. The search strategy employed was "TS = (Hallucinogen *OR Psychedelic*) AND

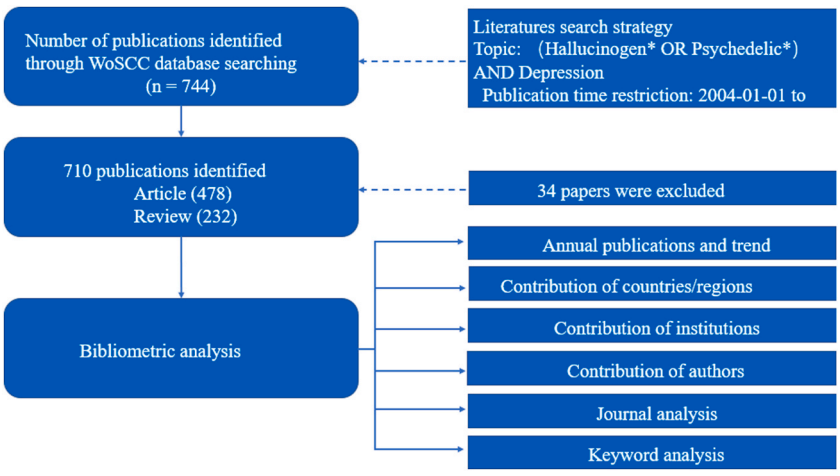

Fig. 1. Flow diagram of literature identification.
The diagram illustrates the process of data crawling and filtering.

Depression," with the publication types limited to "article OR review." Articles are the main criterion for evaluating academic research results and play a crucial role in promoting academic progress and innovation. Reviews are also significant in summarizing topics and predicting advances in specific fields. Therefore, only articles and reviews were included in this study, leading to the exclusion of 34 studies. There were no language restrictions. The search was conducted from January 2004 to October 2023, and the retrieved records were downloaded in "plain text" format to enable detailed information extraction for analysis (Fig. 1).

2.2. Data extraction process

Two researchers independently screened publications and extracted data to enhance the accuracy of the study results. This approach was implemented in our study. Factors such as annual publication volume, authors, countries/regions, institutions, journals, citations, and keywords were extracted and compiled from the collected publications for analysis. Additionally, the corresponding H-index for authors, countries/regions, and institutions was gathered to objectively assess their scientific output and academic contribution in the field of psychedelic treatments for depression. To provide a comprehensive view of the top 10 journals by publication volume, their impact factors and the 2023 Journal Citation Reports were collected.

2.3. Data analysis and visualization

VOSviewer and CiteSpace are two visualization tools that play a significant role in bibliometric research. Although both tools can import data from digital databases and generate visual graphs, each has its distinct advantages. VOSviewer is particularly adept at clustering algorithms, whereas CiteSpace is more effective in illustrating the development of research hotspots [37]. VOSviewer is effective in using clustering algorithms to generate easy-to-understand graphs for visualizing data and identifying latent structures in groupings. Specifically, VOSviewer employs a probability-based method for data standardization and features Network Visualization, Density Visualization, and Overlay Visualization for aspects such as co-occurrence of authors, countries, and keywords [38]. CiteSpace is developed using Java software and produces tabular data and visual maps. This data normalization method, grounded in set theory, analyzes the development processes and trends within a specific domain by creating Timezone and Timeline views using time slices [39]. In summary, VOSviewer and CiteSpace effectively leverage their respective strengths in knowledge mapping. Moreover, despite the availability of approximately 10 bibliometric tools, VOSviewer and CiteSpace are frequently mentioned in the field of bibliometrics [40]. Given these circumstances, we decided to construct the knowledge maps using VOSviewer 1.6.17, developed by the team at Leiden University, and CiteSpace 6.1.3, developed by the team at Drexel University. Considering its unique advantages in data processing, we also utilized Microsoft Excel 2019, developed by Microsoft Corporation.

3. Results

3.1. Annual output

The Web of Science Core Collection (WoSCC) cataloged 710 publications on the treatment of depression using psychedelics, published across 269 journals during the search period. The "Article" category dominated this collection, accounting for 67.32 % (478/710) of the total publications. These works were published in 6 languages, with English being the predominant language at 98.31 % (698/710). The study involved 2878 authors from 53 countries. The annual distribution of publication output, which can reflect the research development level in a specific discipline, has shown an overall upward trend since 2016 (Fig. 2).

