# Web of Science-Based Comprehensive Bibliometric Analysis of the Impact of Physical Activity on Postpartum Depression

Sujie Mao [1, a], Hong Xu[2, b] and Kaiwen Xiao[1,c],*

[1]Discipline Development Office,Nanjing Institute of Physical Education, Jiangsu 210000, China;

[2]Physical Education College, Jiangsu Special Normal College, Jiangsu 210000, China;

[a]403578488@qq.com, [b]747971257@qq.com, [c]941295041@qq.com

*Corresponding Author: KaiWen Xiao，

## Abstract

**Postpartum depression is a complex mental health issue that affects the quality of life for many women. Previous research has suggested that Physical activity may have a positive impact on alleviating postpartum depression symptoms.Research Objectives: This study aims to visually analyze the current status, hot topics, and frontiers of international research on the impact of Physical activity on postpartum depression to promote the development of this field. Research Methods: A bibliometric analysis was conducted using Citespace V on 1315 core articles collected in the "Web of Science" database from 1994 to 2022. We focused on information such as highly cited literature, keywords, and disciplines to comprehensively understand research trends and hotspots in this field. Results show that international research on the impact of Physical activity on postpartum depression has been increasing year by year, reflecting the sustained academic interest in this topic. We also found that the causes of postpartum depression involve multiple fields, including physiological, psychological, and social factors. Additionally, this research field exhibits interdisciplinary characteristics, primarily encompassing disciplines such as medicine, psychiatry, psychology, nursing, and sports science. In terms of research methods, randomized controlled trials and meta-analyses are common methods used in research. Scholars have also studied Physical activity interventions of varying intensities and types. Conclusion: Research on Physical activity and postpartum depression involves interdisciplinary collaboration and covers multiple disciplines. Self-report scales such as EPDS and CES-D are critical in assessing depression. Psychological factors such as anxiety, stress, depression, psychiatric history, and life events influence depression. Physical activity improves physical health, sleep, mental health, and stress reduction. Stroller walking and yoga are common adjunct therapies, with other Physical activity studies underway. Research has significantly increased in recent years, driven by interdisciplinary collaboration, and randomized controlled trials and meta-analyses are crucial. Future research can explore additional indicators to gain a deeper understanding of the mechanisms of Physical activity on postpartum depression and improve patient recovery and mental health.**

## Keywords

**Postpartum depression; Depression; Physical activity; Visual analysis.**

## 1. Introduction

Postpartum depression is a global public health issue, with an incidence rate that can exceed 15%[1] . It is a common postpartum condition, affecting at least 10% to 20% of women in the

United States[2], especially in those who have experienced postpartum depression after a previous childbirth, where the incidence can be as high as 25% or even higher [3]. Postpartum depression is a severe mental illness and results from a combination of physiological, psychological, and social factors[4]. Early signs of postpartum depression include irritability, fatigue, anxiety, and insomnia. Postpartum depression not only causes emotional distress for patients but also affects their quality of life. In severe cases, it can lead to child abuse, infanticide, and suicidal behavior[5]. Additionally, it can impact infant development and place an additional burden on the patient's family, leading to issues within the family such as marital relationships, the mental health of family members, and financial concerns[6].

Research indicates that physical activity has a positive effect on the recovery of postpartum depression patients[7]. Engaging in regular physical exercise during pregnancy can enhance the quality of life for expectant mothers and reduce fatigue, thereby reducing the incidence of postpartum depression to some extent[8]. Pre-pregnancy physical exercise can effectively reduce the risk of postpartum depression[9]. Postpartum women who engage in moderate-intensity physical activity can effectively alleviate stress, relieve fatigue, and reduce symptoms such as insomnia[10]. Postpartum exercise can effectively improve the mental health of mothers and reduce the occurrence of postpartum depression symptoms[11]. Controlled group experiments have shown that there is no significant difference in outcomes between patients under medication treatment and those under placebo conditions[12]. Additionally, many patients are unwilling to undergo medication treatment, and the use of psychotherapy is limited. Therefore, the feasibility of using physical activity as a treatment for such symptoms is worth further exploration[13].

Through literature retrieval, it has been found that extensive research has been conducted internationally to explore the intervention effects of exercise on postpartum depression and its potential physiological mechanisms. Despite the efforts of many scholars in this field, there is still a lack of systematic reviews to summarize the latest research trends and clarify research hotspots. Additionally, there is a need for a deeper exploration of future research trends related to exercise intervention for postpartum depression. In light of this, this study employs bibliometric methods, combined with the Citespace tool, to analyze the effectiveness of exercise in addressing postpartum depression, investigate the causes of postpartum depression, and explore potential physiological mechanisms. By systematically reviewing international literature on the relationship between exercise and postpartum depression and creating a scientific knowledge map, the study aims to explore the overall status of current research and identify the frontier trends in future research. This research approach helps to accurately focus on the core research areas of postpartum depression and exercise intervention while providing essential references for determining future research directions.

## 2. Research Methodologyrganization of the Text

### 2.1. Data Source

The data for this study were sourced from the Web of Science database, covering all years, and restricted to the English language. We employed the full-record format to download each data entry and selected the core collection for our search. Initially, we configured the search terms as:(((TS=(Sport)) OR TS=(exercise)) OR TS=(physical exercise)) OR TS=(physical activity)) OR TS=(train),which yielded 616,296 records. Subsequently, we configured the search terms as:(((TS=(Depression, Postpartum)) OR TS=(Postnatal Depression)) OR TS=(Depression, Postnatal)) AND TS=(Post-Partum Depression OR Depression, Post-Partum OR Post Partum Depression or Postpartum Depression or Post-Natal Depression or Depression, Post-Natal or Post Natal Depression or Postnatal Dysphoria or Dysphoria, Postnatal or Post-Partum Dysphoria or Dysphoria, Post-Partum or Post Partum Dysphoria or Postpartum Dysphoria or

Dysphoria, Postpartum or Post-Natal Dysphoria or Dysphoria, Post-Natal or Post Natal Dysphoria),which retrieved 6,102 records. By using the "AND" operator to combine the #1 and #2 tags into #3, we ultimately obtained 1,558 documents. We selected the core collection and ultimately filtered down to 1,315 documents. It's noteworthy that the retrieval and download were completed as of December 31, 2022.

## 2.2.  Research Tools

 For this study, we employed the method of bibliometric analysis, utilizing the CiteSpace V software (version 5.6.R3)[14], which is based on the JAVA programming language. This software was used to construct a scientific knowledge map for our research. Through visualization, it helps in presenting the knowledge structure, patterns, and distribution of scientific research. Using CiteSpace V, we generated various information related to the field, including annual publication trends, disciplinary distribution, co-occurrence of keywords, keyword clustering, detection of keyword burst values, and keyword timeline charts. Based on this foundation, our study will conduct an in-depth analysis of the dynamics, current status, and frontiers of international research on the impact of physical activity on postpartum depression.

Disciplinary distribution analysis determines the literature's academic categorization by relying on a comprehensive analysis of keywords and citation data to allocate the literature to relevant academic fields. Keyword co-occurrence analysis reveals the simultaneous appearance frequency of keywords in the literature, uncovering core themes and associations. CiteSpace V software employs a "co-occurrence analysis" algorithm to detect keyword co-occurrence relationships and calculate co-occurrence frequencies to determine relevance[15]. Keyword clustering analysis aims to group the literature by themes or research domains based on co-occurrence networks[16]. It uses community detection algorithms such as the Louvain algorithm to identify literature clusters with similar keywords. Each cluster represents a keyword cluster[17]. Keyword burst detection identifies significant increases in keyword usage frequency within specific time periods[18], revealing research field hotspots and trends based on chi-square tests. Keyword timeline visualization displays the developmental trends of different keywords over time, aiding in understanding the evolution of research fields by presenting the temporal distribution of keywords alongside relevant literature19. This visualization illustrates the historical evolution of keywords, facilitating researchers in gaining deeper insights into the developmental dynamics of the field.

## 3.  Research Results and Analysis

## 3.1.  Annual Publication Volume

Through the analysis of data on literature quantity and publication years (see Figure 1), we observe a significant growth trend in the field of physical activity and postpartum depression research from 1990 to 2022. In the early 1990s, the annual number of publications was relatively low, with only a few research articles being published. However, since the early 2000s, the number of publications has gradually increased, with a more pronounced growth trend, especially after 2008.
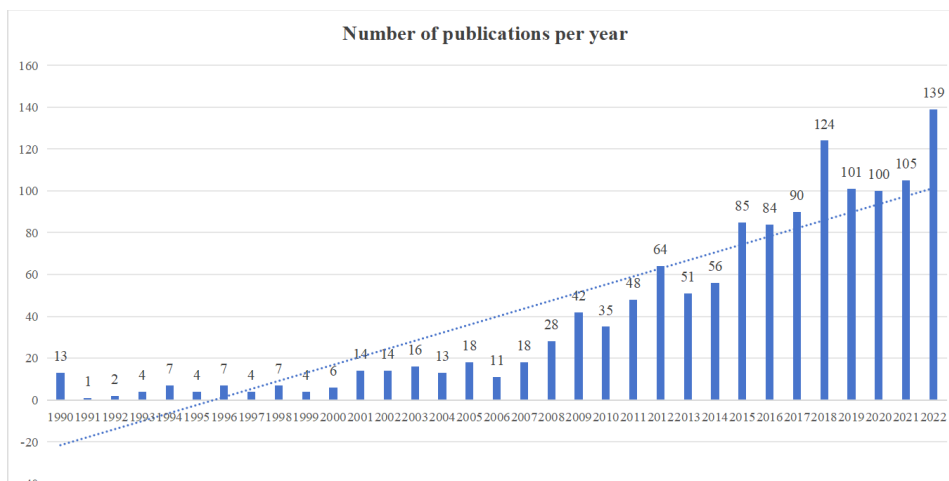
Fig. 1 Annual Publication Volume

The period from 2008 to 2012 witnessed a highly active phase in the field of physical activity and postpartum depression research. The number of publications increased rapidly from 28 in 2008 to 64 in 2012, nearly doubling. This may reflect an increased awareness among researchers regarding postpartum depression and its potential benefits from physical activity. From 2015 to 2018, the number of publications increased rapidly again, rising from 85 in 2015 to 124 in 2018. This could be related to a heightened societal focus on maternal health and postpartum depression, further stimulating research interest in the field.

The most recent data shows that from 2020 to 2022, the number of publications has remained relatively stable, with over 100 publications each year. This indicates that the field of physical activity and postpartum depression research continues to maintain a high level of interest and activity. Based on past growth trends and sustained research interest, it is reasonable to predict that this field will continue to remain active. In the future, researchers may continue to explore the relationship between different types, frequencies, and intensities of physical activity and postpartum depression, as well as potential mechanisms and intervention methods.

## 3.2. Disciplinary Distribution

We conducted a visual analysis of disciplines based on Citespace tool for journals covered from 1990 to 2022. This analysis spans a period of 31 years, with a snapshot taken each year. We selected disciplines as the node type and set the thresholds at 4, 4, 20. This analysis generated Figure 2. Additionally, using the Data data output function, we filtered out disciplines with frequencies higher than 100, resulting in Table 1.
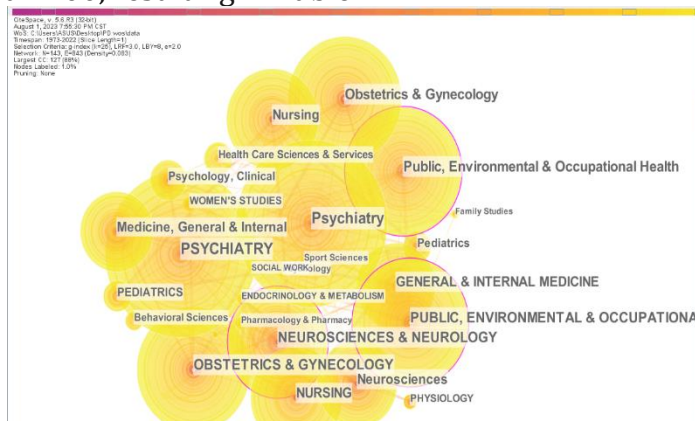


Fig. 2 Disciplinary Co-occurrence

Table 1 Disciplinary Distribution

| Ranking | Discipline | Centrality | Frequency |
|---------|-----------|------------|-----------|
| 1 | Psychiatry | 0.08 | 203 |
| 2 | