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Review

Perinatal Depression Research Trends in Canada: A Bibliometric Analysis

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Abstract

Background: Perinatal depression refers to a major depressive episode that begins during pregnancy or within four weeks after childbirth and persists through the first year postpartum. Perinatal depression is one of the most common complications of pregnancy, with significant adverse maternal and infant outcomes. Numerous reviews and policy guidelines have emerged from Canada; however, a bibliometric analysis that focuses not only on the international sources for perinatal depression research, but also on Canadian sources, has not been undertaken. Purpose: To provide insight on perinatal depression publications conducted by researchers affiliated with Canadian institutions, within an international context. Methods: A bibliometric analysis was performed using performance analysis and science mapping techniques, with data retrieved from Scopus until 31 December 2022. The analysis focused on original peer-reviewed publications, applying no language restrictions and ensuring at least one author was affiliated with a Canadian institution. VOSviewer version 1.6.20 was used to generate visual networks for analysis. Results: In total, there were 763 publications identified in 160 different journals. Among these publications, there were 123 institutions represented. At least one author was associated with a Canadian institution per publication. The University of Toronto had the highest frequency of affiliations (n = 313). Most publications (79.55%) occurred between 2011 and 2022, with 2021 as the year with the most publications (n = 80). The journal with the most publications was Archives of Women's Mental Health (n = 57, 35.65%). Canadian institution-affiliated authors with the largest number of publications were Dennis (n = 57), Oberlander (n = 39), Meaney (n = 38), and Letourneau (n = 37). Conclusion: This is the first study mapping publications on perinatal depression research within a Canadian context. This bibliometric analysis provides a valuable reference for future research by identifying key authors, institutions, journals, and research areas that prioritize perinatal mental health.

Keywords: perinatal depression; perinatal mental health; bibliometrics; publication trends

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1. Perinatal Depression Research Trends in Canada: A Bibliometric Analysis

Perinatal depression is defined as a major depressive episode that begins during pregnancy or within the first four weeks postpartum [1]. However, in clinical practice and research, this definition is commonly extended to include any depression occurring within the first year after childbirth [2–4]. Perinatal depression is one of the most common complications of pregnancy, with significant adverse maternal and infant outcomes [2,5]. Prevalence estimates for perinatal depression have ranged widely; however, it is estimated that, globally, the adjusted pooled prevalence is 11.9% [6] and in Canada, 23% of mothers

report feelings consistent with postpartum depression or an anxiety disorder [7]. As per the Canadian Maternity Experiences Survey, 7.5% of Canadian women scored 13 or higher on the Edinburgh Postnatal Depression Scale (EPDS), indicating probable postpartum depression, with higher rates detected in younger mothers (14.0%) and those with lower education or income levels [8]. In addition, the Maternity Experiences Survey highlighted significant regional differences in postpartum depression prevalence, with rates ranging from 14.3% in Nunavut to 4.5% in New Brunswick, reflecting differing socioeconomic and healthcare conditions [8]. Moreover, in Canada, considerable debate persists regarding whether to recommend screening for depression in pregnancy or postpartum [7]. Thus, understanding the expertise available in Canada that could be brought to bear on this important policy issue could be useful.

The etiology of perinatal depression is often multi-factorial including social, psychological, biological, and genetic components [3]. Risk factors include a history of psychiatric illness, depression or anxiety in pregnancy, stressful life events, poor social support, and adverse pregnancy outcomes [5,9,10]. Symptoms of perinatal depression vary widely and can impact mood, thoughts, and physical health, including feelings of sadness or depressed mood, diminished energy, loss of interest in daily activities, sleep disturbances, changes in appetite, difficulty concentrating, feelings of worthlessness or excessive guilt, fear of harming baby or oneself, and suicidal thoughts [1].

Perinatal depression has negative short- and long-term effects on the physical health and well-being of the maternal–infant dyad and families [2,3,5]. Depression in the antenatal period has been linked to fetal developmental delays, heightened risks of prematurity and low birth weight, and increased occurrences of perinatal complications such as preeclampsia, placental abnormalities, and spontaneous abortion [5]. Perinatal depression reduces maternal quality of life, affecting adaptation to the maternal role and the ability to engage in caregiving behaviours [3]. It also hinders maternal–infant relationship quality, which can have adverse effects on children's emotional, cognitive, and behavioural development [11]. Despite the negative implications of perinatal depression on maternal–infant health, women are undiagnosed and untreated due to a multitude of personal and systematic barriers which prevent disclosure of mental health concerns [5].

Perinatal depression is a serious clinical condition necessitating prompt assessment, diagnosis, and treatment. While various screening tools have been developed, the EPDS remains the most widely employed instrument in both clinical practice and research settings for detection of perinatal depression [5,12]. The Patient Health Questionnaire-9 is another tool frequently used to assess the presence and severity of depression in various populations, including postpartum women [13]. The treatment of perinatal depression varies in terms of symptom severity and the response to interventions [14]. Non-pharmacological methods (i.e., yoga, massage, and counselling) are available for managing perinatal depression [15]. Nevertheless, pharmacological intervention may become necessary in cases of severe depression when other therapies are insufficient in alleviating symptoms [2].

Over the past several decades, there has been substantial growth in the international literature on perinatal depression culminating in numerous systematic reviews focused on prevention and treatment [16–22], policy and practice guidelines [23–25], and bibliometric analyses [26–29]. Numerous reviews [30–33] and policy guidelines [14,23] have emerged from Canada; however, a bibliometric analysis that focuses not only on the international sources for perinatal depression research, but also on Canadian sources, has not been undertaken.

Bibliometric analyses seek to identify emerging trends, prevalent research themes, key publications, influential authors, prominent journals, and major institutions [34]. They shed light on knowledge gaps and potential areas for future investigation by laying a strong

foundation for advancing research in meaningful and innovative directions [34]. Thus, the purpose of this review is to provide insight on perinatal depression publications conducted by researchers affiliated with Canadian institutions, within an international context, using bibliometric review methods. By focusing on Canadian sources, the analysis could be used to directly guide research and time-sensitive policy in Canada.

2. Methods

Bibliometrics utilize statistical techniques to assess research output and impact [35]. This analysis was informed by the techniques proposed by Alfonzo et al. [36] and Donthu et al. [34]. Bibliometric methods, including use of VOSviewer version 1.6.20, were used to provide a comprehensive overview of perinatal research conducted by researchers affiliated with Canadian institutions.

2.1. Search Strategy

The search was completed on 13 January 2023, in Scopus. The search strategy was developed in consultation with a health science librarian and the authors. The search included the following parameters: TITLE-ABS-KEY ((prenatal OR pre-natal OR peripartum OR peri-partum OR intrapartum OR intra-partum OR antepartum OR ante-partum OR postpartum OR post-partum OR puerperium OR puerperal OR perinatal OR peri-natal OR postnatal OR post-natal) W/1 (depress*)) AND (EXCLUDE (PUBYEAR, 2023)) AND (LIMIT-TO (AFFILCOUNTRY, "Canada")) AND (LIMIT-TO (DOCTYPE, "ar")).

For the purposes of this analysis, "perinatal depression" was defined as either minor or major depressive episodes occurring during pregnancy or within the first year postpartum. Studies that involved the full range of measures and diagnostic tools for perinatal depression were thus eligible for inclusion.

The search included published literature on perinatal depression from the first publication available to 31 December 2022. As considered best practice in bibliometric research (in contrast to other types of reviews), one database was employed [37]. The Scopus database was selected as it has built-in analysis tools to export, manipulate, and analyze publications [38]. In addition, data from Scopus can be downloaded in a proper format which enables analysis of the full dataset in a single file [37]. Scopus generates a summary report on key bibliometric outcomes and data can be exported for analysis in Excel and VOSviewer.

2.2. Eligibility Criteria and Data Collection

Original publications of any design on perinatal depression were collected from Scopus until 31 December 2022. No language restrictions were made on the retrieved publications. The limit "AFFILCOUNTRY Canada" was used as Scopus indexes authors' addresses, including their countries, and institutional affiliations. By using the AFFILCOUNTRY limitation and selecting Canada, the search retrieved publications where at least one author is affiliated with a Canadian institution.

The analysis excluded reviews (systematic or otherwise), discussion papers, editorials, letters to authors, commentaries, dissertations, conference abstracts, books, book chapters, book reviews, guidelines, theses, protocols, and animal studies. Early release publications and publications from 2023 were also excluded to allow sufficient time for citation accumulation and reliable bibliometric indicators [39].

2.3. Data Validation and Extraction

Following the initial search in Scopus, the identified studies were imported into Covidence for title and abstract screening. Two reviewers conducted an inter-rater reliability assessment to ensure consistent screening of all articles. This assessment achieved a 94%

inter-rater reliability rate based on 50 randomly selected publications. Any disagreements were addressed, and the eligibility criteria were clarified to improve the quality and consistency of the data collection process. Duplicates were identified and removed during the screening process.

This created a refined dataset from Scopus, including only publications that met the eligibility criteria. This secondary dataset was essential for compatibility with VOSviewer. The selected publications were then exported to Excel and VOSviewer for further extraction and analysis.

With bibliometric analyses, it is generally not standard practice to screen publications for relevance due to the large volume of material. However, authors opted to manually review publications to confirm their relevance to perinatal depression as defined in the study's objectives. It was also verified that at least one author per publication had an affiliation with a Canadian institution. This approach enhanced data accuracy and ensured that the analysis remained comprehensive and relevant to the scope of the study.

2.4. Data Analysis

For this review, performance analysis and science mapping techniques were utilized. Performance analysis, a standard element of bibliometric reviews, assessed the impact of research entities such as authors, journals, and institutions [34]. Whereas science mapping techniques were used to explore relationships among these research components [34]. Descriptive statistics, network visualizations, and narrative summaries were employed to illustrate patterns and trends in perinatal depression research in Canada. VOSviewer, a bibliometric software, was used to analyze and generate visual networks for critical analysis.

3. Results

3.1. Bibliometric Data

The search strategy identified 1160 publications. After title and abstract screening, 397 were excluded, resulting in 763 publications eligible for inclusion in the analysis. Figure 1 shows that research on perinatal depression started in 1978. The first publications (n = 2) were published in the American Journal of Clinical Nutrition (Volume 31, Issue 5) and Obstetrics and Gynecology (Volume 52, Issue 6). From the distribution of perinatal depression publications in Scopus, the largest number of publications was 80 (10.48%) in 2021.