3.2. Authorship contributions

During the study period, 2878 authors contributed to the research on psychedelic drugs for depression. According to Price's Law,

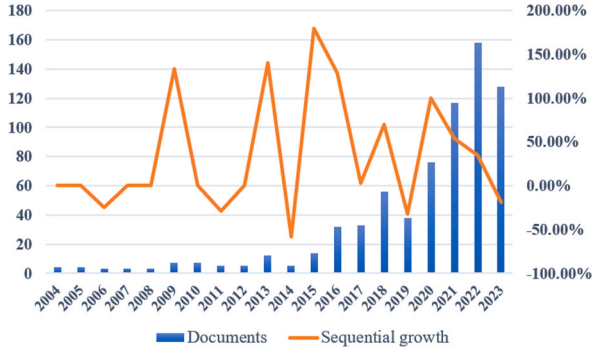

Fig. 2. Annual output.
Global trends and the sequential growth rate of annual publications related to the treatment of psychedelics for depression.

authors with 5 or more publications were considered core contributors, as the most productive authors in this field published up to 33 papers [36,41]. To provide readers with insights into the authors, Table 1 presents the top 15 authors based on publication counts. Notably, the most prolific author in the field of psychedelic drugs for depression was Professor Robin Carhart-Harris from Imperial College London, with 33 publications. Additionally, Professor Carhart-Harris held the highest H-index of 21 in this field, a metric commonly used to evaluate researchers' academic output. Meanwhile, Professor Amanda Feilding from the University of Oxford published a highly regarded work that received an average of 171.55 citations, the highest among her peers. Using VOSviewer, we constructed a co-occurrence network map of 81 authors who each published 5 or more works. The largest group consisted of 63 authors, forming 9 clusters. Notably, the strongest connections were centered around Professor Carhart-Harris. However, connections between clusters were sparse, indicating limited cooperation and communication among different groups, which may hinder the field's development. Therefore, we have selected only the largest group of authors to provide readers with essential information about key scholars in the field and the relationships between them (Fig. 3).

3.3. Contributions by countries or regions

Fifty-three countries or regions contributed to the research on the treatment of psychedelics for depression during the specified retrieval period. Table S1 and Fig. S1 present the 15 countries that produced the most publications. The largest subset included 46 countries, as shown in Fig. 4, indicating limited cooperation between countries in this field. The USA emerged as the most productive and influential country, producing 340 publications and achieving an H-index of 58, thereby confirming its leading position in medical, clinical, and scientific research. Conversely, England published a highly regarded work that received an average of 52.93 citations, the highest among its peers. This reflects the divergence in performance among countries in this research field.

3.4. Contributions by institutions

During the study period, 1033 institutions contributed to the research on the treatment of psychedelics for depression. The institutions were mainly from USA, England, Brazil, Canada, and Netherlands, with the largest number coming from the USA, accounting for 40 %. For reference, the top 10 institutions are listed in Fig. 5. Imperial College London, recognized for having the highest H-index and research output, was regarded as the leading institution in the field. On average, publications from King's College London have been cited 79.48 times, more than those from any other institution. Notably, two institutions in England achieved an average of over 70 citations per paper. This finding is further supported by the observation that publications from institutions in England were widely recognized by researchers in the field.

3.5. Analysis of journals

We found that 710 publications related to the treatment of psychedelics for depression were published in 269 journals by the retrieval deadline. Publications in the top 10 journals accounted for a substantial proportion of the total, reaching 36.48 % with 259 relevant publications (Table 2). Notably, the *Journal of Psychopharmacology* (IF: 4.1, Q2) was the most prolific, publishing 58 publications. Additionally, these publications were highly recognized by researchers, with an average of 65.59 citations. Our analysis revealed that the majority of the top10 journals were classified as Q1 or Q2 in the 2023 Journal Citation Reports (JCR), with 60 % of these productive journals classified as Q2. Furthermore, *Neuropsychopharmacology*, with an impact factor of 7.6, had the highest impact factor among the top 10 journals.

Table 1
Contributions made by authors (The top 15 authors with publications).

Rank	Author	Documents	Citations	Average Citations/Publications	H index
1	Carhart-Harris, Robin	33	3128	94.79	21
2	Dos Santos, Rafael G.	20	1467	73.35	15
3	Griffiths, Roland R.	19	2281	120.05	13
4	Nutt, David J.	17	2544	149.65	12
5	Hallak, Jaime E. C.	16	1172	73.25	16
6	Erritzoe, David	15	1671	111.40	10
7	Roseman, Leor	13	957	73.62	9
8	Johnson, Matthew	13	2076	159.69	7
9	Liechti, Matthias E.	12	411	34.25	8
10	Kaelen, Mendel	11	1269	115.36	9
11	Feilding, Amanda	11	1887	171.55	10
12	Palhano-Fontes, F.	10	482	48.20	7
13	Riba, Jordi	10	1410	141.00	9
14	Barrett, Frederick	10	987	98.70	8
15	Olson, David E.	10	684	68.40	8

