REVIEW ARTICLE

Bibliometric Insights Into the Dynamics of Schizophrenia and Obesity Research

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ABSTRACT

Schizophrenia and obesity are two complicated health disorders that affect both individuals and society. Comprehensive research that investigates the interplay between these two conditions is required. Therefore, a bibliometric analysis was performed to investigate the landscape of schizophrenia and obesity research. The bibliometric analysis was conducted using the Scopus analyser and VOSviewer software. There have been fluctuations in annual output. De Hert is the most influential contributor in this research field, where medicine dominates as the primary subject area (57.5%). A study on the prevalence of metabolic syndrome among schizophrenia is the most cited article. The studies were carried out by distinct clusters of experts, with the United States being the leading contributor. An analysis of the author's keywords showed five main areas of interest. This bibliometric analysis offers an in-depth review of the knowledge gap in these fields and suggests specific recommendations for future research.
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INTRODUCTION

Schizophrenia is a serious mental disorder that manifests itself through distorted thinking, emotions, and perceptions [1]. Conversely, obesity is a chronic condition linked to the excessive build-up of body fat [2]. Both issues pose significant challenges to public health globally [3, 4]. Over the years, psychiatric research has evolved to discover profound developments in the study of schizophrenia. Concurrently, the rapidly developing field of obesity research has experienced ongoing challenges. As obesity is a prevalent issue among schizophrenia patients, it has become a fascinating area of research in the field of mental health and metabolic disorders [5, 6]. The intersection between these two conditions is complex and is gaining significant attention. Over the past few decades, there has been a notable increase in scientific study efforts to unravel these interactions.

Several studies have investigated the relationship between obesity risk and schizophrenia psychopathology. A recent literature review by Li and Hester (2021) systematically examined studies examining the association between schizophrenia and obesity severity. The findings highlight the complexity of the relationship between schizophrenia and obesity and suggest that weight changes in individuals with schizophrenia are caused by multiple factors, including medication effects and specific symptomatology [7]. Furthermore, a scoping review by Singh et al (2022) found preliminary evidence from preclinical and clinical studies that gut microbiota composition changes are associated with schizophrenia pathogenesis and antipsychotic-induced metabolic perturbations [8]. The overlap between these two conditions poses critical questions about potential shared etiological factors, bidirectional relationships, and the implications for holistic patient care [9, 10].

Bibliometric analysis helps elucidate the existing literature, including publication trends, document

characteristics, and the impact of research in a specific field [11]. By analysing the distribution pattern, quantitative relationship, and changing laws of document information, bibliometric analysis allows common themes, emerging topics, and research trends to be identified [12]. Additionally, bibliometric analysis methods, such as bibliographic mapping, provide visual representations that aid in visualising research results and trends [13]. It offers quantitative and qualitative insights into the literature, which can provide a comprehensive understanding of the research landscape [11]. Due to these advantages, bibliometric analysis plays a crucial role in gaining insights, identifying trends, and making informed decisions based on the existing literature in a specific field.

This bibliometric analysis aims to provide a thorough overview of scientific literature by highlighting important figures, trends, and developing issues in schizophrenia and obesity research. Using visual aids, such as figures and mapping, enhances the comprehension of the complex dynamics within schizophrenia and obesity research. This analysis quantifies research growth and impact, identifies prolific authors and influential publications, and unveils collaborative networks that shape the intellectual landscape [14]. The study will also highlight knowledge gaps in this field, offering guidance for future research and encouraging interdisciplinary collaborations [15]. By identifying and examining these key contributors, the intellectual foundations that have significantly shaped the discourse in schizophrenia and obesity research could be discovered.

Research questions:

1. What are the publication trends in the field of schizophrenia and obesity research?
2. Who are the most prolific authors in the field of schizophrenia and obesity research?
3. What is the prevailing subject area within the current landscape of schizophrenia and obesity research?
4. Which are the most highly cited documents in the field of schizophrenia and obesity research?
5. What are the patterns of co-authorship analysis of authors and countries in schizophrenia and obesity research?
6. What are the key themes and topics that emerge from the analysis of co-occurring keywords in schizophrenia and obesity research?