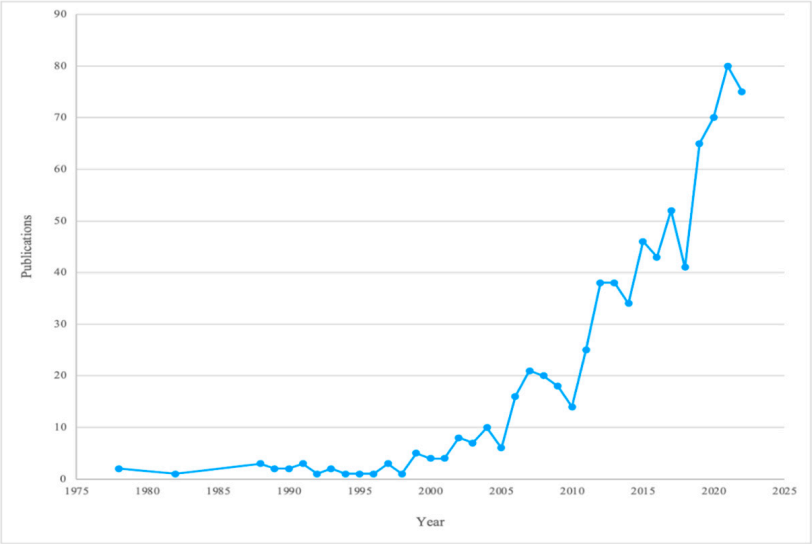

Figure 1. Distribution of the Number of Perinatal Depression Publications Between 1978 and 2022.

There were no publications on perinatal depression identified between the years 1979–1981, as well as between 1983 and 1987. From 1978 to 1998, research on perinatal depression was in its infancy with only 23 publications in 20 years, accounting for 3.01% of the total volume. A pivotal period for perinatal depression research occurred from 1999 to 2005 with 44 papers published in six years, accounting for 5.77% of the total volume. From 2006 to 2010, there was a period of steady growth in perinatal depression research with 89 publications in four years (11.66% of total volume). From 2011 to 2022, the number of publications increased significantly each year. During this period, 607 publications were identified, accounting for 79.55% of the total volume. This surge in publications highlights that research on perinatal depression has attracted increasing attention in the last two decades. The leading 10 authors, journals, and research areas based on the number of publications are summarized in Table 1.

Table 1. Bibliographic summary of perinatal depression publications for the top 10 authors, journals, and research areas (as defined by Scopus).

Top 10 Authors, Journals, and Research Areas	Number of Publications (% of Total Publications)
Canadian Authors	
1. Dennis, C.L.	57 (7.47%)
2. Oberlander, T.F.	39 (5.11%)
3. Meaney, M.J.	38 (4.98%)
4. Letourneau, N.	37 (4.84%)
5. Vigod, S.N.	31 (4.06%)
6. Steiner, M.	30 (3.93%)
7. Tough, S.	29 (3.80%)
8. Chong, Y.S.	22 (2.88%)
9. Giesbrecht, G.F.	22 (2.88%)
10. Mcdonald, S.	21 (2.75%)
Zelkowitz, P.	21 (2.75%)
Journals (not limited to Canada)	
1. Archives Of Women's Mental Health	57 (7.47%)
2. Journal Of Affective Disorders	40 (5.24%)
3. BMC Pregnancy And Childbirth	27 (3.54%)
4. Canadian Journal of Psychiatry	21(2.75%)
5. PLOS One	17 (2.23%)
6. Journal of Obstetrics And Gynaecology Canada	16 (2.10%)
7. International Journal Of Environmental Research And Public Health	15 (1.97%)
8. JOGNN Journal Of Obstetric Gynecologic and Neonatal Nursing	10 (1.31%)
9. Journal of Women's Health	10 (1.31%)
10. BMJ Open	9 (1.18%)
Maternal and Child Health Journal	9 (1.18%)
Translational Psychiatry	9 (1.18%)
Scopus Research Areas	
1. Medicine	55.8%
2. Psychology	14.30%
3. Neuroscience	8.10%
4. Nursing	6.70%
5. Biochemistry, Genetics and Molecular Biology	3.50%
6. Social Sciences	3.10%
7. Multidisciplinary	2.00%
8. Environmental Science	1.60%
9. Arts and Humanities	1.30%
10. Pharmacology, Toxicology, and Pharmaceutics	1.20%

3.2. Country Affiliations

At least one author per publication was affiliated with a Canadian institution. The primary countries that collaborated with Canadian institutions include the United States (n = 149), United Kingdom (n = 63), Australia (n = 40), and Singapore (n = 32). Figure 2 shows the top countries that collaborated with a Canadian institution on perinatal depression research.

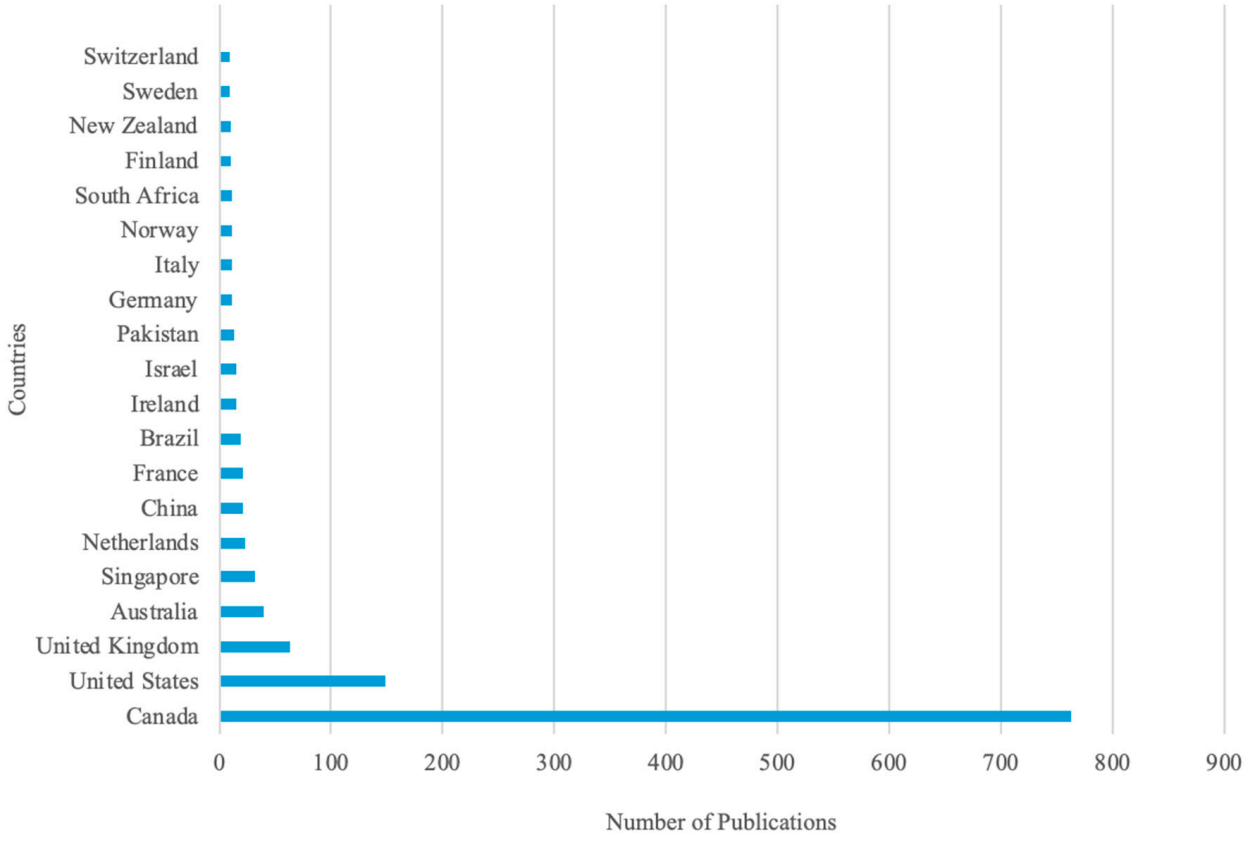

Figure 2. Top countries collaborating with Canadian institutions on perinatal depression research.

3.3. Canadian Institutional Affiliations

The Canadian institution with the most perinatal depression researcher affiliations was the University of Toronto (n = 313), followed by both McGill University (n = 220) and the University of Calgary (n = 220). Figure 3 shows the leading 10 Canadian institutions with perinatal depression research affiliates. Remarkably, 9 out of the top 10 Canadian affiliations are academic institutions. The Center for Addictions and Mental Health (n = 52) is the outlier as a mental health teaching hospital and research centre. Furthermore, 14 of the top 20 Canadian intuitions affiliated with perinatal depression research are in central provinces (Ontario and Quebec), three in the prairie provinces (Manitoba and Alberta), two on the west coast (British Columbia), and one in the Atlantic region. It is apparent that perinatal depression research is highly collaborative and interdisciplinary across Canada's major universities and healthcare institutions.

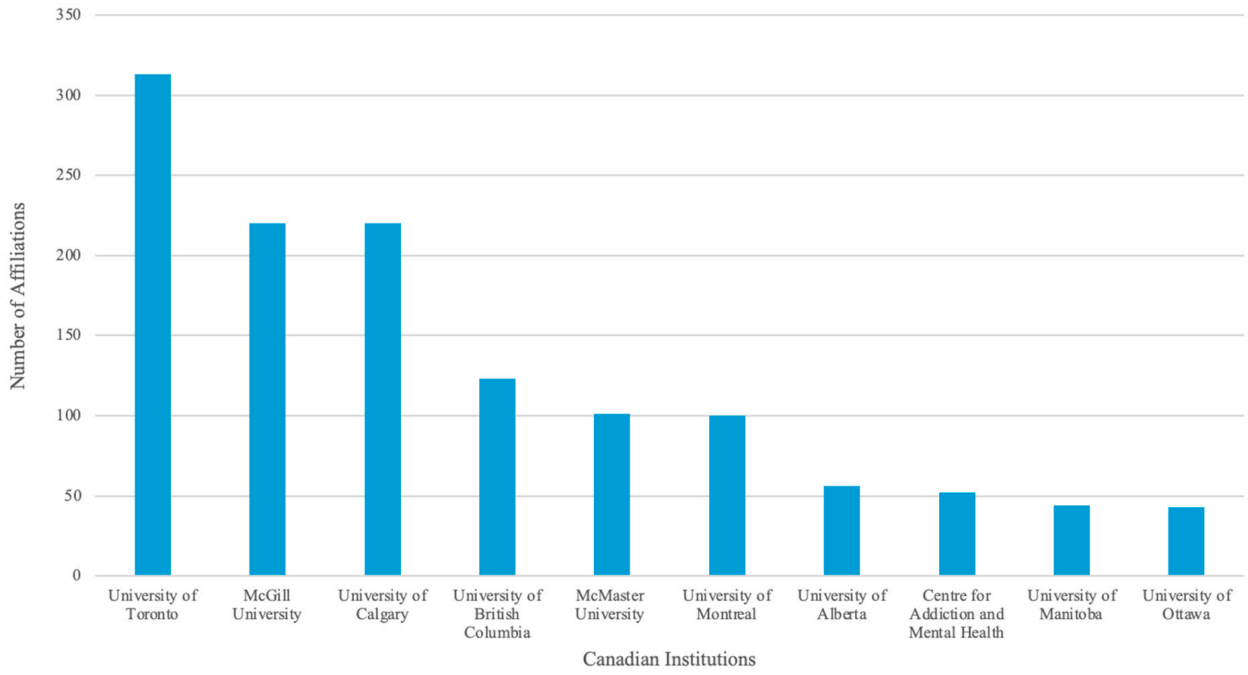

Figure 3. Top 10 Canadian institutional affiliations on perinatal depression research.