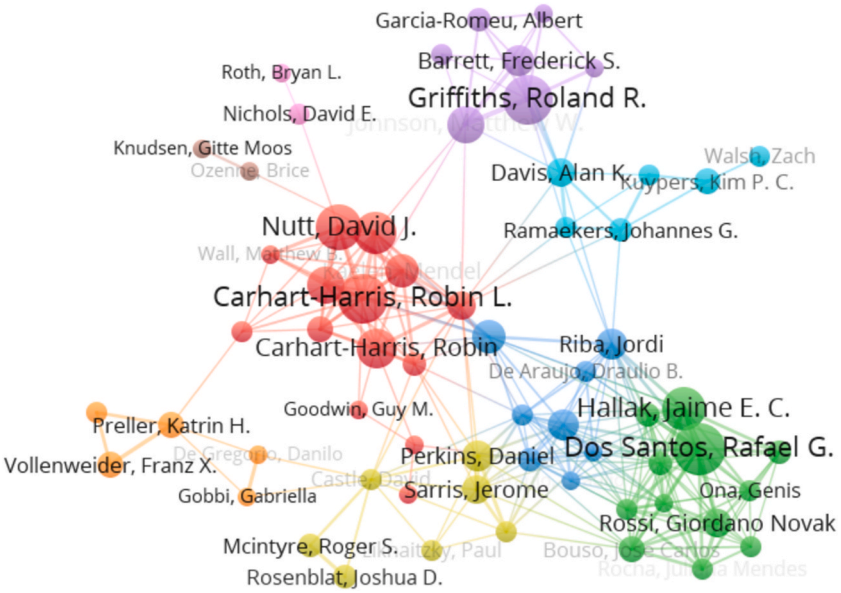

Fig. 3. Contributions by authors.
Mapping of co-occurrence analysis among authors who published at least 5 publications in the field of psychedelic drugs for depression using VOSviewer. Node sizes represent the number of publications, node colors represent different clusters, and line thickness represents the strength of the connection between two authors.

Fig. 4. Contributions by countries or regions.
Mapping of co-occurrence analysis among 46 countries/regions in the field of psychedelic drugs for depression using VOSviewer. Node sizes represent the number of publications, node colors represent different clusters, and line thickness represents the strength of the connection between two countries/regions.

3.6. Characteristics of keywords

Keywords in a publication play a critical role in condensing its core themes. Analyzing the co-occurrence of keywords is essential, as it can reveal the evolution of research hotspots and assist researchers in exploring developmental trends within a field. According to Price's Law, keywords that appeared 15 times or more are considered core keywords, with the maximum frequency noted as 377 appearances in this field. Using VOSviewer, we created a keyword co-occurrence map for 710 publications, selecting 79 keywords that appeared at least 15 times for visualization (Fig. 6A). The recognized keywords in Fig. 6A were clustered into 4 groups, with the main areas depicted in red and green. The red cluster primarily focused on topics related to the connection between depression and psychedelics, while the green cluster was associated with side effects such as abuse and addiction. The keyword co-occurrence network diagram, as presented in the Timezone graph in CiteSpace (Fig. 6B), offered insight into research progress within a temporal context. However, the figure did not clearly illustrate the gradual evolution of research in the treatment of psychedelics for depression. Instead, the research focused on using psychedelics such as LSD, psilocybin, and ketamine for treating depression. Furthermore, burst

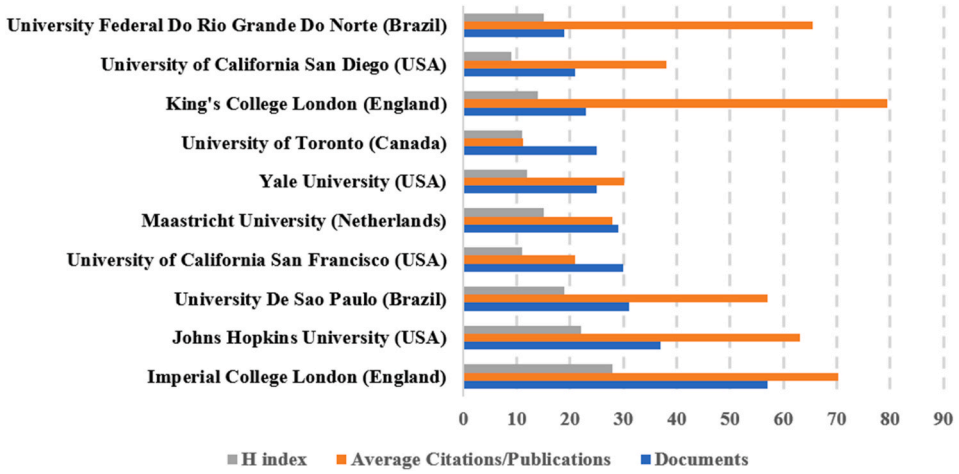

Fig. 5. Contributions by institutions.
The publications, average citations, and H-index of the top 10 institutions.