METHODS

This study included the most reputable publications to better understand the theoretical perspective of the evolution of the research domain. To accomplish this, the study utilised the Scopus database, a reliable source for data collection that has been recognized for its comprehensive coverage [16]. Articles published in meticulously peer-reviewed and high-quality academic journals were also considered to include top-tier publications [17].

Data Search Strategy

The bibliometric methodology employed in this study involved initiating research by querying the Scopus database using a specific search string: (TITLE(schizophrenia) AND TITLE-ABS-KEY(obesity)). This first query was done on 3rd January 2024 and yielded a total of 1168 articles. Subsequently, the research methodology underwent refinement, adjusting parameters such as publication year, document type, publication stage, and language to meet specific criteria. The final keyword search strings used were as follows: TITLE (schizophrenia) AND TITLE-ABS-KEY (obesity)) AND PUBYEAR > 2002 AND PUBYEAR < 2024 AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "re")) AND (LIMIT-TO (LANGUAGE, "English"). This process resulted in a dataset of 932 articles, which was then subjected to bibliometric analysis.

Data Analysis

Datasets with information on the publication year, title, author, journal, citation, and keywords were obtained from the Scopus database, spanning 2003 to December 2023. Subsequently, these datasets underwent analysis using the VOSviewer software version 1.6.20, where in-depth exploration was done using the software's clustering and mapping methods [18]. The software emphasizes placing items in a low-dimensional space such that the accurate reflection of relatedness and similarity between any two items is captured by the distance between them [19]. Visualizing the dataset using VOSviewer revealed patterns based on mathematical relationships, allowing for keyword co-occurrence analysis, citation analysis, and co-citation analysis.

Development of the research area over time was evaluated using keyword co-occurrence analysis, which has been proven to be successful in identifying popular topics across different fields [20]. Additionally, citation analysis is valuable for identifying key research issues, trends, and techniques, along with exploring the historical relevance of a discipline's primary focus [21]. Document co-citation analysis is a commonly applied bibliometric method that utilizes network theory to produce maps identifying the relevant structure of the data method [22-24].

RESULT

Publication Trends

Over the last twenty years, there have been several dynamic research discoveries in the schizophrenia and obesity field with variations in the annual output publications. The publication trends in this area indicate fluctuations in research output. Looking back, there were fewer publications in the earlier years, especially from 2003 to 2005; research into the relationship between schizophrenia and obesity began during this period. Then, research output more than doubled in the next

three years. The year 2010 witnessed a notable decrease with 34 documents, suggesting a temporary decline in research output. Periods of heightened research activity occurred in 2011 and 2013, with 54 and 57 documents, respectively. The years 2014 and 2016 were especially productive, each recording 61 publications. However, 2020 saw a slight drop to 42 documents, likely influenced by global events. The succeeding year, 2021, gained back the momentum with 62 publications, indicating a consistently high scholarly engagement. Followed by the most recent years, 2022 and 2023 witnessed a peak in productivity with 57 and 58 documents, respectively.

Publication by Authors

The most active and influential author in schizophrenia and obesity research over the past two decades shows De Hert emerges as the most influential contributor, having authored 18 publications. Remington and Correll are close behind, each with notable publication records with 15 and 14 documents, respectively. Ganguli, Strassnig, Sugawara, Vancampfort, and Yasui-Furukori are also noteworthy contributors, each with 13 publications. Fan, Wysokiński, and Zhang contribute significantly with 12 publications each. Their consistent productivity represents a sustained interest and expertise across various dimensions of schizophrenia and obesity research. Boyer, Cohn, Goff, and Henderson round out the list with 11 and 10 publications, respectively. While their output is slightly lower than the top contributors, it still signifies a substantial contribution to the field.

