Research Trends on Smoking, Depression, and Anxiety: Bibliometric Analysis

Актуальные тенденции взаимосвязи курения, депрессии и тревоги в научных исследованиях: библиометрический анализ

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Review

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ABSTRACT

BACKGROUND: Smoking, along with mental illnesses such as depression and anxiety, represents a major public health concern. Bibliometric analysis offers a distinct perspective on the connections between these conditions.

AIM: To conduct a bibliometric analysis using network visualization mapping to explore research on smoking, depression, and anxiety.

METHODS: A literature search was performed using PubMed, Scopus, and Lens. The search used keywords “smoking”, “nicotine dependence”, “anxiety”, and “depression”. Data were extracted and analyzed using bibliometric indicators, including publication and citation trends, leading countries and organizations, influential authors, journals, and frequently occurring keywords. Network visualization mapping was performed by using VOSviewer software.

RESULTS: A total of 138 papers were selected and reviewed based on the predefined eligibility criteria. These papers were published between 1991 and 2024. The analysis highlighted key trends: publications peaked in 2013 with 10 papers, while citations were highest in 2008 with 549. The most influential organizations were the Department of Preventive Medicine, University of Southern California, and the Department of Psychiatry, New York University School of Medicine. Naomi Breslau was identified as the most influential author, and *Nicotine and Tobacco Research* as the leading journal. The most frequently occurring keywords were “smoking”, “depression”, and “anxiety”, and “nicotine dependence”.

CONCLUSION: This bibliometric analysis identified the scholarly impact and characteristics of publications and provides researchers and policymakers with baseline data to guide research strategies on smoking and mental health.

АННОТАЦИЯ

ВВЕДЕНИЕ: Курение и психические заболевания, в частности депрессия и тревожное расстройство, являются серьезными проблемами общественного здоровья. Библиометрический анализ вносит уникальный вклад в установление связи между курением, депрессией и тревогой.

ЦЕЛЬ: Выполнить библиометрический анализ с построением карт сетевой визуализации для исследования взаимосвязи курения, депрессии и тревоги в научной литературе.

МЕТОДЫ: Провели поиск литературы в базах PubMed, Scopus и Lens с использованием ключевых слов: «курение», «никотиновая зависимость», «тревога», «депрессия». Из отобранных публикаций извлекли данные и проанализировали с помощью таких библиометрических показателей, как динамика публикаций и цитирований; ведущие страны и организации; наиболее влиятельные авторы, журналы и часто встречающиеся ключевые слова. Для построения и визуализации сетей применяли программное обеспечение VOSviewer.

РЕЗУЛЬТАТЫ: В соответствии с заданными критериями включения в анализ вошли 138 статей, опубликованных в период с 1991 по 2024 г. Проведенный анализ выявил следующие тенденции: пик публикационной активности пришелся на 2013 г. (10 статей), тогда как максимальное число цитирований (549) зафиксировано в 2008 г. Согласно анализу, наиболее влиятельными организациями были признаны кафедра профилактической медицины Университета Южной Калифорнии и кафедра психиатрии Медицинской школы Нью-Йоркского университета. Naomi Breslau заняла первую позицию среди авторов по влиятельности, а журнал *Nicotine and Tobacco Research* лидировал среди научных журналов. Анализ ключевых слов выявил преобладание следующих терминов: «курение», «депрессия», «тревога» и «никотиновая зависимость».

ЗАКЛЮЧЕНИЕ: Данный библиометрический анализ взаимосвязи курения, депрессии и тревоги предоставляет исследователям и органам, формирующим политику в сфере здравоохранения, систематизированную основу для формирования приоритетных направлений научных исследований в области психического здоровья и курения.

Keywords: *bibliometric analysis; anxiety; depression; nicotine dependence; smoking*
Ключевые слова: *библиометрический анализ; тревога; депрессия; никотиновая зависимость; курение*

INTRODUCTION

Tobacco consumption is a global health concern, responsible for over 8 million deaths annually[1]. Cigarette smoking is the most common form of tobacco use worldwide. Smoking is considered a chronic nicotine dependence disorder that contributes to numerous non-communicable diseases (NCDs) [1] and to disabilities affecting physical and mental health [2, 3]. According to the World Health Organization 2021 factsheet, tobacco use is closely linked to a range of mental health issues. Smoking is twice as prevalent among individuals with mental illness[2]. Together, mental illness and smoking represent two prevalent and debilitating conditions that pose a significant public health challenge.

Existing literature shows an association between smoking, depression and anxiety. There are several hypotheses about this association. One hypothesis is that smoking serves as a form of "self-medication" for sadness or negative mood, whereby symptoms of depression and anxiety may increase the likelihood of smoking. Another hypothesis suggests that smoking itself may lead to depression and anxiety by altering an individual's neurocircuitry and increasing susceptibility to environmental stressors. The relationship may also be bidirectional, with occasional smoking used to relieve symptoms but ultimately exacerbating them over time [4]. Because nicotine has a short half-life and quickly triggers withdrawal symptoms (including mood disturbances), smokers may misinterpret the short-term relief as a genuine anxiolytic effect [4, 5].

Bibliometric analysis (BA) allows researchers to investigate the development of a discipline over time and to identify new areas within the field [6]. According to the BIBLIO guideline[3], BA is defined as "a review of all full published papers that appear in biomedical journals and includes all types of evidence, such as descriptive studies, observational studies, experimental studies, qualitative studies, and systematic reviews in order to account for every single existing piece of evidence. BA excludes electronic publications ahead of print since the final publication dates are not known" [7]. The academic impact of research is commonly assessed by citation counts [8]. BA is considered the key technique

[1] WHO report on the global tobacco epidemic, 2023: protect people from tobacco smoke. Geneva: World Health Organization 2023. Available from: https://www.who.int/publications/i/item/9789240077164

[2] The vicious cycle of tobacco uses and mental illness-a double burden on health. Available from: https://www.who.int/europe/news/item/08-11-2021-the-vicious-cycle-of-tobacco-use-and-mental-illness-a-double-burden-on-health

[3] Available from: https://systematicreviewsjournal.biomedcentral.com/articles/10.1186/s13643-023-02410-2/tables/3

in performing citation analysis [9]. BA also provides an overview of the relationship among studies through graphical representations, tables, network diagrams, typically using specialized software [10]. Systematic review and meta-analysis are the traditional methods of reviewing and evaluating the literature. A systematic review involves the structured collection, organization, and appraisal of existing literature [11]. However, this process is time-consuming, and the number of studies analyzed is limited and susceptible to bias, raising the risk of excluding important evidence [12]. In meta-analysis, the investigator summarizes empirical evidence on relationships between variables, while uncovering associations not directly examined in existing studies [6]. Hence, meta-analysis is a compelling method, but it is limited in the studies' nature and breadth that can be analyzed. Compared with traditional approaches such as systematic review and meta-analysis, BA can reduce bias and yield a broader and more informative overview of the literature [13].