Table 2
Analysis of journals (The top 10 journals with publications).

Rank	Journal	Documents	Total Citations	Average Citations	Impact FactorTM (2023)	Journal Citation ReportsTM (2023)
1	Journal of Psychopharmacology	58	3804	65.59	4.1	Q2
2	Frontiers in Psychiatry	52	581	11.17	4.7	Q2
3	Psychopharmacology	38	1894	49.84	3.4	Q2
4	Frontiers in Pharmacology	23	1185	51.52	5.6	Q1
5	Journal of Affective Disorders	18	224	12.44	6.6	Q1
6	Neuropsychopharmacology	17	709	41.71	7.6	Q1
7	Scientific Reports	16	771	48.19	4.6	Q2
8	Neuropharmacology	16	738	46.13	4.7	Q1
9	ACS Chemical Neuroscience	11	396	36.00	5.0	Q2
10	Therapeutic Advances in Psychopharmacology	10	324	32.40	4.2	Q2

keywords, which emerge frequently within a specific period and reflect the development and change of research hotspots, can unveil research trends and offer suggestions for future studies. In our study, we evaluated the top 15 burst keywords to reveal recent research trends, although the figure was relatively vague on the evolution of research hotspots, involving keywords such as abuse, addiction, DMT, and LSD (Figure S2).

4. Discussion

Bibliometrics uniquely facilitates the description and analysis of a discipline's or research field's development. VOSviewer offers network and density visualizations for co-authors, co-countries, and co-occurring keywords. In contrast, CiteSpace provides timezone and timeline views within specific time slices, making it indispensable for understanding the evolution and trends of a particular domain.

As powerful psychoactive substances, psychedelics alter sensory perception, emotion, and cognition [1]. They can induce various sensory and perceptual changes, including hallucinations, delusions, synesthesia, and enhanced imagination [42]. According to the World Health Organization, over 300 million people globally suffer from depression, a significant concern [21]. More alarmingly, approximately 15 % of these individuals choose to end their lives by suicide [22]. Depression has emerged as a major public health issue, necessitating increased focus due to its widespread occurrence and substantial impact [21,22]. Furthermore, the limitations of conventional antidepressant therapies highlight the need for new treatments that offer rapid, long-lasting relief and prompt alleviation of suicidal ideation [18,19]. This urgent medical imperative underscores the need for swift and effective interventions to address the complex challenges posed by depression. In recent years, mounting evidence indicates that psychedelics can significantly enhance perception, emotion, and cognition. Moreover, these substances could play a crucial role in promoting individual social functioning and improving moderate to severe depression rapidly and sustainably [43–51]. Consequently, the antidepressant properties of psychedelics have garnered increasing attention within academic and medical communities.

In our study, we collected and analyzed 710 publications on the treatment of psychedelics from a designated digital database. The annual distribution of publication output reflects the level of research development, indicating an increasing focus on the