Publication by Subject Area

Medicine (57.5%) showed a clear dominance as the primary subject area for research on schizophrenia and obesity (Fig. 1). Subfields within Medicine, like Neuroscience (17.8%) and Biochemistry, Genetics & Molecular Biology (4.5%), play a significant role in understanding schizophrenia and obesity. Other subject areas, such as Psychology (4.2%) and Nursing (3.5%), highlight the interdisciplinary nature of this research field; this indicates the psychological and clinical aspects of these conditions. In addition, Pharmacology, Toxicology, and Pharmaceutics (7.4%) had been published as subject areas of interest due to the importance of medication in schizophrenia. While medicine and health sciences are dominant, other research fields, such as Social Sciences (0.7%) and Arts and Humanities (0.6%), are also involved in this research area.

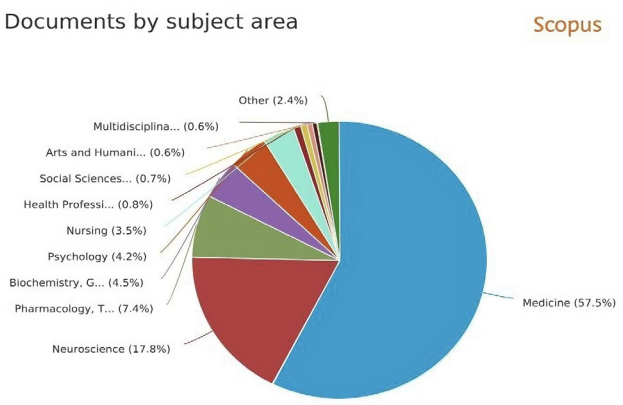

Fig. 1: Subject area classification

Highly Cited Documents

The top 10 highly cited documents are shown in Table I. The study done by McEvoy et al. (2005) is regarded as a foundational study in this field, as it reveals the prevalence of metabolic syndrome in schizophrenia patients and has been cited 1023 times [25]. The research conducted by Hennekens et al. (2005) elucidated the link between schizophrenia and the risk of cardiovascular disease [26]. With 889 citations, this study significantly contributes to the broader understanding of schizophrenia. The systematic review and meta-analysis done by Vancampfort et al. (2015) and Mitchell et al. (2013) delve into the risk of metabolic syndrome across various psychiatric disorders, including schizophrenia, with 791 and 750 citations, respectively [27, 28]. The emphasis placed by Marder et al. (2004) on physical health monitoring for schizophrenia patients underscores the necessity of holistic care beyond psychiatric considerations, and this study was cited 729 times [29]. Other highly cited studies included the exploration of the neurobiology of schizophrenia (Ross et al., 2006) (560 citations), the assessment of early mortality in schizophrenia (Laursen et al., 2014) (544 citations), the study on clinical practice guidelines for schizophrenia management (Galletly et al., 2016) (537 citations), and the investigation of the effects of psychotropic medications on physical health (Correll et al., 2015) (535 citations) [30-33]. Additionally, De Hert et al. (2009) conducted a comprehensive review of metabolic syndrome in schizophrenia, with 469 citations; their study consolidates existing knowledge and enhances our understanding of the metabolic aspects of the disorder [34].