Existing bibliometric studies on smoking and mental illness are limited in scope and highlight several key research gaps. For example, a significant portion of current research [14] has focused exclusively on Australia and on the co-occurrence of physical illness with serious mental disorders. As a result, this study lack a global perspective and treat smoking as one of many physical health issues rather than a specific area of focus. In addition, other studies [15, 16] have addressed mental illness as a single broad category. This approach hinders a detailed understanding of the research landscape for specific, high-prevalence comorbidities like depression and anxiety, making it difficult to pinpoint research trends and needs in these areas. To address these gaps, we conducted a BA using network visualization mapping to examine research on smoking, depression, and anxiety. Specifically, the study identifies trends in research publications and keywords, influential researchers, highly cited works, and leading research organizations in this field.

METHODS

Data sources

The literature was searched using PubMed, Scopus, and Lens.

Search strategy

The search was based on the keywords "smoking", "nicotine dependence", "depression", and "anxiety" in the title, abstract or other publication fields. Boolean operators (AND, OR) were used to combine these terms effectively. The search was limited to English-language publications and was conducted up to August 2024. To ensure research quality, only original research articles and review papers were included.

The search strategies are as below:

- PubMed: ("smoke"[MeSH Terms] OR "smoke"[All Fields] OR "smoke s"[All Fields] OR "smoked"[All Fields] OR "smokes"[All Fields] OR "smoking"[MeSH Terms] OR "smoking"[All Fields] OR "smokings"[All Fields] OR "smoking s"[All Fields]) AND ("tobacco use disorder"[MeSH Terms] OR ("tobacco"[All Fields] AND "disorder"[All Fields]) OR "tobacco use disorder"[All Fields] OR ("nicotine"[All Fields] AND "dependence"[All Fields]) OR "nicotine dependence" [All Fields]) AND ("depress anxiety"[Journal] OR "arch depress anxiety"[Journal] OR ("depression"[All Fields] AND "anxiety"[All Fields]) OR "depression anxiety"[All Fields]);
- Scopus: TITLE-ABS-KEY (smoking AND nicotine AND dependence AND depression AND anxiety);
- Lens: smoking AND (nicotine AND (dependence AND (depression AND anxiety))).

Time period

No time restrictions were placed on the literature selection.

Eligibility criteria

Inclusion criteria:

- papers published in English;
- observational studies conducted on human participants;
- narrative and systematic reviews, editorials and conference papers.

Exclusion criteria:

- studies that included participants who were pregnant or had systemic comorbidities;
- studies examining the association between parental smoking and offspring outcomes.

Data refinement

Two authors (P.S. and Z.M.) independently screened the papers retrieved from the electronic searches. Based on eligibility criteria, both authors independently conducted a full-text appraisal, compared their assessments, discussed any discrepancies, and reached a final decision. Inter-rater

reliability was assessed using kappa statistics, yielding a value of 0.89, which indicates strong agreement between the authors.

For data extraction, the following parameters were entered into a pre-formatted sheet: authors' names, publication year, author affiliation, publication trends (frequency of publications per year from the first included paper), title and paper type (original research, review, editorial, conference paper), keywords, and citation counts. Citation counts were recorded from publication up to August 2024, using citation metrics from the Scopus database. The impact factor was based on the journal's homepage and CiteScore (Scopus).

Data synthesis

Data analysis involved constructing bibliometric networks for the selected papers. Bibliometric indicators were selected to address the research questions (Table 1). The analysis considered several aspects, including publication and citations trends, leading countries and organizations (based on first author affiliation), influential authors, journals, and frequently occurring keywords.

Descriptive analysis was conducted for proportions and means, as applicable. The Statistical Package for the Social Science (SPSS, version 23, IBM Corp., USA) was used for all analyzes. VOSviewer software[4] (version 1.6.18) was used to construct and visualize the bibliometric networks. These networks can be constructed based on influential authors, journals, the top-cited papers, and co-occurrence patterns of keywords.

RESULTS

Descriptive findings

A total of 3,259 papers were retrieved from PubMed (*n*=488), Scopus (*n*=824), and Lens (*n*=1,947). Of these, 381 duplicates were removed. A further 2,329 non-English papers or those not meeting eligibility criteria were excluded. The titles and descriptions of the remaining 549 papers were manually extracted. An additional 411 papers were excluded based on study descriptions, leaving 138 papers for the final analysis (Figure 1 and Table S1 in the Supplementary).

Schematic map and trend

The selected papers were published between 1991 and 2024 (Table 2). Figure 2 shows publications over time. Nine papers were published in both 2008 and 2012, while publication peaked in 2013 with 10 papers. On average, 4.76 papers were published per year. There were a total of 110 original research papers. Between 1991 and 2024, publications came from 32 countries, led by the United States of America (*n*=66), followed by the United Kingdom (*n*=10) (Figure 3). The total 138 papers received a total of 5,115 citations. The average number of citations per paper is 37.07. The highest annual citation count was recorded in 2008 (*n*=549). The citation trends are presented in Figure 4.

Tabulation and summarizing the findings

The most cited authors

In total, 479 authors contributed to the literature on smoking, depression, and anxiety. The top five influential authors were identified based on average citations per

Table 1. Bibliometric indicators and its significance

Indicators	Significance
What is the publication trend?	To determine publication volume to predict the future trend.
What type of papers are published on smoking, depression, and anxiety?	To help identify paper types to assist the researcher in identifying future research directions.
Which countries lead in the publication of research on smoking, depression, and anxiety?	To help understand which country is concentrating more on smoking, depression, and anxiety.
Who are the most influential authors and which journals contributing the most articles on smoking, depression, and anxiety?	To help researchers find specific studies, methods, and material to conduct high-quality research. Also, to help select journals for future publication.
What are the leading organizations for research on smoking, depression, and anxiety?	To help researchers select institutions, universities, or organizations.
What is the keyword and citation network of smoking, depression, and anxiety?	To be an easy search method for future researchers.

[4] Available from: https://www.vosviewer.com

Table 2. Descriptive statistics of selected papers

Variables	Outcomes
Total number of selected papers	138
Timespan	1991–2024
Total number of journals	95
Minimum- maximum paper published in a year	1–10
Average papers published per year	4.76
Type of paper: original research review editorial conference paper	 110 (79.71%) 23 (16.67%) 3 (2.17%) 2 (1.45%)
Papers published in total number of countries	32
Total citations	5,115
Average citations per paper	37.07
Average citations per year per paper	1.28
Authors	479
Papers per Author	28.81
Authors per paper	3.47
Total keywords	1,105
Author's keywords	188

paper (Table 3). Figure 5 presents the co-citation network of authors with 112 clusters, 1,179 links, and a total link strength of 1,205. Groups of authors in the citation map are represented by clusters of the same color. Naomi Breslau was the most influential author, with six publications totaling 711 citations and an average of 118.5 citations per paper. The network shows that Naomi Breslau has 16 links and a total link strength of 18.

The most influential journals

A total of 95 journals reported papers on smoking, depression, and anxiety. The network of 95 journals is shown in Figure 6. *Nicotine and Tobacco Research* published 10 papers, which received a total of 816 citations, averaging 81.60 citations per paper (Table 4).