3.4. Journals

The journals with the most perinatal depression publications were Archives of Women's Mental Health (n = 57), Journal of Affective Disorders (n = 40), BMC Pregnancy and Childbirth (n = 27), Canadian Journal of Psychiatry (n = 21), and PLOS One (n = 17). Trends of perinatal depression publications by the top 5 journals (not limited to Canada) is shown in Figure 4.

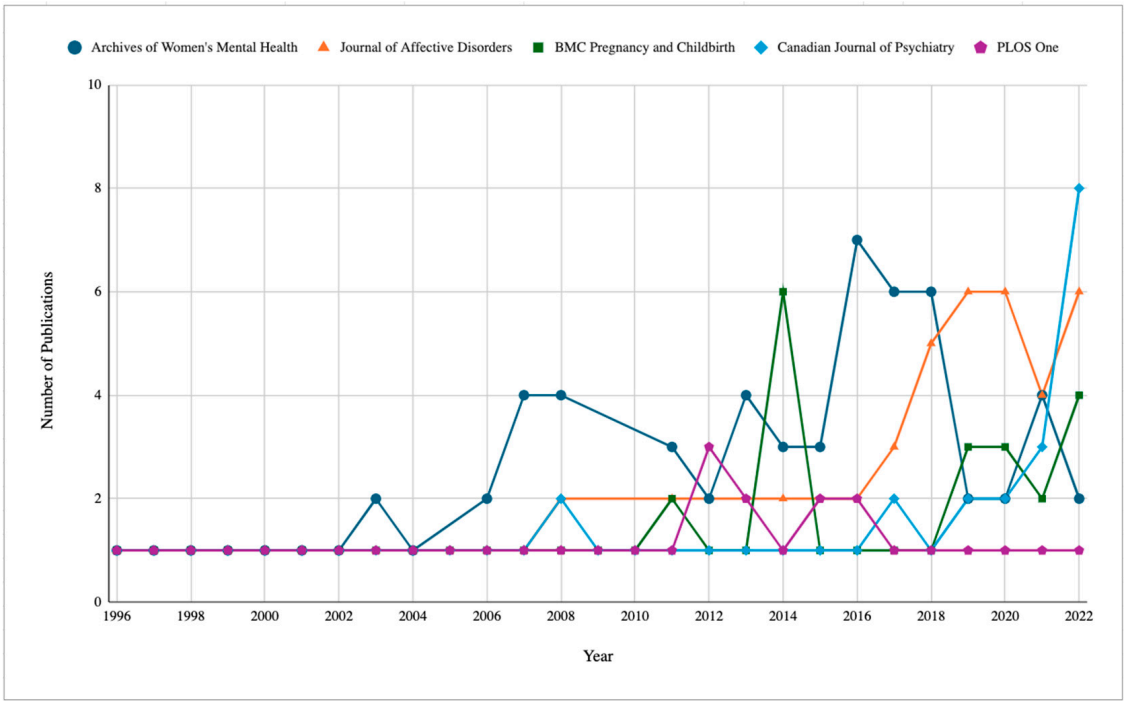

Figure 4. Perinatal depression publications per year by top 5 journals.

Furthermore, journals were classified under 15 different type of research areas defined by Scopus with the most common being medicine (n = 611, 57.00%), psychology (n = 157,

14.30%), and neuroscience (n = 90, 8.20%). Figure 5 shows the breakdown of publications by subject area (retrieved from Scopus). Of note, publications were categorized under multiple research areas as categories were not mutually exclusive.

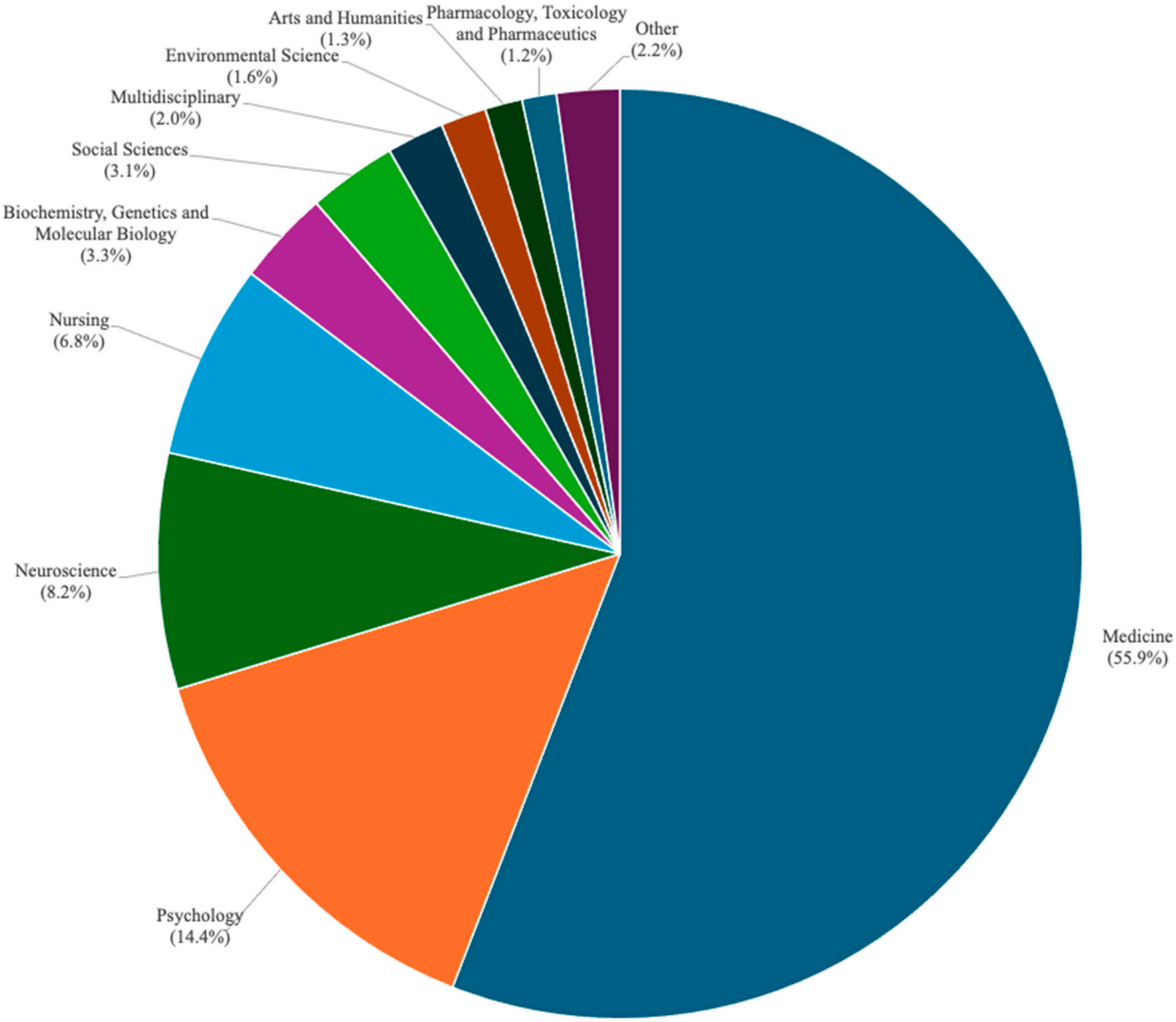

Figure 5. Perinatal depression publications by subject area.

To examine the relationships between journals, a citation analysis was performed. This analysis assessed the journals' connectivity by evaluating how frequently they cite each other. The citation analysis included journals that were cited at least five times and linked to each other (Figure 6). The journals with the greatest number of citations were Journal of Affective Disorders (n = 2231 from 40 publications), Archives of Women's Mental Health (n = 2168 from 57 publications), Canadian Journal of Psychiatry (n = 1255 from 21 publications), and Epigenetics (n = 1151 from 2 publications). Table 2 supports data in Figure 6 showing the links and total link strength of the top 10 producing journals. As per the VOSviewer manual [40], each link has a strength represented by a positive numerical value—the higher this value, the stronger the link or connection.