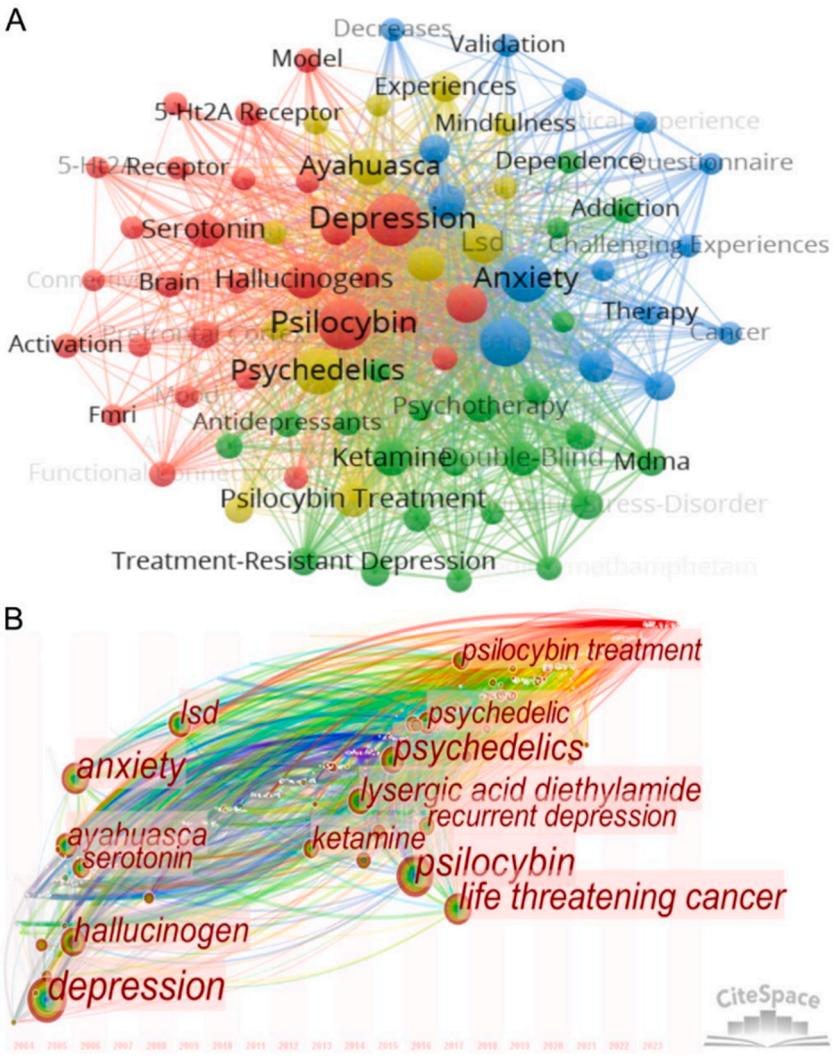

Fig. 6. Characteristics of keywords.
(A) Mapping of co-occurrence analysis among keywords that appeared at least 5 times in publications related to the treatment of psychedelics for depression using VOSviewer. Node sizes represent the number of keyword occurrences, node colors represent different clusters, and line thickness represents the strength of the connection between two keywords. (B) Timezone mapping of keywords in publications related to the treatment of psychedelics for depression using CiteSpace.

antidepressant effects of psychedelics. Professor Robin Carhart-Harris from Imperial College London is considered a leading author, and his work warrants attention from researchers in this field. Additionally, the significance of publications by Professor Amanda Feilding must be acknowledged. Contributions from researchers in the United States and England are especially notable, underscoring the importance of strengthening international cooperation. Imperial College London and King's College London are the leading institutions in terms of research output and impact in this field. It is recommended that researchers pay more attention to their publications and seek to enhance cooperation and communication.

High-quality publications can enhance both the academic impact and the impact factor of a journal. However, it is important to note that a journal's impact factor should only be used as a reference for evaluating its quality. In the field of psychedelic drugs for depression, the significance of keywords in determining research hotspots is evident. Changes in research hotspots in this area have remained relatively obscure, likely due to the strict control and limitations on psychedelic research. In the last century, studies found that psychedelics had some antidepressant effects, and there was clear support among psychiatrists for their use in treating psychiatric disorders such as depression [52]. However, their psychedelic nature, potential neurotoxicity, and abuse risk led to strict controls. These restrictions have impeded researchers from studying the efficacy and mechanisms of psychedelics as antidepressants, resulting in prolonged research gaps. While such regulation is necessary, it should not obstruct the progress of research on these substances. Despite numerous questions and challenges, the increased attention on psychedelics will enhance drug development for depression treatment. Fortunately, considerable efforts are underway to commercialize psychedelics as medicines for depression and other

conditions [53].

5. Limitation

This study has several limitations due to unavoidable circumstances. For instance, we selected the Web of Science Core Collection, a widely recognized database, as the data source and established the "citation index" as SCI-EXPANDED. Given the high specifications and standards of bibliometric analysis software, it is essential to ensure the quality and integrity of data collection. However, the exclusion of other databases (such as Scopus) inevitably resulted in a lack of comprehensive data analysis. Additionally, the information in the WoSCC database is constantly updated, leading to a frequent lag in bibliometric analysis data compared to current data. Furthermore, producing high-quality bibliometrics requires researchers to possess a thorough and nuanced understanding of their field of study, inevitably introducing some subjectivity.