The most influential organizations

A total of 134 organizations reported their work on smoking, depression, and anxiety. The top three organizations are presented in Table 5. The Department of Preventive Medicine at the University of Southern California, the Keck School of Medicine, Los Angeles, California, and the Department of Psychiatry, New York University School of Medicine rank first among the three papers.

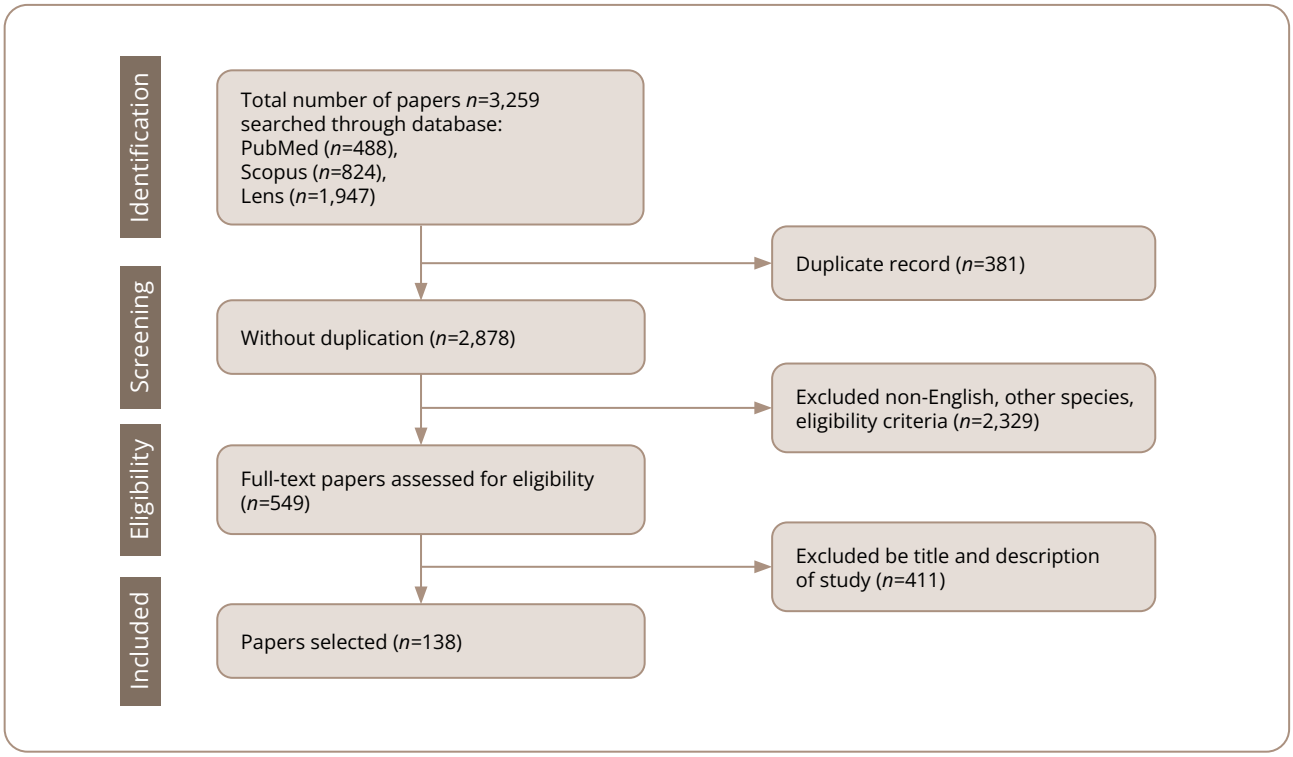

Figure 1. Flow diagram for selection of papers.

Source: Parkar et al., 2025.

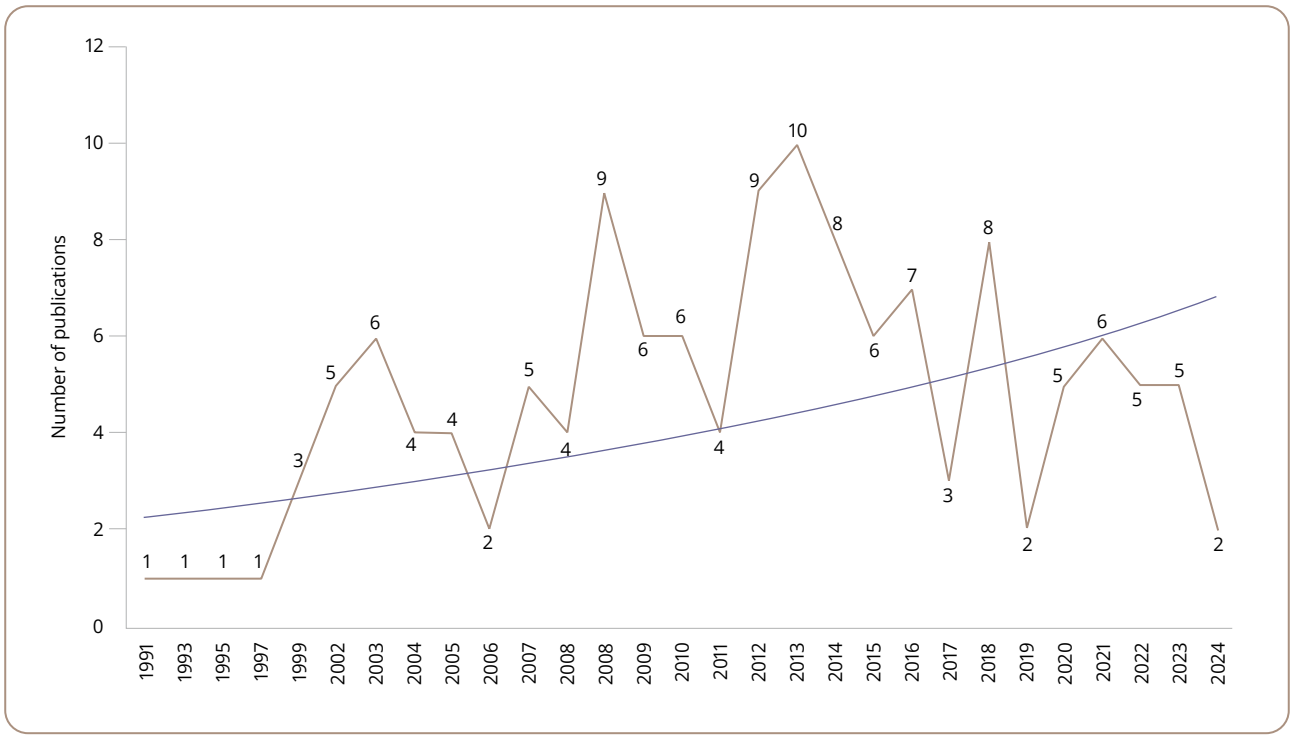

Figure 2. Publication trends.

Source: Parkar et al., 2025.