Table I: Top 10 highly cited articles

Authors	Title	Year	Source Title	Number of Citations
McEvoy J.P., et al. [25]	Prevalence of the metabolic syndrome in patients with schizophrenia: Baseline results from the Clinical Antipsychotic Trials of Intervention Effectiveness (CATIE) schizophrenia trial and comparison with national estimates from NHANES III	2005	Schizophrenia Research	1023
Hennekens C.H., et al. [26]	Schizophrenia and increased risks of cardiovascular disease	2005	American Heart Journal	889
Vancampfort D., et al. [27]	Risk of metabolic syndrome and its components in people with schizophrenia and related psychotic disorders, bipolar disorder and major depressive disorder: A systematic review and meta-analysis	2015	World Psychiatry	791
Mitchell A.J., et al. [28]	Prevalence of metabolic syndrome and metabolic abnormalities in schizophrenia and related disorders-a systematic review and meta-analysis	2013	Schizophrenia Bulletin	750
Marder S.R., et al. [29]	Physical health monitoring of patients with schizophrenia	2004	American Journal of Psychiatry	729
Ross C.A., et al. [30]	Neurobiology of Schizophrenia	2006	Neuron	560
Laursen T.M., et al. [31]	Excess early mortality in schizophrenia	2014	Annual Review of Clinical Psychology	544
Galletly C., et al. [32]	Royal Australian and New Zealand College of Psychiatrists clinical practice guidelines for the management of schizophrenia and related disorders	2016	Australian and New Zealand Journal of Psychiatry	537
Correll C.U., et al. [33]	Effects of antipsychotics, antidepressants, and mood stabilisers on risk for physical diseases in people with schizophrenia, depression and bipolar disorder	2015	World Psychiatry	535
De Hert M., et al. [34]	Metabolic syndrome in people with schizophrenia: A review	2009	World Psychiatry	469

Co-authorship Analysis of Authors and Countries

Fig. 2 shows the co-authorship analysis of authors and countries. Several distinct clusters of researchers appear on the map, and each of them is likely to focus on specific aspects of these complex diseases. One prominent cluster involves Ahn, Kim, and Hong, who appeared to be at the forefront in this field, focusing on the genetics and biology of schizophrenia. Another cluster, which includes researchers such as Kisely, Lee, and Ebdrup, focuses more on the psychosocial and social aspects of schizophrenia. The cluster around Meyer, Ganguli, and Garcia-Garcia seems to close the gap between these two fields of schizophrenia and obesity. Furthermore, smaller clusters around authors like Krogh, Fink-Jensen, Knop, Mьller, and Strassnig indicate ongoing investigation of specific subtopics within schizophrenia and obesity research. The map also includes individual researchers with significant contributions, such as Kane, Liu, Chen, Hoffmann, and De Hert.

The leading country in schizophrenia and obesity research is the United States, followed by China, Canada, and Australia (Fig. 2). Notably, several East Asian countries, such as Japan, Taiwan, and India, feature prominently on the global scientific collaboration landscape, indicating a growing research interest in these countries. There are various clusters of countries on the map; a smaller one consists of Spain, France, Italy, and Belgium whereby these countries have collaborated on research, but they have not collaborated as extensively with other countries in the network. The map also displays some isolated countries, such as Venezuela and Lebanon. Despite their lack of collaboration with many other countries in the network, they have contributed to some publications.

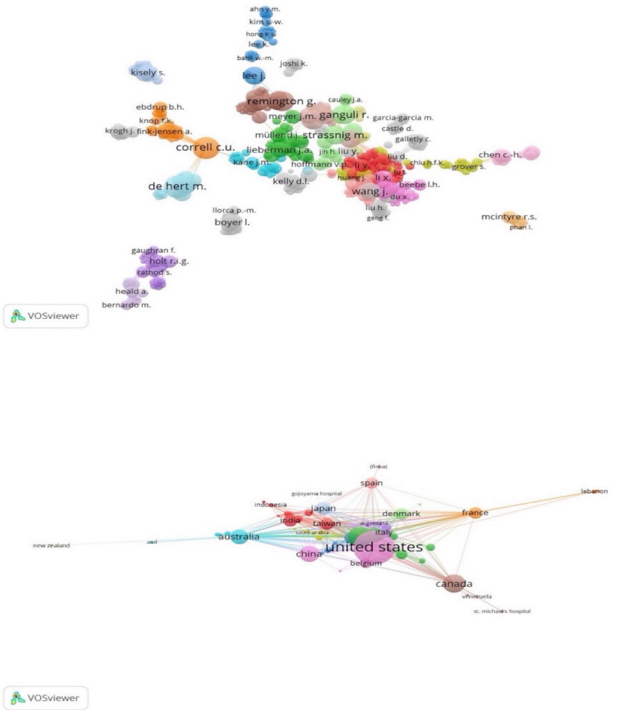

Fig. 2: Network visualisation map of co-authorship analysis by authors and countries