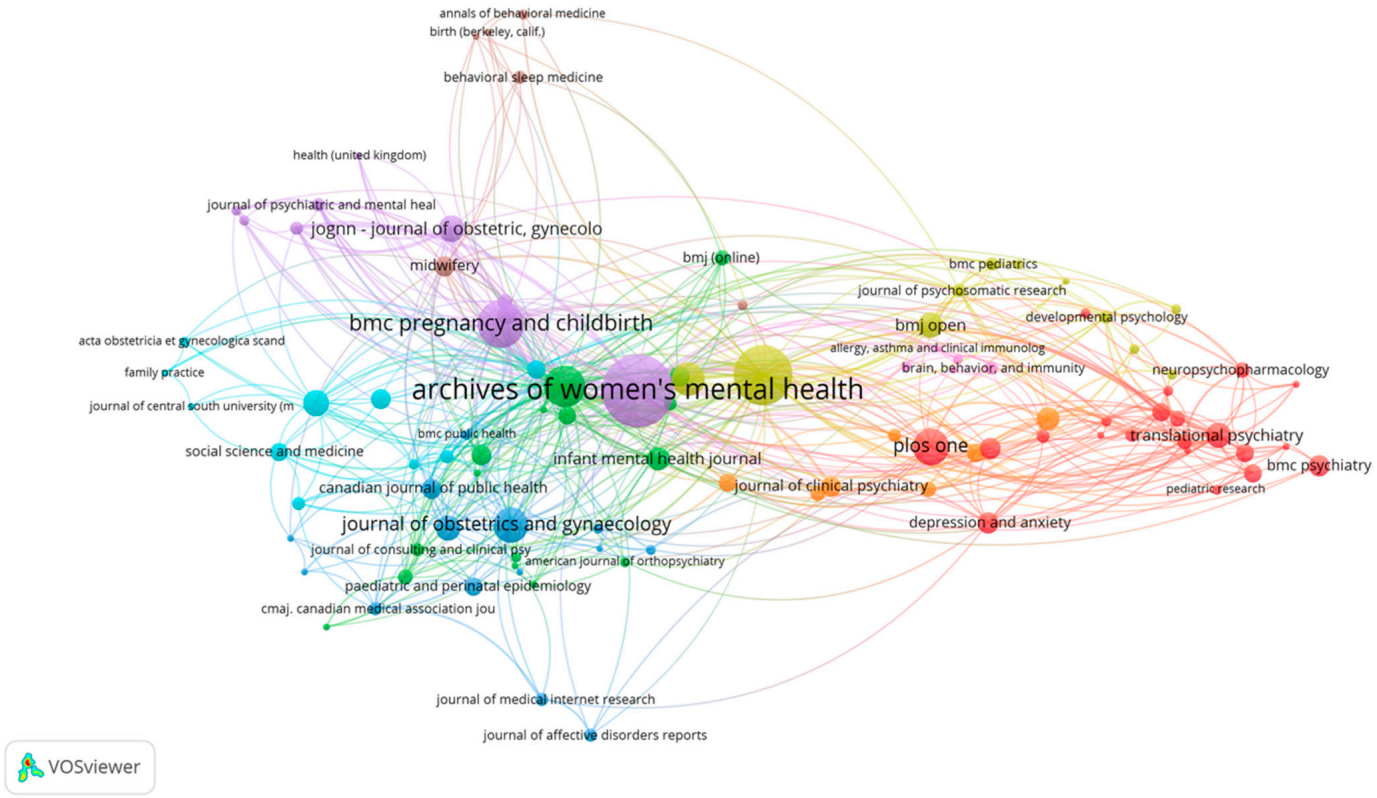

Figure 6. Network visualization of citations among journals on perinatal depression. Note: This figure demonstrates the citation between journals on perinatal depression with at least five citations (top 100 included based on total link strength).

Table 2. The link and total link strengths of the top 10 journals with at least 5 publications.

Rank	Journal	Publications	Cluster Number	Links	Total Link Strength
1	Archives of Women's Mental Health	57	5	48	128
2	Journal of Affective Disorders	40	4	50	106
3	BMC Pregnancy and Childbirth	27	5	31	56
4	Canadian Journal of Psychiatry	21	2	51	129
5	PLOS One	17	1	19	25
6	Journal of Obstetrics and Gynaecology	16	3	22	38
7	International Journal of Environment Research and Public Health	15	4	6	8
8	JOGNN—Journal of Obstetric, Gynecologic, and Neonatal Nursing	10	5	18	25
9	Journal of Women's Health	10	6	17	23
10	BMJ Open	9	4	11	12
	Maternal and Child Health Journal	9	3	16	23
	Translational Psychiatry	9	1	16	37

3.5. Publications

All included publications were research articles. The most frequently cited publication, with 1118 citations, was "Prenatal Exposure to Maternal Depression, Neonatal Methylation of Human Glucocorticoid Receptor Gene (NR3C1), and Infant Cortisol Stress Responses" by Oberlander et al. [41], published in Epigenetics. The authors did not specify the study design, however it appears to be a prospective cohort study. Table 3 presents the top 20 most cited publications as retrieved from Scopus.

Table 3. Top 20 cited publications on perinatal depression.

Authors	Publication	Journal Title	Publication Year	Total Citations
Oberlander T.F., Weinberg J., Papsdorf M., Grunau R., Misri S., Devlin A.M. [41]	Prenatal exposure to maternal depression, neonatal methylation of human glucocorticoid receptor gene (NR3C1) and infant cortisol stress responses	Epigenetics	2008	1118
Lebel C., MacKinnon A., Bagshawe M., Tomfohr-Madsen L., Giesbrecht G. [42]	Elevated depression and anxiety symptoms among pregnant individuals during the COVID-19 pandemic	Journal of Affective Disorders	2020	541
Gotlib I.H., Whiffen V.E., Mount J.H., Milne K., Cordy N.I. [43]	Prevalence Rates and Demographic Characteristics Associated With Depression in Pregnancy and the Postpartum	Journal of Consulting and Clinical Psychology	1989	470
Bergink V., Kooistra L., Lambregtse-van den Berg M.P., Wijnen H., Bunevicius R., van Baar A., Pop V. [44]	Validation of the Edinburgh Depression Scale during pregnancy	Journal of Psychosomatic Research	2011	418
Wu Y., Zhang C., Liu H., Duan C., Li C., Fan J., Li H., Chen L., Xu H., Li X., Guo Y., Wang Y., Li X., Li J., Zhang T., You Y., Li H., Yang S., Tao X., Xu Y., Lao H., Wen M., Zhou Y., Wang J., Chen Y., Meng D., Zhai J., Ye Y., Zhong Q., Yang X., Zhang D., Zhang J., Wu X., Chen W., Dennis C.-L., Huang H.-F. [45]	Perinatal depressive and anxiety symptoms of pregnant women during the coronavirus disease 2019 outbreak in China	American Journal of Obstetrics and Gynecology	2020	414
Forman D.R., O'Hara M.W., Stuart S., Gorman L.L., Larsen K.E., Coy K.C. [46]	Effective treatment for postpartum depression is not sufficient to improve the developing mother-child relationship	Development and Psychopathology	2007	367
O'Donnell K.J., Bugge Jensen A., Freeman L., Khalife N., O'Connor T.G., Glover V. [47]	Maternal prenatal anxiety and downregulation of placental 11β-HSD2	Psychoneuroendocrin	2012	346
O'Donnell K.J., Glover V., Barker E.D., O'Connor T.G. [48]	The persisting effect of maternal mood in pregnancy on childhood psychopathology	Development and Psychopathology	2014	293
Devlin A.M., Brain U., Austin J., Oberlander T.F. [49]	Prenatal exposure to maternal depressed mood and the MTHFR C677T variant affect SLC6A4 methylation in infants at birth	PLoS ONE	2010	255
Dennis C.-L., Hodnett E., Kenton L., Weston J., Zupancic J., Stewart D.E., Kiss A. [50]	Effect of peer support on prevention of postnatal depression among high risk women: Multisite randomised controlled trial	BMJ (Online)	2009	248
Cameron E.E., Joyce K.M., Delaquis C.P., Reynolds K., Protudjer J.L.P., Roos L.E. [51]	Maternal psychological distress & mental health service use during the COVID-19 pandemic	Journal of Affective Disorders	2020	246
Gotlib I.H., Whiffen V.E., Wallace P.M., Mount J.H. [52]	Prospective Investigation of Postpartum Depression: Factors Involved in Onset and Recovery	Journal of Abnormal Psychology	1991	246
Dennis C.L., Ross L. [53]	Relationships among infant sleep patterns, maternal fatigue, and development of depressive symptomatology.	Birth (Berkeley, Calif.)	2005	244

Table 3. *Cont.*

Authors	Publication	Journal Title	Publication Year	Total Citations
Da Costa D., Larouche J., Dritsa M., Brender W. [54]	Psychosocial correlates of prepartum and postpartum depressed mood	Journal of Affective Disorders	2000	244
Ross L.E., Evans S.E.G., Sellers E.M., Romach M.K. [55]	Measurement issues in postpartum depression part 1: Anxiety as a feature of postpartum depression	Archives of Women's Mental Health	2003	232
McLearn K.T., Minkovitz C.S., Strobino D.M., Marks E., Hou W. [56]	Maternal depressive symptoms at 2 to 4 months post partum and early parenting practices	Archives of Pediatrics and Adolescent Medicine	2006	228
Whiffen V.E., Gotlib I.H. [57]	Infants of Postpartum Depressed Mothers: Temperament and Cognitive Status	Journal of Abnormal Psychology	1989	225
Boukhris T., Sheehy O., Mottron L., Berard A. [58]	Antidepressant use during pregnancy and the risk of autism spectrum disorder in children	JAMA Pediatrics	2016	215
Le Strat Y., Dubertret C., Le Foll B. [59]	Prevalence and correlates of major depressive episode in pregnant and postpartum women in the United States	Journal of Affective Disorders	2011	201
Dennis C.-L.E., Janssen P.A., Singer J. [60]	Identifying women at-risk for postpartum depression in the immediate postpartum period	Acta Psychiatrica Scandinavica	2004	200

To explore the relationship between publications on perinatal depression, the research conducted a citation analysis on publications that were cited at least 10 times and interconnected (n = 399). Table 4 lists the top ten publications based on links. In the overlay visualization (Figure 7), each node represents a publication, and the size of the node is determined by the number of links. A citation link is a link between two items where one item cites the other. In addition, the colour of the node represents the year of publication from 2005 (dark purple) to 2020 (in yellow). In Figure 7, publications with the largest number of links to other publications were by Dennis et al. [60] with 26 links, Bergink et al. [44] with 25 links, Zelkowitz and Milet [61] with 25 links, and Rifkin-Graboi [61] with 22 links. This citation analysis highlights key authors, landmark publications, and the flow of knowledge within perinatal depression research.

Table 4. Top 10 publications based on citation analysis.

Rank	Publication	Citations	Links
1	Dennis, C.-L. E, Janssen, P. A. [60]	200	26
2	Bergink et al. [44]	418	25
3	Zelkowitz, P. & Milet, T. H. [61]	126	25
4	Rifkin-Graboi, A., Bai, J., Chen, H., Hameed, W. B., Sim, L. W., Tint, M. T., Leutscher-Broekman, B., Chong, Y., Gluckamn, P. D., Fortier, M. V., Meaney, M. J., & Qiu, A. [62]	190	22
5	Lanes, A., Kuk, J. L., & Tamim, H. [63]	124	19
6	Qiu, A., Anh, T. T., Li, Y., Chen, H., Rifkin-Graboi, A., Broekman, B. F. P., Kwek, K., Saw, S., Chong, Y., Gluckamn P. D., Fortier, M.V., & Meaney, M. J. [64]	199	16

Table 4. *Cont.*

Rank	Publication	Citations	Links
7	Oberlander et al. [41]	1118	16
8	Stewart, D. E., Gagon, A., Sauciet, J., Wahoush, O., & Dougherty, G. [65]	123	16
9	Gotlib, I. H., Whiffern, V. E., Mount, J. H., Milne, K., & Cordy, N. I. [43]	470	16
10	Dennis, C.-L., Brown, H. K., & Brennenstuhl, S. [66]	17	14
	Dennis, C.-L. [67]	161	14
	Dennis, C.-L. [68]	158	14