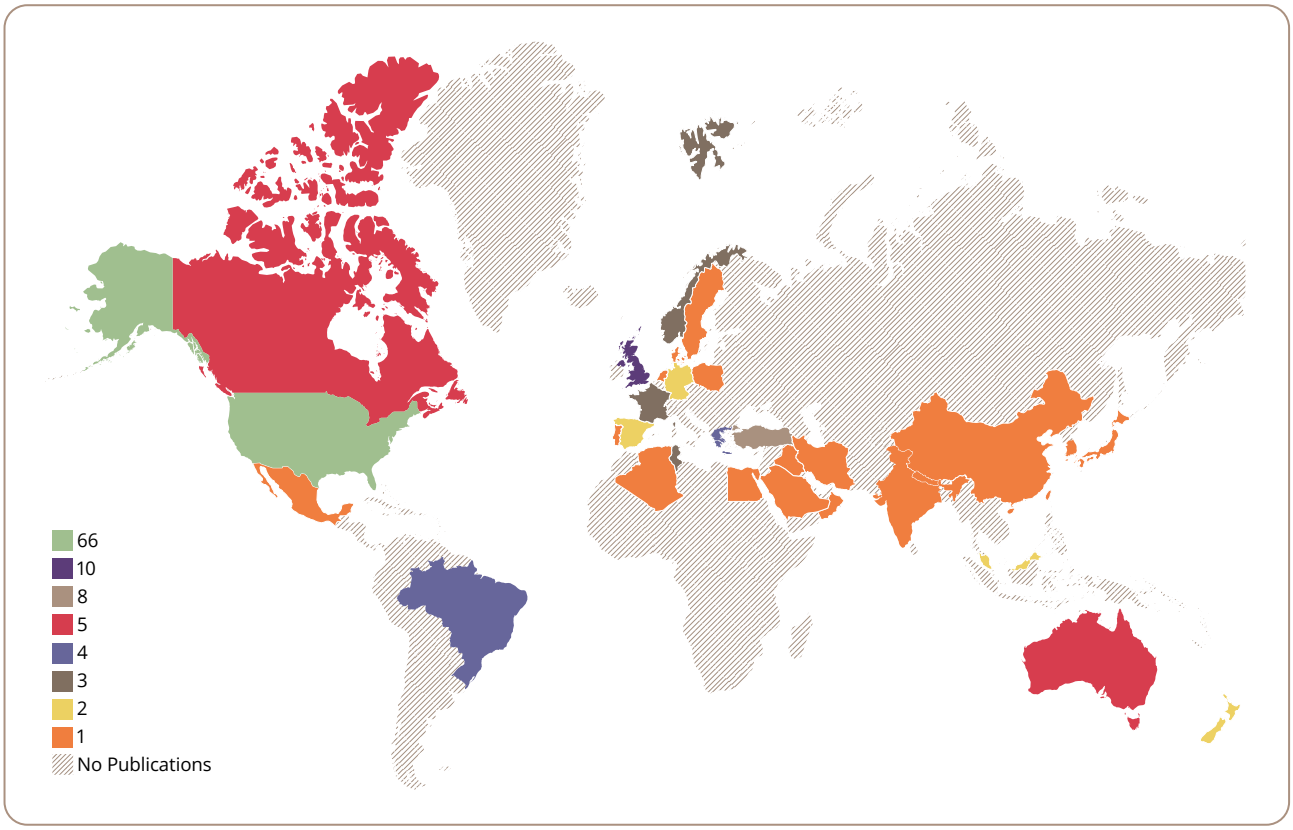

Figure 3. Publication countries.

Source: Parkar et al., 2025.

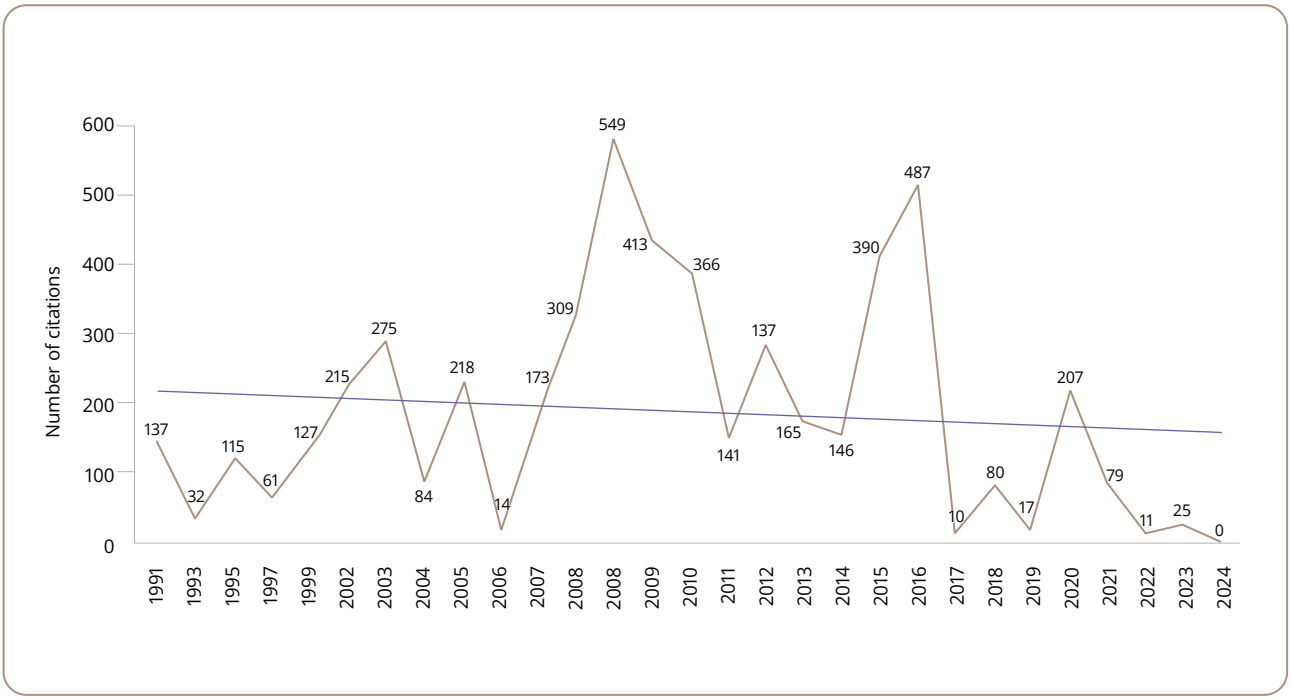

Figure 4. Trends in paper citations.

Source: Parkar et al., 2025.

The most cited papers

Figure 7 presents the citation network of the 138 papers. Table 6 shows the top 10 cited papers. The paper titled "The Association of Cigarette Smoking with Depression and Anxiety: A Systematic Review," published in 2017 by Fluharty et al. [4] is the most cited paper having 363 citations.

Keywords analysis

A co-occurrence network analysis of the keywords was conducted. A total of 118 keywords were identified. For visualization, mapping of keywords with a minimum occurrence of 2 threshold 41 words were distributed in four clusters, as shown in Figure 8. There were 193 links, with a total link strength of 349. The first cluster (red) includes 12 words with "smoking" the most frequent (*n*=59), linked 33 times with a total link strength of 101. The second cluster (green) includes 11 words with "nicotine dependence" the most frequent (*n*=23), with 24 links and a total link strength of 59. The third cluster (blue) included 10 words with "smoking cessation" the most frequent (*n*=15), having 17 links and a total link strength of 33. The fourth cluster (pink) includes eight words with "cigarette smoking" the most frequent (*n*=3), having eight links and a total link strength of 9. The interaction between the nodes influences smoking behaviors, dependence levels, and cessation outcomes. The node characteristics show the smoking attributes to the frequency of smoking, duration, and level of dependence. The link strength reflects the relationship between nodes.