6. Conclusion

In conclusion, our study utilized VOSviewer, CiteSpace, and Excel to visually analyze the field of psychedelics for depression from the perspectives of annual publication, author, country/region, institution, journal, citation, and keywords. We conclude that research on psychedelics is significantly limited by their regulation in most countries. Despite this limitation, there is a growing recognition of the substantial potential of psychedelics for depression. Consequently, it is anticipated that this field will garner increased attention and research focus in the future. Additionally, we believe that while regulating psychotropic drugs is necessary, it should not impede scientific research progress.

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Data availability statement

Data included in article/supp. material/referenced in article.

CRediT authorship contribution statement

Hao Hua: Writing – original draft, Validation, Software, Methodology. **Xinghuo Fu:** Writing – original draft, Methodology, Investigation. **Wenli Wang:** Investigation, Conceptualization. **Sen Wang:** Methodology, Investigation. **Di Wang:** Methodology, Investigation. **Zifeng Wu:** Methodology, Investigation. **Qi Zhang:** Writing – review & editing. **Teng He:** Writing – review & editing, Writing – original draft, Conceptualization. **Chun Yang:** Writing – review & editing, Writing – original draft, Investigation, Conceptualization.

Declaration of competing interest

Dr. Chun Yang is an associate editor for the surgery section of *Heliyon*. The other authors have no conflicts of interest to declare.

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None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e36886.

References

[1] D.E. Nichols, Psychedelics, Pharmacol. Rev. 68 (2016) 264–355.
[2] R. Nardou, E. Sawyer, Y.J. Song, M. Wilkinson, Y. Padovan-Hernandez, J.L. de Deus, et al., Psychedelics reopen the social reward learning critical period, Nature 618 (2023) 790–798.
[3] B. Kelmendi, A.P. Kaye, C. Pittenger, A.C. Kwan, Psychedelics, Curr Biol, vol. 32, 2022, pp. R63–r67.
[4] S. Kamal, M.K. Jha, R. Radhakrishnan, Role of psychedelics in treatment-resistant depression, Psychiatr. Clin. 46 (2023) 291–305.