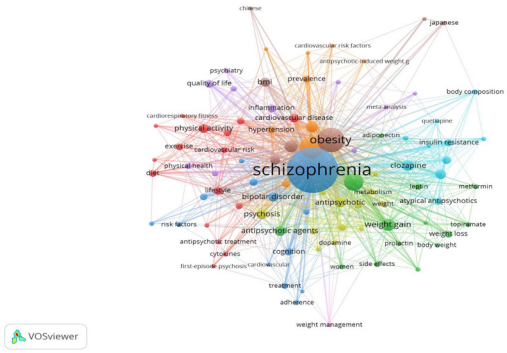

Fig. 3: Network visualisation map of authors' keywords

DISCUSSION

Publication trends in schizophrenia and obesity research have dynamically evolved over the past two decades. The significant increase in publications since 2005 suggests that the complex relationship between schizophrenia and obesity is becoming increasingly recognized and reflects the maturation of research in this interdisciplinary field [35, 36]. The subsequent decline in 2020 can be attributed to external factors such as global events, changes in research priorities, and methodological changes. The notable spikes in 2021, 2022, and 2023 reflect continued interest and productivity in this research area. Despite the increasing evidence supporting the intricate association between these conditions, there are still literature gaps that need to be investigated, such as the underlying mechanisms connecting obesity and schizophrenia as well as the formulation of effective interventions [37-39].

De Hert has been a prominent author in the fields of obesity and schizophrenia research over the last twenty years, as reflected by the remarkably large number of citations (469 citations) for one of his reviews on metabolic syndrome in people with schizophrenia. Notably, this important study is a cooperation with Vancampfort, another well-known researcher in the field [34]. Vancampfort reciprocally collaborated with De Hert to demonstrate a mutual engagement in a research venture. Their joint efforts led to a comprehensive review of the risk of metabolic syndrome and its components in individuals with schizophrenia [27]. Examining the publications authored by Remington, this review explores his research collaboration with many

Co-occurrence Analysis of Authors' Keywords

The findings presented in Fig. 3 illustrate five separate clusters of the authors' keywords, each indicating a significant area of interest in the study of schizophrenia and obesity. The red cluster, in particular, delves into the cardiovascular aspects of these conditions and prominently features terms like "cardiovascular risk factors," "hypertension," "physical activity," and "exercise". The green cluster centers on the metabolic and biological factors of obesity, exploring terms such as "adiponectin," "inflammation," "body composition," and "diet". On the other hand, the blue cluster examines the psychological and social aspects of schizophrenia, examining terms like "quality of life," "psychosis," and "cognition,". The purple cluster is focused on exploring treatment and management strategies for schizophrenia and obesity. It features terms such as "weight management," "adherence," "lifestyle," and "metformin," reflecting the ongoing search for effective interventions for these complex conditions. Meanwhile, the smaller yellow cluster is focused on the genetic and neurobiological underpinnings of schizophrenia, with terms like "dopamine," "cytokines," and "brain".

different authors on interventions for weight gain among schizophrenia patients [40-43]. The consistent research efforts from the authors suggest a collaborative and multidisciplinary approach to elucidate the relationship between schizophrenia and obesity.

Unsurprisingly, the majority of works on schizophrenia and obesity have been published under the subject of Medicine. However, the subfields such as Neuroscience, Biochemistry, Genetics & Molecular Biology reflect the focus of research during these twenty years and indicate ongoing research into the neurological and biological basis of schizophrenia and obesity. Despite the proliferation of medical research, the presence of Psychology and Nursing signifies the importance of psychological and clinical perspectives in the management of these disorders. The inclusion of Pharmacology, Toxicology & Pharmaceutics indicates the importance of drug development and treatment optimization. Furthermore, the presence of Social Sciences and Arts & Humanities signifies new research directions for examining the social and cultural factors that influence the co-occurrence of schizophrenia and obesity, reflecting the interdisciplinary nature of this research field.