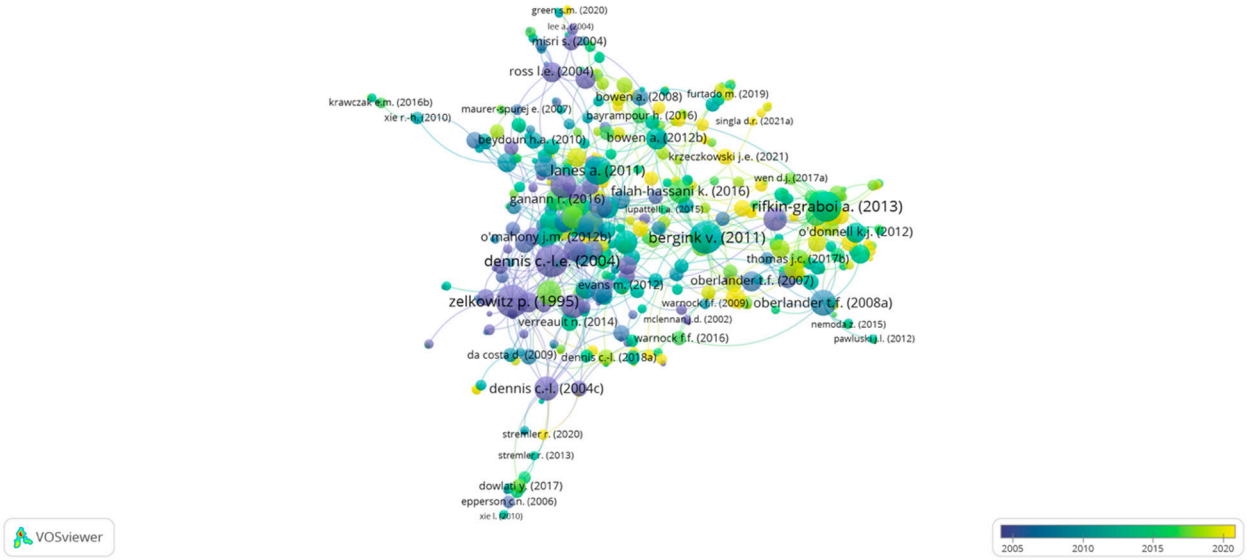

Figure 7. Citation analysis of publications on perinatal depression. Note. Overlay is the visualization of links between connected publications on perinatal depression with at least 10 citations (n = 399).

3.6. Authors

The authors with the highest number of citations were Dennis (n = 3079 with 57 publications), Oberlander (n = 2681 with 39 publications), Misri (n = 2280 with 18 publications) and Meaney (n = 1548 with 38 publications). VOSviewer was utilized to analyze the collaboration pattern of the authors on perinatal depression. Specifically, co-authorship relations were explored—which is when two authors are listed together in an author list [28]. Co-authorship networks provide a visual representation of research networks and help illustrate the level of collaboration among a group of researchers. Co-authorship was explored by removing non-connected authors, reducing authors' first name to initial only, and placing no limit on minimum publications or citations (Figure 8). In Figure 8, the researchers are linked based on the number of publications they have authored together. The authors with the highest number of links were Dennis (n = 241), Meaney (n = 215), and Letourneau (n = 161). The high link counts identify researchers that are central figures in the field of perinatal depression and foster collaboration between research teams and disciplines.

Co-authorship relations were further explored by setting a minimum of 5 publications by author, reducing authors' first name to initial only, and removing non-connected authors. As a result, 119 authors were identified as illustrated in Figure 9. In the network visualization, the size of the node shows the author productivity (publications) and the lines connecting the authors shows collaboration. Nodes in the same cluster (colour) are more closely related authors indicating a stronger research relationship.

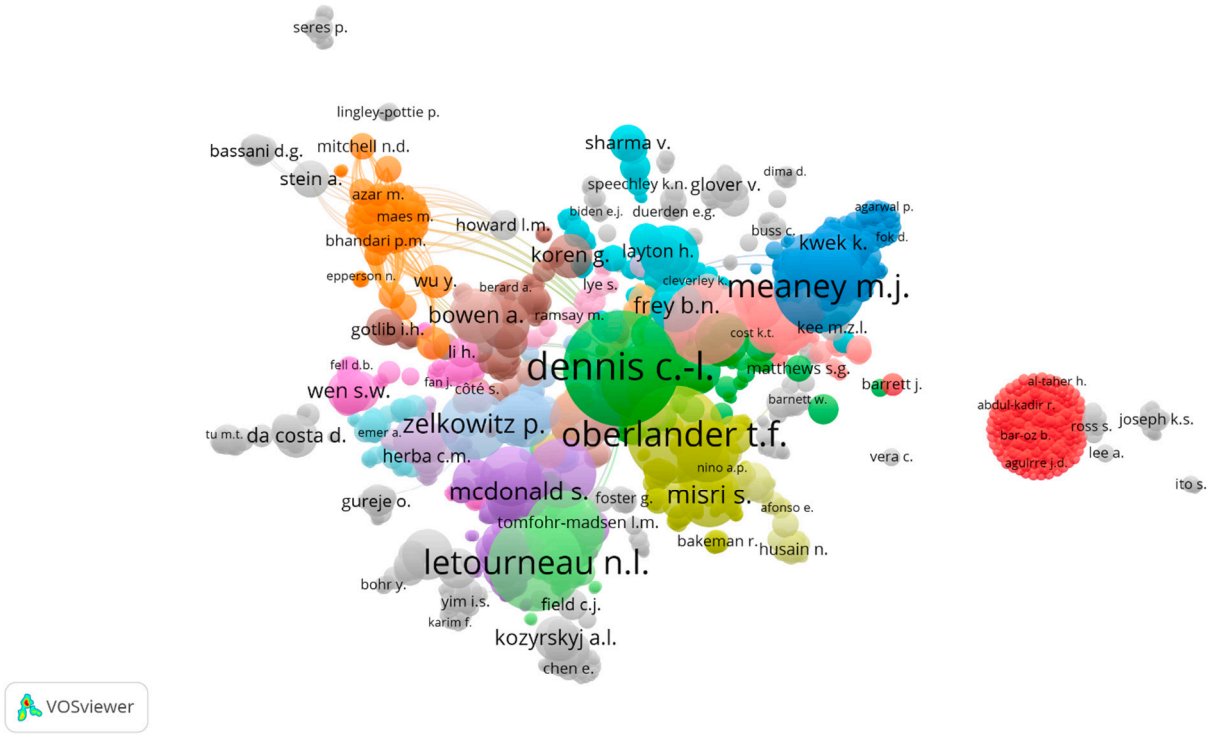

Figure 8. Network visualization of co-authorship. Note: Network visualization of co-authorship between connected authors (n = 2496). No limit on minimum publications or citations.

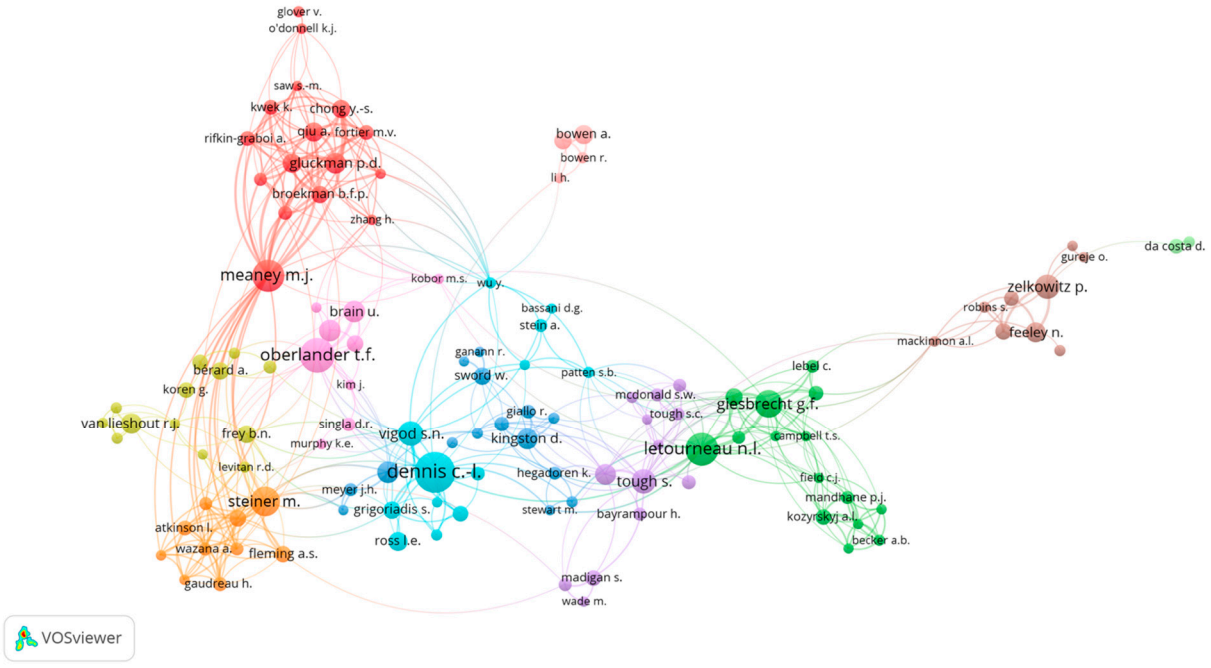

Figure 9. Network visualization of co-authorship between authors with at least 5 publications. Note: Network visualization of co-authorship between connected authors with at least 5 publications (n = 119).

3.7. Keywords

Keywords are useful in scholarly publications for information retrieval and research. In this analysis, all keywords were considered, including those from the title, abstract, and author-supplied lists. VOSviewer was used to create a keyword co-occurrence network visualization, illustrating the connections among concepts and ideas in the field. A total of 4641 keywords were identified, and a co-occurrence analysis was conducted using

keywords that appeared at least 25 times. Out of the 4541 keywords analyzed, 168 met the inclusion threshold and are depicted in Figure 10. The 168 items were divided into 5 clusters with 12,593 links. Links denote the co-occurrence of two keywords. The greater the total link strength, the stronger the link. Table 5 shows the top 25 keywords including occurrences and total link strength.