DISCUSSION

The present BA provides novel insights into research trends, influential authors, journals, and organizations related to smoking, depression, and anxiety. BAs typically focus on quantitative indicators such as highly cited authors, journals, articles, and countries that have significantly shaped the research domain of smoking, depression, and anxiety [17]. Additionally, analyzing depression and anxiety together in relation to smoking may be more resource-efficient, as it avoids duplication and allows for a more comprehensive examination of smoking's impact on mental health. Furthermore, a combined analysis can capture these complex relationships more effectively than separate analyzes.

Fluctuating trends were observed in the number of yearly publications. During the initial years, the publications were minimal. A gradual increase occurred between 2012 and 2017. This trend is consistent with previous findings [15, 16]. Publications peaked in 2013 with 10. From 2020 to 2023, publications remained steady. By August 2024,

Table 3. Top five influential authors based on the published papers and average citation per paper

Rank*	Author	Published papers	Total citations	Average citation per paper	Average citations per year per paper
1st	Naomi Breslau	6	711	118.5	4.62
2nd	Adam Matthew Leventhal	5	291	58.2	6.77
3rd	Michael J Zvolensky	4	297	74.25	5.60
3rd	Reene D Goodwin	4	104	26	1.89
3rd	Richard Hébert	4	2	0.5	0.03
5th	Nicola Lindson	3	165	55	15.00

Note: *In the ranking, authors having an equal number of papers were given similar ranks and the subsequent position in the rank was skipped.

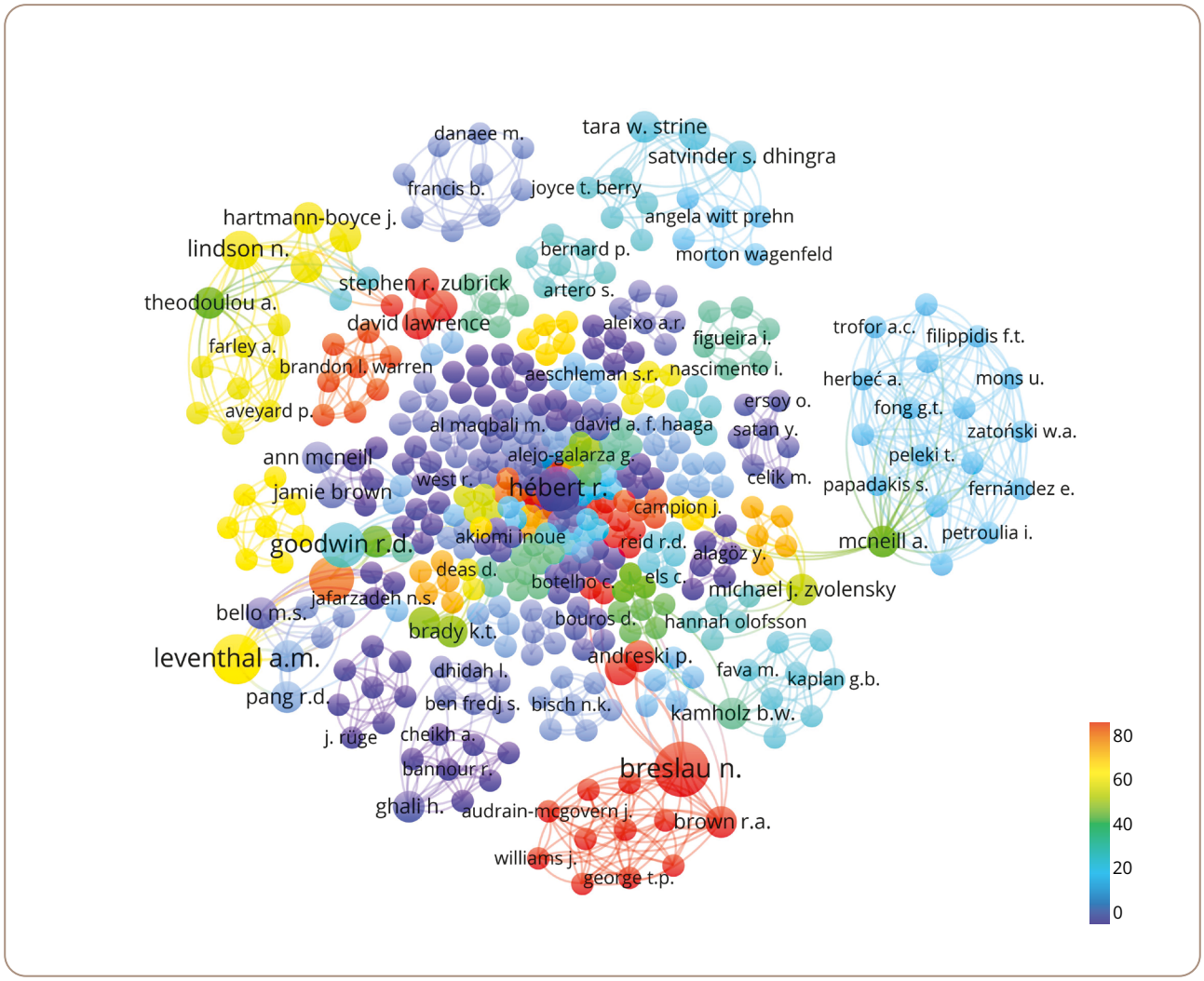

Figure 5. Network visualization map of author co-citations.

Note: Each node on the map represents an author; the size of the circle reflects the number of articles published by them. Cool colors represent fewer average citations than warm colors. Total clusters — 112; items — 479; links — 1,179; total link strength — 1,205.

Source: Parkar et al., 2025.

Table 4. Top five most influential journals based on the published papers and average citation per paper

Rank*	Journal	Published papers	Total citations	Average citation per paper	Publisher	Impact factor**
1st	*Nicotine and Tobacco Research*	10	816	81.60	Oxford University Press	4.7 (2022)
2nd	*Addictive Behaviors*	7	180	25.71	Elsevier	4.4 (2023)
3rd	*Addiction*	4	237	59.25	Wiley	6.10 (2022)
3rd	*Cochrane Database of Systematic Reviews*	4	379	94.75	Wiley	8.4 (2023)
3rd	*Journal of Dual Diagnosis*	4	33	8.25	Taylor & Francis	2.2 (2022)
5th	*American Journal on Addictions*	3	71	23.67	Wiley	3.7 (2022)
5th	*BMC Public Health*	3	232	77.33	BioMed Central	4.5 (2022)
5th	*Drug and Alcohol Dependence*	3	27	9.00	Elsevier	4.2 (2023)
5th	*Journal of Psychiatric Research*	3	108	36.00	Elsevier	4.8 (2023)

Note: *Journals with the same number of papers were assigned the same rank, and the subsequent rank was skipped. **The impact factor was based on the journal's homepage and CiteScore (Scopus).