[5] J.F. López-Giménez, J. González-Maeso, Hallucinogens and serotonin 5-HT(2A) receptor-mediated signaling pathways, Curr Top Behav Neurosci 36 (2018) 45–73.
[6] N.R. Raval, A. Johansen, L.L. Donovan, N.F. Ros, B. Ozenne, H.D. Hansen, et al., A single dose of psilocybin increases synaptic density and decreases 5-HT(2A) receptor density in the pig brain, Int. J. Mol. Sci. 22 (2021).
[7] C. Ly, A.C. Greb, L.P. Cameron, J.M. Wong, E.V. Barragan, P.C. Wilson, et al., Psychedelics promote structural and functional neural plasticity, Cell Rep. 23 (2018) 3170–3182.
[8] Y. Schmid, F. Enzler, P. Gasser, E. Grouzmann, K.H. Preller, F.X. Vollenweider, et al., Acute effects of lysergic acid diethylamide in healthy subjects, Biol. Psychiatr. 78 (2015) 544–553.
[9] N. Hutten, N.L. Mason, P.C. Dolder, E.L. Theunissen, F. Holze, M.E. Liechti, et al., Low doses of LSD acutely increase BDNF blood plasma levels in healthy volunteers, ACS Pharmacol. Transl. Sci. 4 (2021) 461–466.
[10] D. De Gregorio, L. Posa, R. Ochoa-Sanchez, R. McLaughlin, S. Maione, S. Comai, et al., The hallucinogen d-lysergic diethylamide (LSD) decreases dopamine firing activity through 5-HT(1A), D(2) and TAAR(1) receptors, Pharmacol. Res. 113 (2016) 81–91.
[11] D.S. Hasin, A.L. Sarvet, J.L. Meyers, T.D. Saha, W.J. Ruan, M. Stohl, et al., Epidemiology of adult DSM-5 major depressive disorder and its specifiers in the United States, JAMA Psychiatr. 75 (2018) 336–346.
[12] S.G. Hofmann, A.T. Sawyer, A. Fang, A. Asnaani, Emotion dysregulation model of mood and anxiety disorders, Depress. Anxiety 29 (2012) 409–416.
[13] M. Rincón-Cortés, A.A. Grace, Antidepressant effects of ketamine on depression-related phenotypes and dopamine dysfunction in rodent models of stress, Behav. Brain Res. 379 (2020) 112367.
[14] I. Conejero, E. Olié, R. Calati, D. Ducasse, P. Courtet, Psychological pain, depression, and suicide: recent evidences and future directions, Curr. Psychiatr. Rep. 20 (2018) 33.
[15] L.S. Rotenstein, M.A. Ramos, M. Torre, J.B. Segal, M.J. Peluso, C. Guille, et al., Prevalence of depression, depressive symptoms, and suicidal ideation among medical students: a systematic review and meta-analysis, JAMA 316 (2016) 2214–2236.
[16] I.H. Stanley, J.W. Boffa, M.L. Rogers, M.A. Hom, B.J. Albanese, C. Chu, et al., Anxiety sensitivity and suicidal ideation/suicide risk: a meta-analysis, J. Consult. Clin. Psychol. 86 (2018) 946–960.
[17] A. Lengvenyte, R. Strumila, E. Olié, P. Courtet, Ketamine and esketamine for crisis management in patients with depression: why, whom, and how? Eur. Neuropsychopharmacol 57 (2022) 88–104.
[18] N. Can, D. Can Ö, D. Osmaniye, Ü. Demir Özkay, Synthesis of some novel thiadiazole derivative compounds and screening their antidepressant-like activities, Molecules 23 (2018).
[19] M. Kato, H. Hori, T. Inoue, J. Iga, M. Iwata, T. Inagaki, et al., Discontinuation of antidepressants after remission with antidepressant medication in major depressive disorder: a systematic review and meta-analysis, Mol. Psychiatr. 26 (2021) 118–133.
[20] W.W. Ishak, J.M. Greenberg, R.M. Cohen, Predicting relapse in major depressive disorder using patient-reported outcomes of depressive symptom severity, functioning, and quality of life in the Individual Burden of Illness Index for Depression (IBI-D), J. Affect. Disord. 151 (2013) 59–65.
[21] M.J. Friedrich, Depression is the leading cause of disability around the World, JAMA 317 (2017) 1517.
[22] L. Orsolini, R. Latini, M. Pompili, G. Serafini, U. Volpe, F. Vellante, et al., Understanding the complex of suicide in depression: from research to clinics, Psychiatry Investig 17 (2020) 207–221.
[23] K. Kleine-Budde, R. Müller, W. Kawohl, A. Bramesfeld, J. Moock, W. Rössler, The cost of depression - a cost analysis from a large database, J. Affect. Disord. 147 (2013) 137–143.
[24] A. Diem, S.C. Wolter, The use of bibliometrics to measure research performance in education sciences, Res. High. Educ. 54 (2012) 86–114.
[25] P. Mayr, A. Scharnhorst, Scientometrics and information retrieval: weak-links revitalized, Scientometrics 102 (2014) 2193–2199.
[26] J.M. Merigó, A.M. Gil-Lafuente, R.R. Yager, An overview of fuzzy research with bibliometric indicators, Appl. Soft Comput. 27 (2015) 420–433.
[27] A.F. Choudhri, A. Siddiqui, N.R. Khan, H.L. Cohen, Understanding bibliometric parameters and analysis, Radiographics 35 (2015) 736–746.
[28] J. Weleff, T.J. Akiki, B.S. Barnett, Bibliometric analysis of academic journal articles reporting results of psychedelic clinical studies, J. Psychoact. Drugs 55 (2023) 434–444.
[29] A. Hadar, J. David, N. Shalit, L. Roseman, R. Gross, B. Sessa, et al., The psychedelic renaissance in clinical research: a bibliometric analysis of three decades of human studies with psychedelics, J. Psychoact. Drugs 55 (2023) 1–10.