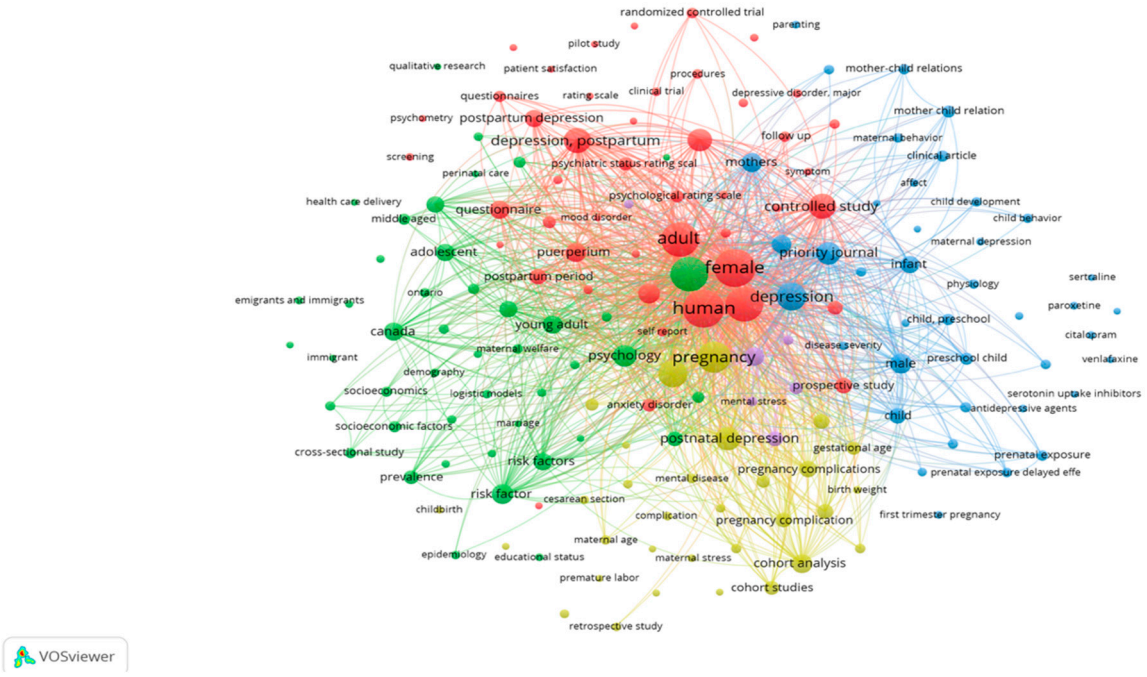

Figure 10. Network visualization of all keyword co-occurrences. Note: Network visualization of all keyword co-occurrences which appeared at least 25 times (168 keywords).

Table 5. The occurrences and total link strength of the top 25 occurrence keywords.

Rank	Keyword	Cluster	Occurrences	Total Link Strength
1	Human	1	718	15,046
2	Female	1	714	15,012
3	Article	1	614	13,490
4	Humans	2	611	13,603
5	Adult	1	605	13,144
6	Pregnancy	4	481	10,687
7	Depression	3	385	8519
8	Major Clinical Study	4	367	8594
9	Controlled study	1	329	7388
10	Depression, postpartum	1	327	7135
11	Postnatal depression	4	281	6294
12	Puerperal depression	1	266	5546
13	Priority journal	3	261	6129
14	Psychology	2	243	5786
15	Edinburgh postnatal depression scale	1	212	4946
16	Risk factor	2	205	4927
17	Male	3	197	4694
18	Puerperium	1	193	4387
19	Cohort analysis	4	188	4678
20	Mothers	3	187	4418
21	Anxiety	5	174	4089
22	Mother	3	170	4053
23	Young adult	2	167	3981
24	Canada	2	165	3731
25	Questionnaire	1	163	3854

In Figure 10, the size of the nodes and the font size reflect the frequency of the keywords, with larger nodes and fonts indicating more frequent occurrences. Lines connecting the nodes show that keywords co-occur within publications, with the thickness of the lines representing the strength of these connections; thicker lines signify more frequent co-occurrence. The total link strength represents the number of publications where the keywords appear together. Keywords are organized into clusters based on related topics, with different clusters represented by different colours. Five main clusters emerged in the network visualization in Figure 10:

1. The largest cluster (red) contains 46 keywords related to "diagnostic labels," including terms like postpartum depression, anxiety disorder, postpartum period, puerperium, and mood disorder. It also includes "psychometric terms" such as controlled study, questionnaire, screening, and psychological rating scale.
2. The second cluster (green) consists of 45 keywords related to "risk factors and social aspects of research," including terms such as adolescent, mental health, psychology, prenatal care, social support, and socioeconomics.
3. The third cluster (blue) includes 40 keywords pertaining to "depression outcomes and treatment" such as prenatal exposure, mother child relation (s), mood, affect, maternal behaviour, priority journal, and antidepressant medications.
4. The fourth cluster (yellow) and the fifth cluster (purple), with 31 and 6 keywords, respectively, are centred on "research methods and outcomes." These include terms such as complications, stress, anxiety, disease association, gestational age, premature labour, cohort analysis, and longitudinal studies.

This network illustrates the connections among concepts in the field. Major central terms include "female," "human," "pregnancy," and "postnatal depression", indicating the primary focus on maternal mental health and related outcomes. The most common keyword is "human" (n = 718 with 167 links and total link strength of 15,046) which is appropriate as all publications were related to human studies. "Female" (n = 714 with 167 links and total link strength of 15,012) is the second most common keyword. "Adult" (n = 605 with 167 links and total link strength of 13,144) is the third most common keyword—which is anticipated as perinatal depression research is naturally associated with females in their childbearing years.

Interestingly, "perinatal depression" ranked 88 out of 100 in the keyword list, despite being the focus of this bibliometric analysis. This ranking is understandable given that "perinatal depression" is a relatively recent term, with its average publication year being 2018 (as per VOSviewer data). Historically, the term "postpartum depression" was more prevalent, ranking 37 with an average publication year of 2012. The terminology, definition, and measurement of perinatal depression have evolved over time. For instance, terms such as "postnatal depression," "puerperal depression," and "postpartum depression" all describe the same concept but use slightly different terminology.

VOSviewer was used to analyze the chronological co-occurrence of keywords, as depicted in Figure 11. The colour of the lines connecting the keywords indicates the initial year of their co-occurrence, with thicker lines representing a higher frequency and intensity of co-occurrences between the keywords. The colour of the node reflects the average publication year for the keyword co-occurrence. The colour gradient from blue to yellow shows how research focus evolved from 2013 to 2017. Older terms (in blue) include foundational topics such as "pregnancy," "human," and "female." Newer terms (in yellow), like "serotonin uptake inhibitors," "citalopram," and "fluoxetine," suggest growing interest in pharmacological interventions over time.

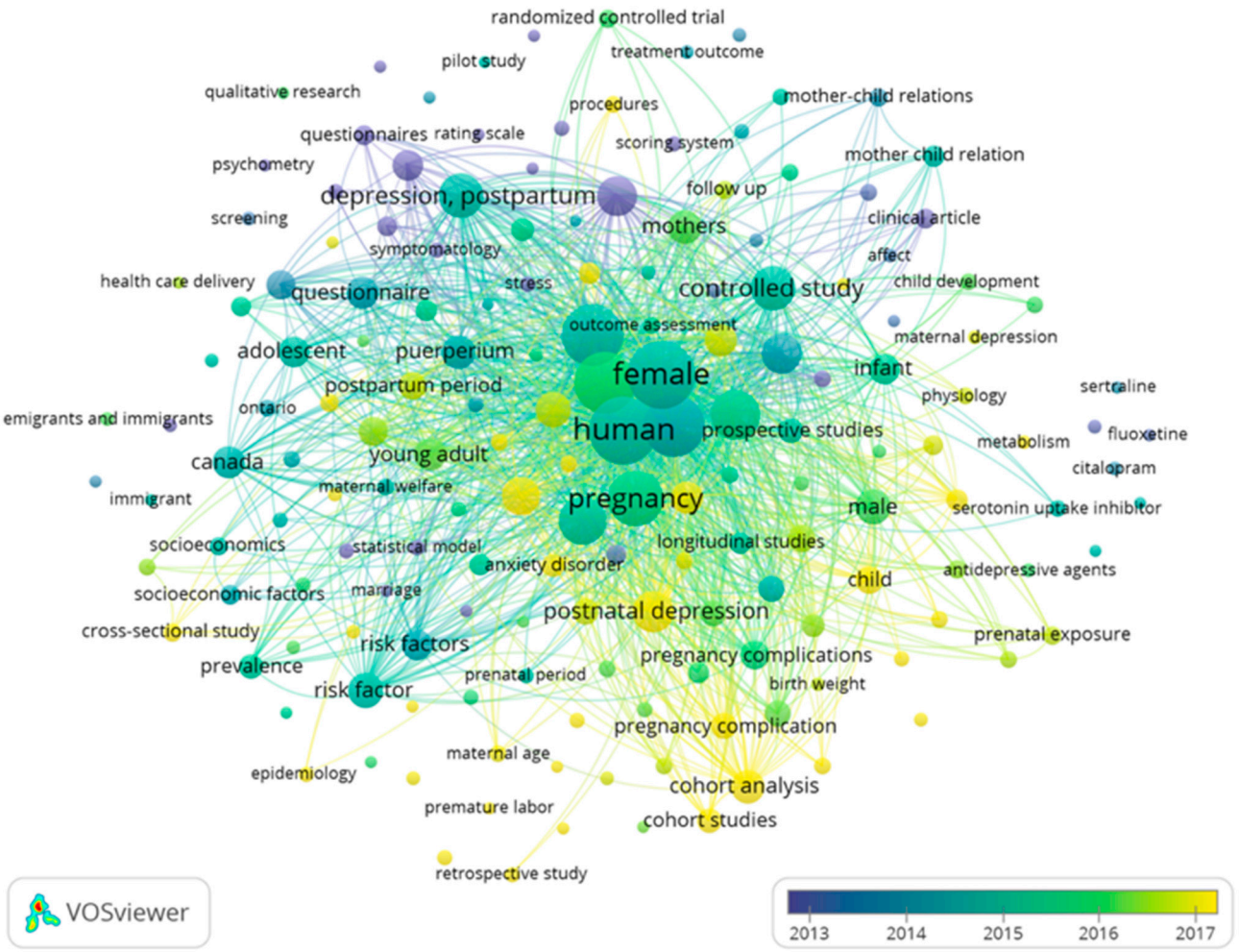

Figure 11. The co-occurrence chronology view of all keywords.

VOSviewer was also used to generate a density visualization of all keywords (Figure 12). In this visualization, each node represents a keyword and is coloured to reflect the density of items at that location, with a gradient from yellow to green to blue. Nodes at the centre, which are denser, display deeper and brighter colours, highlighting key research focus areas. Conversely, nodes with lower density are positioned toward the edges, appearing less vibrant and blue-tinged, indicating these topics are less prominent in the research landscape. Figure 12 reveals that the yellow-coloured nodes at the centre represent the current research hotspots, with associated keywords including pregnancy, depression, human, female, and adult. The keywords in blue areas along the edges such as "socioeconomics," "immigrant," "logistic models," and "screening," represent specialized or emerging areas in the field, reflecting an interest in how social and demographic factors influence perinatal mental health.

For comparison, the researcher performed a keyword co-occurrence analysis using only the keywords from the author-supplied lists (Figure 13). This analysis focused on keywords that co-occurred at least 5 times, resulting in a set of 72 keywords out of a possible 1499. The most frequently occurring keywords were postpartum depression (n = 156), depression (n = 146), pregnancy (n = 144), and postpartum (n = 75). Notably, the analysis of the author-supplied keywords yielded a visualization with terms more specifically related to perinatal depression, in contrast to the broader set of terms found in the previous analysis of all keywords (Figure 10), which included more general terms like human, adults, and female, as well as terminology related to study designs.