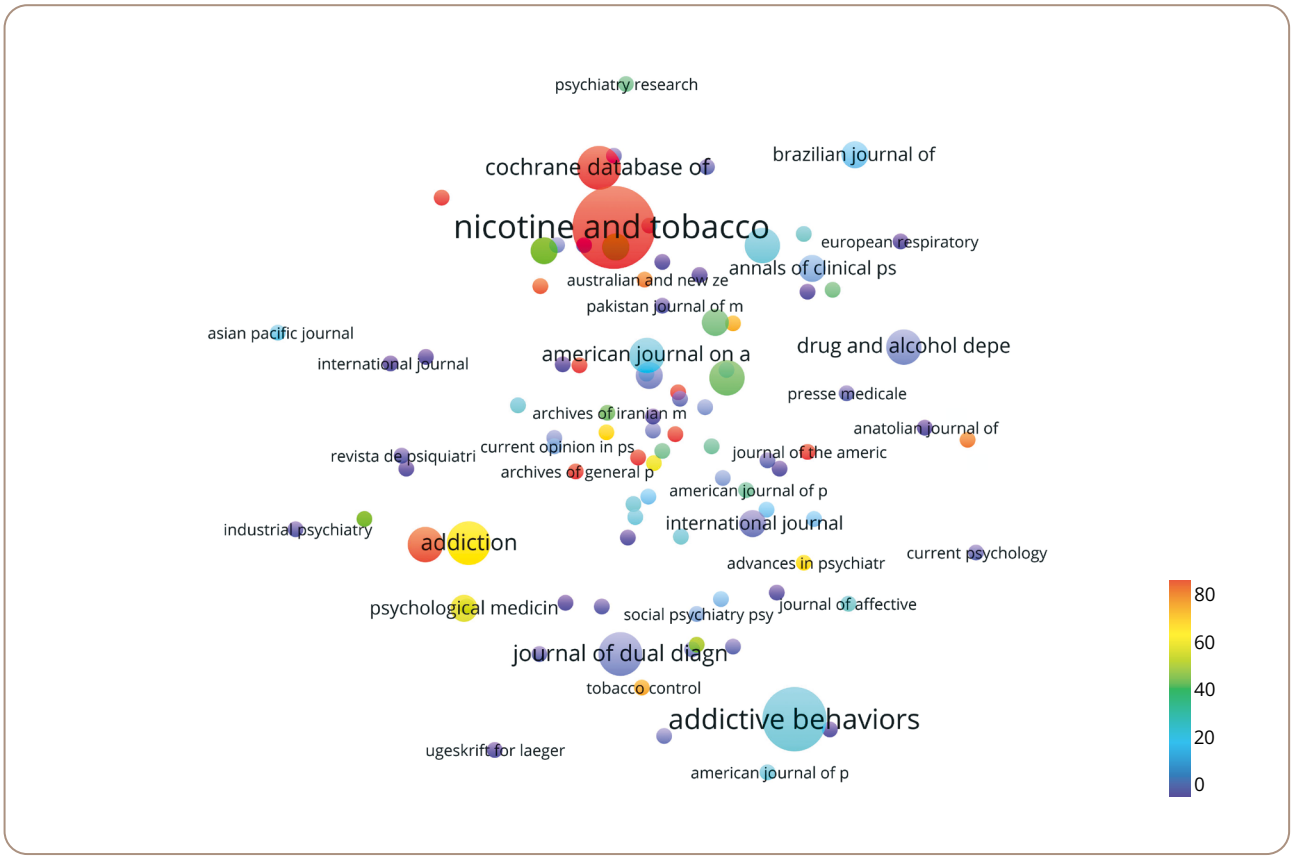

Figure 6. Network visualization map of influential journals.

Note: Cool colors represent lesser average citations than warm colors. Total clusters — 95; items — 95.

Source: Parkar et al., 2025.

Table 5. Top three most influential organizations based on the published papers

Rank*	Organization	City, State	Country	Published papers
1st	Department of Preventive Medicine, University of Southern California, Keck School of Medicine	Los Angeles, California	United States of America	3
1st	Department of Psychiatry, New York University School of Medicine	New York	United States of America	3
3rd	Department of Epidemiology, Mailman School of Public Health, Columbia University	New York	United States of America	2
3rd	Department of Psychology, Queens College, City University of New York	New York	United States of America	2
3rd	Department of Sociology and Human Geography, University of Oslo	Oslo	Norway	2
3rd	Laboratório De Pânico E Respiração, Instituto De Psiquiatria, Universidade Federal Do Rio De Janeiro	Rio De Janeiro	Brazil	2
3rd	National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention	Atlanta	United States of America	2
3rd	Va Boston Healthcare System and Boston University School of Medicine	Boston	United States of America	2
3rd	Respiratory Department, Sotiria Hospital	Athens	Greece	2

Note: *In the ranking, organizations having an equal number of papers were given similar ranks, and the subsequent position in the rank was skipped.

only two publications had been recorded as the year was just beginning when the data collection began. Given the urgent need to understand the association between smoking and NCD — with particular emphasis on mental illness, especially depression — the number of publications is expected to increase in the coming years. Increasing research publications on smoking and depression can enhance our understanding, guide interventions, and ultimately improve public health outcomes.

The distribution of publication types provides valuable insights into ongoing research on the relationship between smoking, depression, and anxiety. Of the publications, 79.71% were original research. The original papers were in the form of descriptive studies, with a limited focus on interventional studies. Similar findings were observed by Metse et al. [15]. Intervention-focused research suggested a recent surge in the adoption of clinical trials, although progress in translating this research into practice has remained limited [16]. Only 16.67% of the publications were review papers, indicating that future research will be driven by the need to address identified gaps or resolve contradictory findings. Editorials accounted for just 2.17% of the publications, indicating that, despite the strength of the empirical work, there has been relatively little scholarly commentary, potentially limiting theoretical development and policy guidance in this field.

Geographically, North America contributed 71 papers (51.45%), with the majority coming from the United States of America (47.82%). Europe ranked second, contributing 29 papers (21.01%), led by the United Kingdom (7.25%). This country-level pattern of publication is consistent with the findings of Rinaldi et al. [16]. Countries with a high prevalence of smoking, depression, and anxiety often experience a significant public health burden related to these issues within their populations[5]. However, when certain regions or demographic groups within a country exhibit a high burden but limited corresponding research output, it indicates a critical knowledge gap. This difference is frequently due to a complex interplay of factors, including insufficient research funding, poor research infrastructure, and a lack of knowledge or prioritization of these specific health concerns [27]. In our analysis, very few papers originated from Asian nations. This suggests that international funding and scientific collaboration are crucial, especially for Asian nations with high rates of tobacco use.

[5] The vicious cycle of tobacco uses and mental illness-a double burden on health. Available from: https://www.who.int/europe/news/item/08-11-2021-the-vicious-cycle-of-tobacco-use-and-mental-illness-a-double-burden-on-health

Table 6. Top ten most cited papers

Rank	Author (Year)	Title	Journal	Citations*
1st	Fluharty et al. (2017) [4]	The Association of Cigarette Smoking with Depression and Anxiety: A Systematic Review	*Nicotine and Tobacco Research*	363
2nd	Ziedonis et al. (2008) [18]	Tobacco use and cessation in psychiatric disorders: National Institute of Mental Health report	*Nicotine and Tobacco Research*	310
3rd	Hughes et al. (2007) [19]	Antidepressants for smoking cessation	*Cochrane Database of Systematic Reviews*	214
4th	Leventhal et al. (2015) [20]	Anxiety, depression, and cigarette smoking: A transdiagnostic vulnerability framework to understanding emotion-smoking comorbidity	*Psychological Bulletin*	204
5th	Lawrence et al. (2009) [21]	Smoking and mental illness: results from population surveys in Australia and the United States	*BMC Public Health*	202
6th	Picciotto et al. (2002) [22]	Effect of nicotine and nicotinic receptors on anxiety and depression	*Neuroreport*	167
7th	Moylan et al. (2012) [23]	Cigarette smoking, nicotine dependence and anxiety disorders: A systematic review of population-based, epidemiological studies	*BMC Medicine*	159
8th	Breslau et al. (1991) [24]	Nicotine Dependence, Major Depression, and Anxiety in Young Adults	*Archives of General Psychiatry*	137
9th	Tidey et al. (2015) [25]	Smoking cessation and reduction in people with chronic mental illness	*BMJ* (Online)	130
10th	McKenzie et al. (2010) [26]	Association of adolescent symptoms of depression and anxiety with daily smoking and nicotine dependence in young adulthood: Findings from a 10-year longitudinal study	*Addiction*	128

Note: *Citation counts were recorded from publication up to August 2024, using citation metrics from the Scopus database.

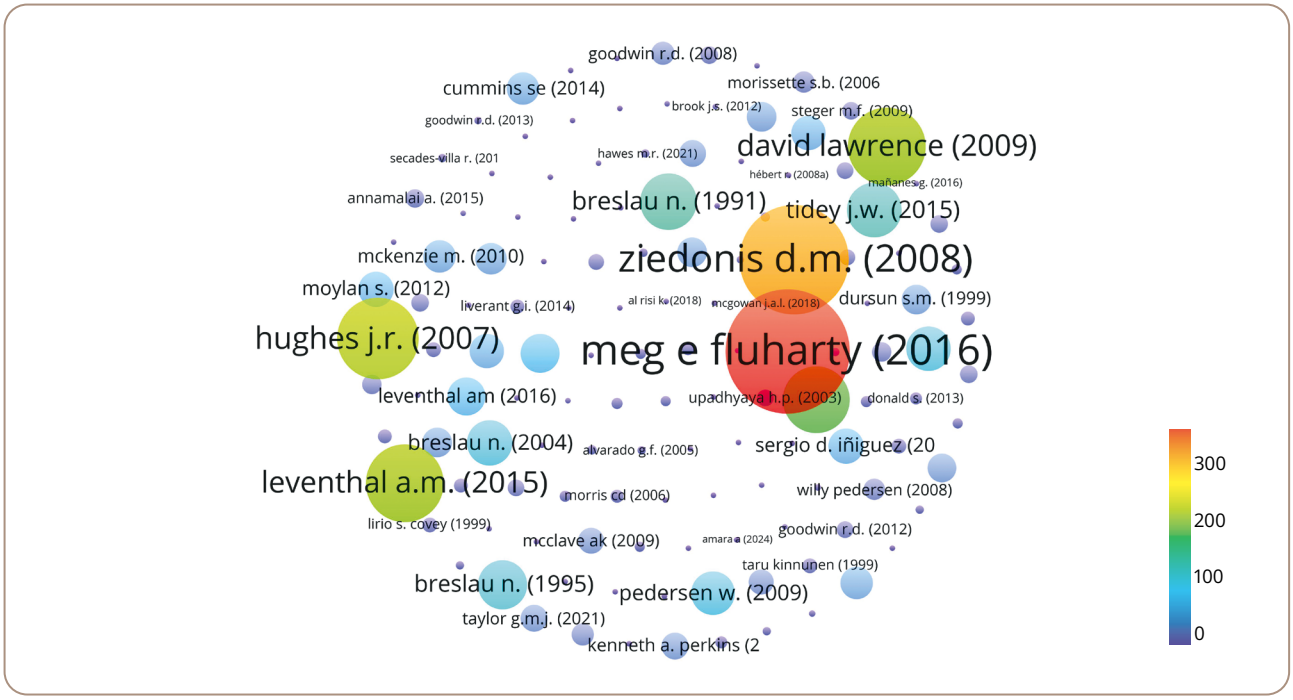

Figure 7. Network visualization map of top cited papers by authors.

Note: Cool colors represent fewer average citations than warm colors. Total clusters — 138; items — 138.

Source: Parkar et al., 2025.

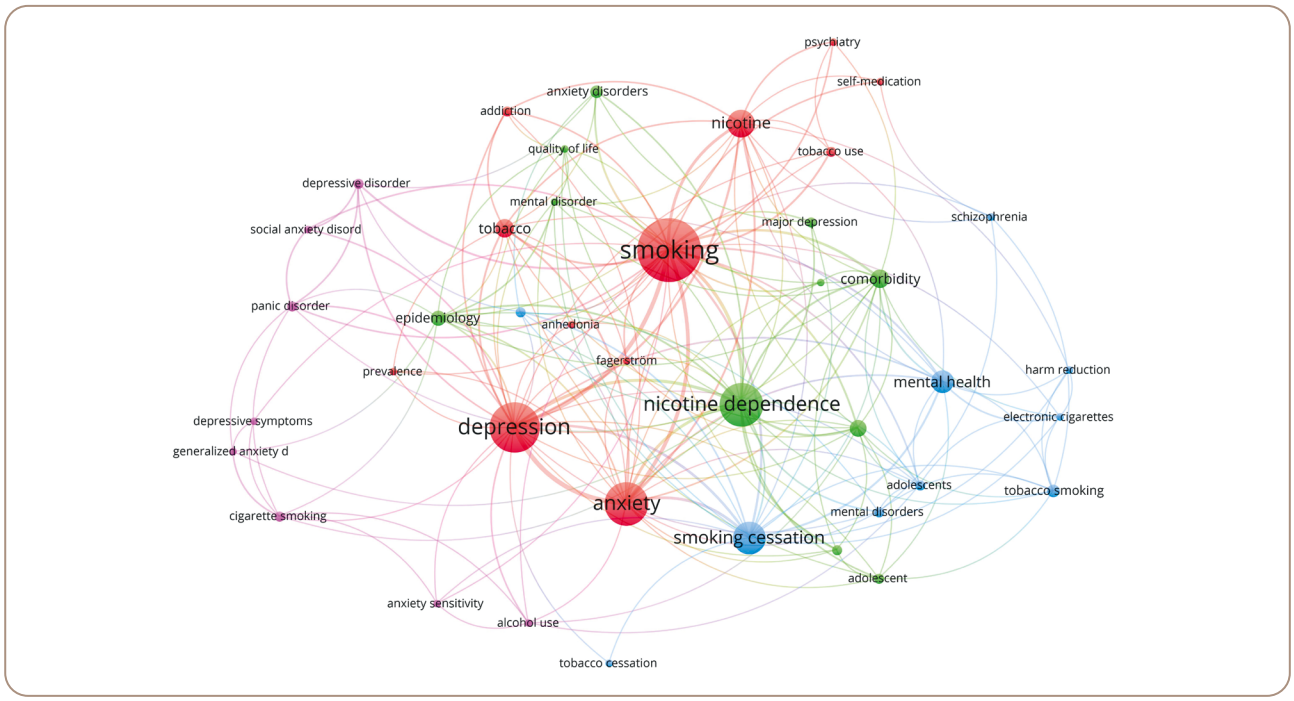

Figure 8. Network visualization map of keywords.

Note: The minimum occurrence of included terms was 2. Nodes with similar color represent a cluster of related items. Total clusters — 4; items — 41; links — 193; total link strength — 349.

Source: Parkar et al., 2025.

Identifying influential authors through co-citation analysis in VOSviewer provides valuable insights into past research. These authors offer diverse perspectives and insights into the field. The co-citation map illustrates relationships among scholars. Our BA identified Naomi Breslau as the most influential author. Naomi Breslau was an American sociologist, psychiatric epidemiologist, and professor at Michigan State University. She passed away in 2018, but her scholarly impact remains substantial, with an h-index of 129. Other prominent authors include Adam M. Leventhal and Michael J. Zvolensky. Adam M. Leventhal is a clinical psychologist and Professor of Population and Public Health Sciences at the Keck School of Medicine of USC, Los Angeles, USA. Michael J. Zvolensky is a Professor in the Department of Psychology at the University of Houston and Director of the Research on Emotion, Substance Use Treatment Outcomes, Rehabilitation, & Empowerment Laboratory and Substance Use Treatment Clinic, West Virginia University. Our findings differ from those of Rinaldi et al. [16] who identified Zvolensky as the leading author.

Our findings, consistent with those of Rinaldi et al. [16], indicated that *Nicotine and Tobacco Research* was the leading journal, followed by *Addictive Behaviors*. The top five journals primarily focused on nicotine and tobacco, including research from the bio-behavioral, addiction, psychiatric disorders, and epidemiology fields, which had high impact factors. Publishing in specific journals can help reach a targeted audience and contribute to in-depth discussions within the research community. It also increases the research visibility, leading to more citations and recognition of the researcher.

The Department of Preventive Medicine, the University of Southern California's Keck School of Medicine, and the Department of Psychiatry, New York University School of Medicine, were two leading organizations each contributing three papers (2.17%). These institutes not only advance the research but also foster collaboration, growth, and influence within the academic community. Such organizations often have a direct impact on policy development, public health initiatives, and mental health interventions related to smoking, depression, and anxiety. Examining the publications and advocacy efforts of these organizations can provide insights into the intersection of research, policy, and practice in these areas.

The most cited paper was "The Association of Cigarette Smoking with Depression and Anxiety: A Systematic Review",

published in 2017 by Fluharty et al. [4] and has 363 citations. This paper systematically reviewed the association between smoking and depression and anxiety in longitudinal studies. It reported considerable variation in the associations between smoking, depression, and anxiety. The second most cited paper was "Tobacco Use and Cessation in Psychiatric Disorders: National Institute of Mental Health Report" by Ziedonis et al. [18] which has received 310 citations since its publication in 2008. This review examined tobacco use, nicotine dependence, and smoking cessation among individuals with mental disorders, particularly those with anxiety, depression, or schizophrenia.

The three frequently occurring words were smoking (*n*=59), nicotine dependence (*n*=23), and smoking cessation (*n*=15). These keywords highlight the need for further research, as these words form the core link between smoking, depression, and anxiety. Shared keywords with similar research are represented by linking lines. For example, the term "'smoking (in red)" (for the author's keywords in Figure 8) is part of the words depression, anxiety, tobacco, prevalence, Fagerstrom scale, etc. The width of the lines connecting keywords to nodes is proportional to the strength of their co-occurrence. Cluster analysis of these keywords provides a complex relationship and cluster dynamics which can lead to targeted interventions and support strategies. Examining keywords and citation networks provides a comprehensive, data-driven overview of the research domain related to smoking, depression, and anxiety. This approach enables the identification of central concepts and the clarification of interactions among sub-concepts [28]; researchers can assess changes in focus, terminology, and scholarly communication practices.

The BA provides an integrated and up-to-date overview of research activity. However, because of limited or incomplete results in published work, often shaped by differing journal guidelines, evidence cannot be generated. The BA often addresses these issues by systematizing the consolidation of various research in similar fields [29].

To our knowledge, this is the second study to use BA with network visualization mapping in the fields of smoking, depression, and anxiety following the study by Rinaldi et al. [16]. This study identified the scholarly impact and characteristics of publications on smoking and mental illness through BA. These findings can inform researchers in developing research strategies to address smoking and mental health-related issues. This study also highlights key bibliometric indicators — such as top journals, organizations, and keywords — that reaffirm the interconnectedness of these research areas.

The results of this study should be interpreted with caution, as they have some limitations. First, the BA was limited to English-language papers under PubMed, Scopus, and Lens. As a result, non-English publications and papers in non-indexed journals were excluded, meaning the findings may not fully represent all research on smoking, depression, and anxiety. However, these search engines are the largest and may contribute to achieving reliable results. Second, only studies conducted among human participants were considered. This choice reflects the fact that findings from human studies are more directly applicable to clinical practice, and that the complex interactions among smoking, depression, and anxiety are difficult to replicate in animal models. Third, this study did not include a country-level distribution of publications. Acknowledging this omission provides transparency and indicates a direction for future research. A separate analysis of country-level publication patterns could offer valuable insights into global research trends, collaboration, and knowledge exchange.

Another limitation is that self-citations were not excluded during citation analysis. Self-citation may create a bias for both authors and journals. Lastly, the search relied on broad and complex definitions of smoking, depression, and anxiety. This makes it difficult to achieve 100% coverage of the papers. However, every effort was made to include all pertinent published work with a minimum of irrelevant literature.

Future BA should include related subject areas, using new search terms such as smoking and co-morbid substance use disorders, and other psychiatric disorders to be analyzed and investigated for future lines of research. Longitudinal BA could track the evolution of research on smoking, depression, and anxiety over time. Such analysis would help identify shifting trends, emerging topics, and enduring research themes. Integrating BA with a meta-analytical approach will help to synthesize quantitative data from multiple studies on the relationship between smoking, depression, and anxiety. Future work could also explore how interventions, such as smoking cessation programs and mental health treatments, shape the research landscape on smoking, depression, and anxiety.

CONCLUSION

This was the first bibliometric study on smoking, depression, and anxiety using network visualization mapping. Despite

its limitations, this study provides researchers and policymakers with baseline data on smoking and mental illness. Building on these insights and future directions, researchers can advance the understanding of the complex interplay between smoking, depression, and anxiety, leading to improved interventions, policies, and outcomes in public health and mental health research.

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