[30] D.W. Lawrence, B. Sharma, R.R. Griffiths, R. Carhart-Harris, Trends in the top-cited articles on classic psychedelics, J. Psychoact. Drugs 53 (2021) 283–298.
[31] M. Solmi, C. Chen, C. Daure, A. Buot, M. Ljuslin, V. Verroust, et al., A century of research on psychedelics: a scientometric analysis on trends and knowledge maps of hallucinogens, entactogens, entheogens and dissociative drugs, Eur. Neuropsychopharmacol 64 (2022) 44–60.
[32] C.M. Reiff, E.E. Richman, C.B. Nemeroff, L.L. Carpenter, A.S. Widge, C.I. Rodriguez, et al., Psychedelics and psychedelic-assisted psychotherapy, Am. J. Psychiatr. 177 (2020) 391–410.
[33] R.L. Carhart-Harris, G.M. Goodwin, The therapeutic potential of psychedelic drugs: past, present, and future, Neuropsychopharmacology 42 (2017) 2105–2113.
[34] S. Muttoni, M. Ardissino, C. John, Classical psychedelics for the treatment of depression and anxiety: a systematic review, J. Affect. Disord. 258 (2019) 11–24.
[35] X. Ding, Z. Yang, Knowledge mapping of platform research: a visual analysis using VOSviewer and CiteSpace, Electron. Commer. Res. 22 (2022) (2020) 787–809.
[36] T. He, D. Wang, Z. Wu, C. Huang, X. Xu, X. Xu, et al., A bibliometric analysis of research on (R)-ketamine from 2002 to 2021, Neuropharmacology 218 (2022) 109207.
[37] C. Chen, R. Dubin, M.C. Kim, Emerging trends and new developments in regenerative medicine: a scientometric update (2000 - 2014), Expet Opin. Biol. Ther. 14 (2014) 1295–1317.
[38] N.J. van Eck, L. Waltman, Software survey: VOSviewer, a computer program for bibliometric mapping, Scientometrics 84 (2010) 523–538.
[39] C. Chen, CiteSpace II: detecting and visualizing emerging trends and transient patterns in scientific literature, J. Am. Soc. Inf. Sci. Technol. 57 (2006) 359–377.
[40] X. Pan, E. Yan, M. Cui, W. Hua, Examining the usage, citation, and diffusion patterns of bibliometric mapping software: a comparative study of three tools, Journal of Informetrics 12 (2018) 481–493.
[41] T. He, Z. Wu, X. Zhang, H. Liu, Y. Wang, R. Jiang, et al., A bibliometric analysis of research on the role of BDNF in depression and treatment, Biomolecules 12 (2022).
[42] F.X. Vollenweider, K.H. Preller, Psychedelic drugs: neurobiology and potential for treatment of psychiatric disorders, Nat. Rev. Neurosci. 21 (2020) 611–624.
[43] L.P. Cameron, R.J. Tombari, J. Lu, A.J. Pell, Z.Q. Hurley, Y. Ehinger, et al., A non-hallucinogenic psychedelic analogue with therapeutic potential, Nature 589 (2021) 474–479.
[44] R.L. Carhart-Harris, M. Bolstridge, C.M.J. Day, J. Rucker, R. Watts, D.E. Erritzoe, et al., Psilocybin with psychological support for treatment-resistant depression: six-month follow-up, Psychopharmacology (Berl) 235 (2018) 399–408.
[45] R.L. Carhart-Harris, L. Roseman, M. Bolstridge, L. Demetriou, J.N. Pannekoek, M.B. Wall, et al., Psilocybin for treatment-resistant depression: fMRI-measured brain mechanisms, Sci. Rep. 7 (2017) 13187.
[46] R.R. Griffiths, M.W. Johnson, M.A. Carducci, A. Umbricht, W.A. Richards, B.D. Richards, et al., Psilocybin produces substantial and sustained decreases in depression and anxiety in patients with life-threatening cancer: a randomized double-blind trial, J. Psychopharmacol. 30 (2016) 1181–1197.
[47] N. Hutten, N.L. Mason, P.C. Dolder, K.P.C. Kuypers, Self-rated effectiveness of microdosing with psychedelics for mental and physical health problems among microdosers, Front. Psychiatr. 10 (2019) 672.
[48] H.C. Denber, A. Van West, X. Studies on mescaline, Psychological changes before and after mescaline as measured by the M. M. P. I, Am. J. Psychiatr. 115 (1958) 546.
[49] G. Agin-Liebes, T.F. Haas, R. Lancelotta, M.V. Uthaug, J.G. Ramaekers, A.K. Davis, Naturalistic use of mescaline is associated with self-reported psychiatric improvements and enduring positive life changes, ACS Pharmacol. Transl. Sci. 4 (2021) 543–552.

[50] D. De Gregorio, J. Popic, J.P. Enns, A. Inserra, A. Skalecka, A. Markopoulos, et al., Lysergic acid diethylamide (LSD) promotes social behavior through mTORC1 in the excitatory neurotransmission, Proc Natl Acad Sci U S A (2021) 118.
[51] J. Rhead, The psychedelic explorer's guide: safe, therapeutic, and sacred journeys, J. Psychoact. Drugs 46 (2014) 347–348.
[52] B.S. Barnett, M. Arakelian, D. Beebe, J. Ontko, C. Riegal, W.O. Siu, et al., American psychiatrists' opinions about classic hallucinogens and their potential therapeutic applications: a 7-year follow-up survey, Psychedelic Medicine 2 (2023) 1–9.
[53] J.S. Aday, B.S. Barnett, D. Grossman, K.S. Murnane, C.D. Nichols, P.S. Hendricks, Commercialization Psychedelic, A wide-spanning overview of the emerging psychedelic industry, Psychedelic Medicine 1 (2023) 150–165.