For comparative purposes, overlay and density visualizations are provided in Figures 14 and 15. Figure 14 depicts the evolution of research trends in perinatal depression from 2014 to 2020. Initially (2014-2015), highlighted in purple nodes and lines, research focused on foundational concepts of PND including risk factors, social support, screening, prevention, parenting, and breastfeeding. From 2015 to 2018 (blue and teal nodes), there was a shift towards deeper inquiries into the connections between pregnancy, depression, anxiety, and stress, indicating a growing understanding of perinatal mental health complexities. Finally, from 2018 to 2022 (green and yellow nodes), there was a notable surge in research related to the COVID-19 pandemic's impact on perinatal depression, along with studies on public health implications, temperament, postpartum anxiety, and adverse childhood experiences. Overall, Figures 14 and 15 illustrate how research trends have evolved towards a more diverse exploration of perinatal mental health issues.

The analyses of keywords reveal a multidisciplinary approach to perinatal depression research with representation from various fields such as psychology, pharmacology, and sociology. There is an emerging focus on treatment options and risk factor identification indicating a shift towards personalized care and prevention. Furthermore, the presence of socioeconomic and demographic factors highlights the importance of inclusive research that considers diverse populations in Canada.

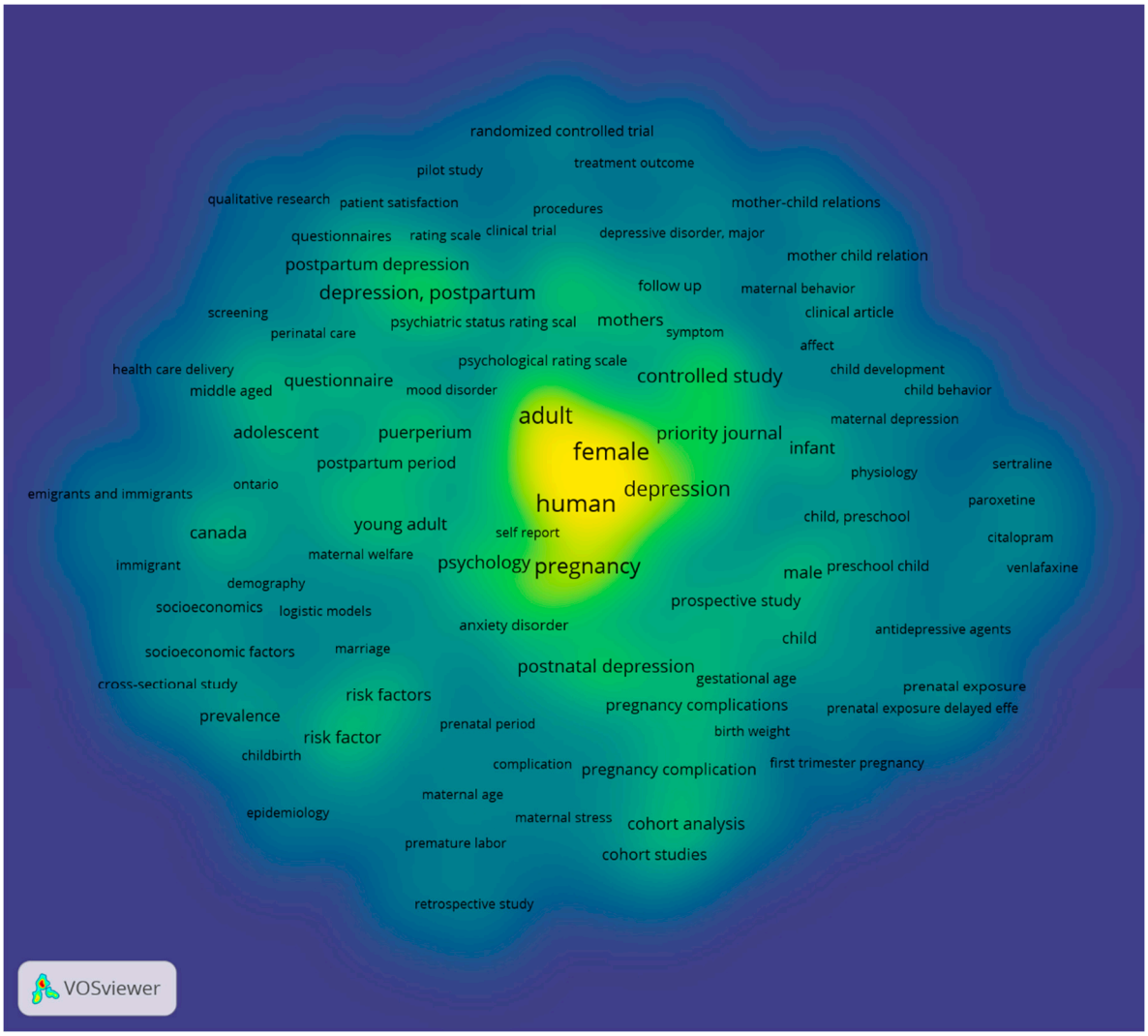

Figure 12. Density visualization of co-occurrence of all keywords.

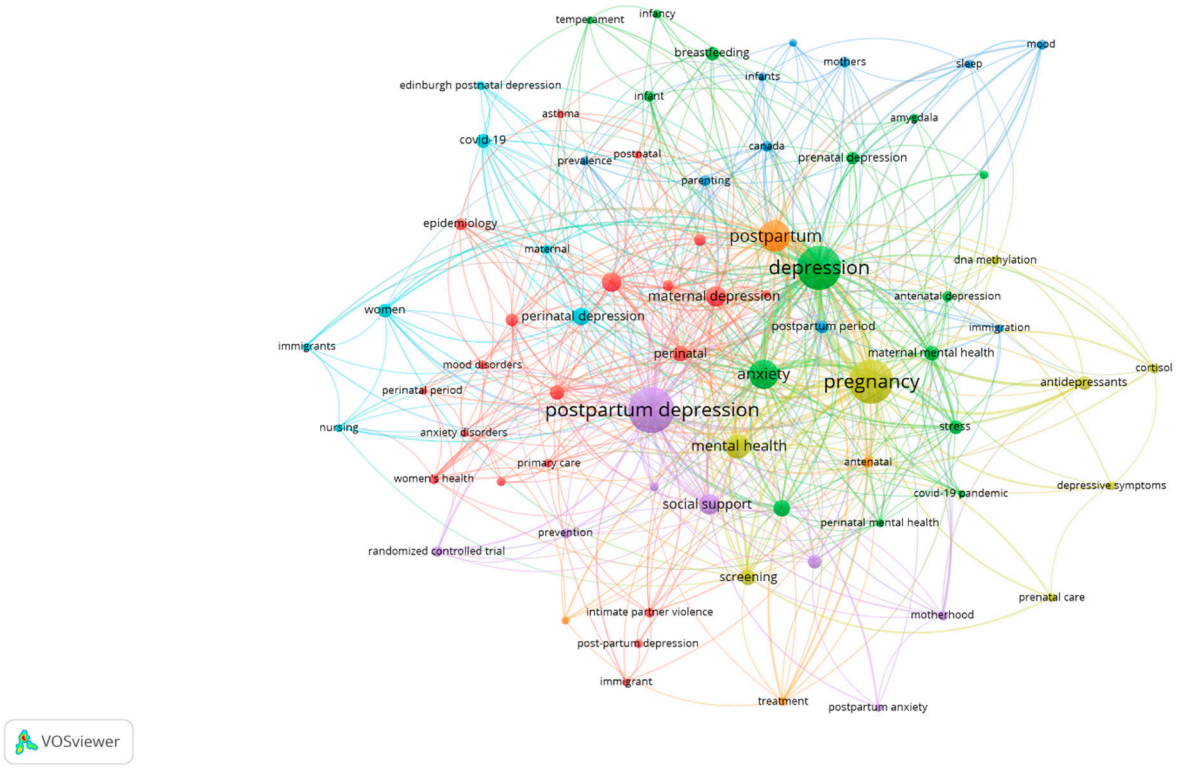

Figure 13. Network visualization of co-occurrence of authors' keywords.

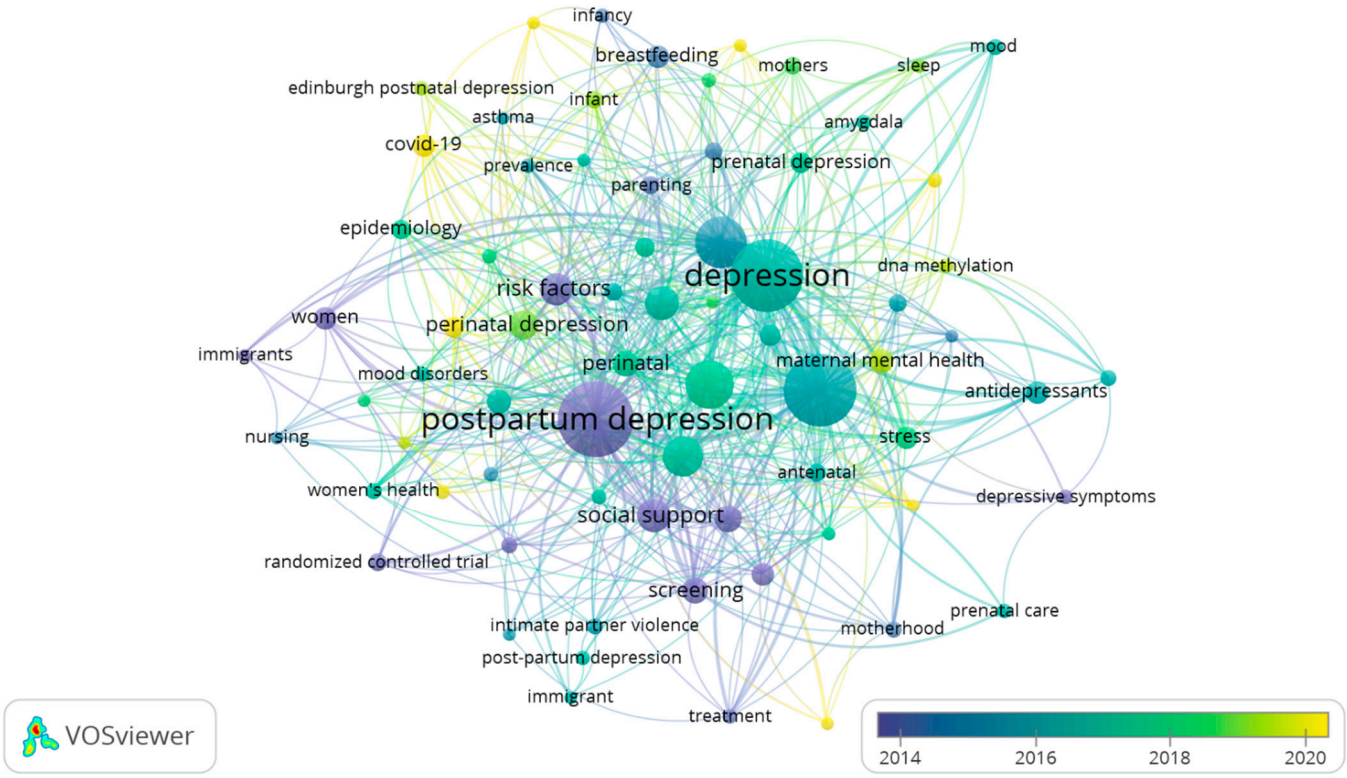

Figure 14. Overlay visualization of authors' keywords.

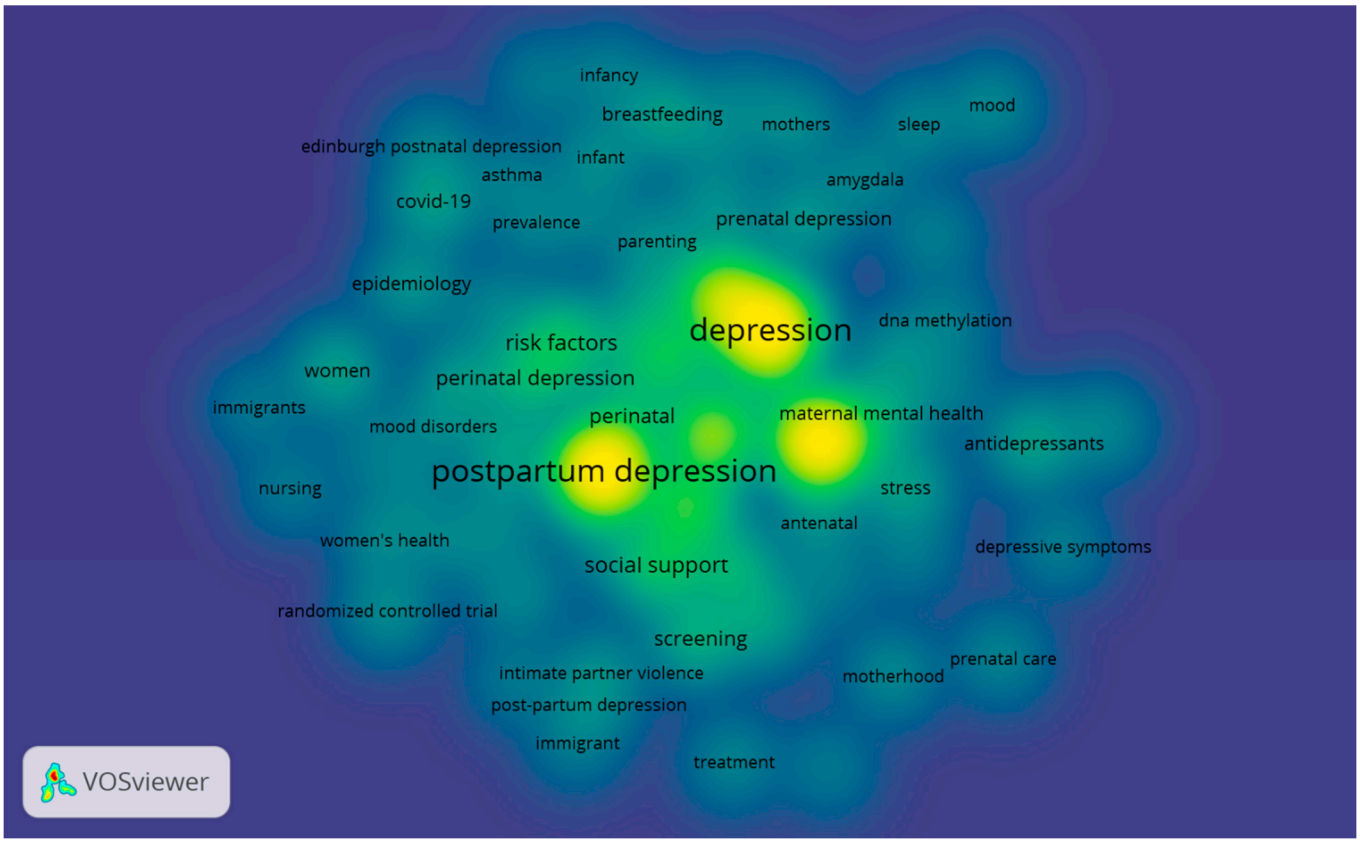

Figure 15. Density visualization of authors' keywords.

4. Discussion

This study is the first bibliometric analysis of perinatal depression publications within a Canadian context, focusing on publications affiliated with Canadian institutions. It reveals a significant increase in perinatal depression research since the early 2000s. Before 2002, the annual number of publications consistently remained below six. However, by 2012, this figure had increased nearly fivefold, and the growth continued into the following decade, with the number of annual publications in 2022 being 1.97 times higher than in 2012. It is worth noting that 95.28% of the analyzed publications were produced in the last two decades. This rise can be attributed to the recognition of perinatal depression in the Diagnostic and Statistical Manual in 1994 [1] and aligns with an overall surge of interest in mental health research and funding [69]. Additionally, the substantial rise in perinatal depression publications over the past two decades can be partially linked to advancements in information technology and the rise of online publishing in the 1990s, which greatly enhanced the dissemination of scholarly work and created new avenues for knowledge sharing [35].

In this analysis, publications on perinatal depression appeared in 160 journals, including authors affiliated with 123 institutions from 69 countries. The most prolific journals based on citations were the Journal of Affective Disorders (n = 2231 from 40 publications), Archives of Women's Mental Health (n = 2168 from 57 publications), Canadian Journal of Psychiatry (n = 1255 from 21 publications), and Epigenetics (n = 1151 from 2 publications). The Canadian institutions with the most perinatal depression researcher affiliations were the University of Toronto (n = 313), McGill University (n = 220), and the University of Calgary (n = 220). In terms of productivity, the authors with the highest number of citations were Dennis (n = 3079 with 57 publications), Oberlander (n = 2681 with 39 publications), Misri (n = 2280 with 18 publications) and Meaney (n = 1548 with 38 publications).

While the literature on perinatal depression is expanding, there remains a significant gap in examining research trends within this field. Dol et al. [28] conducted one of the first bibliometric analyses of published research on perinatal depression, mapping publications from 1920 to 2020 using the Web of Science. Dol et al. [28] identified trends in authorship, influential journals, key publications, countries, and keywords. Another bibliometric analysis was conducted by Ali et al. [26], which addressed a broader range of perinatal mental health topics by extending its review to include publications dating back to 1900. Ali et al. [26] identified the publication by Oberlander et al. [41] as the fourth most cited in an international context. It is worth noting that this publication by Oberlander et al. [41] was also identified as the most cited publication in our analysis. This suggests that perinatal depression research by Canadian researchers is highly recognized and cited globally.

The present analysis situates Canadian scholarship within the international context, showcasing the high citation rates of Canadian researchers. Connected, collaborative, expert, and productive Canadian researchers abound focused on perinatal depression; these findings may offer guidance to policymakers grappling with the challenges of perinatal depression prevention, screening, care, and treatment in Canada. Perinatal depression is a troubling and persistent problem in Canada [35] and debates continue about whether and when to implement screening for perinatal depression [7,39]. Systematic barriers to diagnosis and treatment of perinatal depression and identifying actionable solutions to bridge research and implementation gaps [39] could be addressed by engaging with Canada's top researchers, fostered by their identification in this analysis. These experts could offer insights to help resolve Canada's pressing policy and practice challenges, ultimately to reduce suffering for women affected by depression and their families.

By exploring the historical development and current landscape of perinatal depression research and researchers in Canada, this bibliometric analysis provides many essential insights to: (1) guide identification of topics for future research, (2) inform funding bodies when setting relevant research priorities, and (3) help policymakers to establish expert teams to guide best practice. In summary, this bibliometric analysis stands to provide a foundation to Canadian research directions, policy, mental health strategies, and care for women and their families affected by perinatal depression.

Strengths and Limitations

First, this bibliometric analysis relied solely on Scopus for retrieving relevant publications, which, while considered best practice to avoid over emphasis on citations appearing in multiple databases [37], may increase the risk of missing identification of literature on perinatal depression. While using multiple databases might seem beneficial, it can lead to issues such as publication overlap or repetition and technical challenges in integrating large datasets from different sources [37]. Additionally, not all journals are indexed in bibliometric databases, which can result in incomplete or outdated analyses, particularly for emerging or less mainstream topics. The search strategy undertaken was highly reliable and valid, however some publications may have been omitted as Scopus does not use subject headings in their database. In addition, relevant publications may not have been recovered in the search due to the evolution of the perinatal depression terminology over decades. However, a strength of this study was that a manual review was conducted to eliminate false positive and false negative publications to ascertain a robust dataset.

Second, bibliometric research often relies on citation counts, which may not accurately reflect the true impact or quality of a publication. Citation counts may be inflated by self-citations or frequent co-citations of certain publications, which do not necessarily indicate genuine impact. Citations also accumulate over time, thus bibliometric indicators tend to favour older publications and more established authors, leading to a bias toward historically

significant works. Third, while bibliometric analysis offers insights beyond many other review methods, it is also limited in scope. It is not appropriate for more detailed analysis of research, such as identifying the most used tool for measuring depression in Canada. Other review methods, such as scoping reviews are more appropriate for questions of a more nuanced nature [70]. Once a decision has been made to focus on a given setting, such as Canada, it is nearly impossible to employ bibliometric data to determine larger impacts of a region's body of work at the international level. Finally, an analysis of annual growth rate was beyond the scope of the paper.

5. Conclusions

This analysis makes a significant contribution to the field of perinatal depression research as the first bibliometric study focused on Canadian publications. By analyzing 763 publications from 1978 to 2022, the analysis highlights a dramatic increase in research output, particularly over the last two decades, emphasizing Canada's growing prominence in this area of study. The findings reveal the rise in publication volume and the identification of influential authors and institutions, which reflect a stronger global interest in mental health research. The analysis also identifies both established and emerging research approaches, offering guidance for individuals seeking to undertake their own studies. In addition, the analysis provides valuable insights for stakeholders, researchers, funding agencies, policymakers, and journals, by identifying avenues for future research. This analysis serves as a valuable reference for perinatal depression research and will ultimately contribute to more meaningful studies and collaborations to address the pressing needs and suffering of many depressed women and their families in Canada.

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