The most frequently cited article by McEvoy et al. (2005) provides insights into metabolic health conditions associated with schizophrenia, establishing a benchmark for subsequent research [25]. Various aspects of the connection between schizophrenia and obesity are represented by the higher number of citations of the articles which delve into the metabolic implications [27, 28, 34], cardiovascular risks [26], clinical management [29, 32], neurobiology [30], mortality patterns [31], and antipsychotic effects [33]. Among these studies, the key factor that stands out is their interdisciplinary approach, which highlights the complex nature of the relationship between schizophrenia and obesity. These studies incorporate evidence from numerous fields, such as endocrinology, cardiology, neuroscience, and pharmacology, to provide a more holistic understanding of the complex relationship between schizophrenia and obesity.

As seen in the network visualisation map, several researchers appear to be working on different aspects of complex diseases related to schizophrenia and obesity. The distinct clusters of authors represent the various areas of specialized research discoveries, from genetic and molecular foundations [44-46] to psychological and social factors [47, 48]. Meanwhile, the co-authorship analysis by countries reveals global trends in collaboration. These trends include the dominance of Western nations, the development of Asian collaborations, and the clustering of rising and regional economies. The map also indicates cross-country collaboration in different regions, such as the United States and China, Europe and Australia, and South America and Asia. These researchers from different countries are working together to examine the complex association between schizophrenia and obesity. The need for global expertise and data sharing reflects the complex challenges of investigating these conditions.

The co-occurrence analysis of the authors' keywords offers insightful information about the changes in study themes over time. Notable relationships, including the interaction between metabolic characteristics and cardiovascular risk factors, highlight the complexity of these disorders. It is also crucial to understand the effects of psychological and emotional factors on obesity and schizophrenia to investigate the reasons behind weight challenges in individuals with this condition. In addition, the relationship between antipsychotic medications and weight gain is an important aspect of treatment. Apart from that, the genetic and neurobiology of obesity in schizophrenia would provide insights into the inherited factors that may contribute to weight-related issues in people with schizophrenia.

CONCLUSION

With the findings of this bibliometric analysis, researchers can establish a solid foundation to further investigate schizophrenia and obesity. This study provides a comprehensive analysis to reveal knowledge gaps in this field and identify directions for further research. The bibliometric analysis in this study has several strengths, primarily in its methodological approach utilising advanced tools like Scopus analyser and VOSviewer to explore research trends, influential contributors, and thematic developments in the study of schizophrenia and obesity. This enables a deeper understanding of the evolution of research in this field and the significant contributions made. However, the study also has limitations that need to be acknowledged. Using data from only one database (Scopus) could result in the exclusion of relevant publications, especially those in non-indexed journals or languages other than English. This may lead to the underrepresentation of certain regions or institutions. Additionally, while bibliometric analysis provides insights into publication and collaboration trends, it does not evaluate the quality or clinical impact of the studies reviewed. It would be more beneficial to include a more qualitative assessment to complement the quantitative findings presented.

For future research, a more integrated approach is necessary, such as combining insights from biological, psychological, and social perspectives to fully understand the complex relationship between schizophrenia and obesity. Longitudinal studies are particularly important to monitor changes in obesity and metabolic health among schizophrenia patients over time, considering the effects of antipsychotic medications and lifestyle factors. Furthermore, there is a need to develop comprehensive intervention strategies that address both psychiatric

and metabolic health. These strategies should include personalised pharmacological treatments, behavioural therapies, and lifestyle modifications. These strategies should aim to reduce weight gain and improve overall health outcomes, thereby enhancing the quality of life for individuals affected by both schizophrenia and obesity.

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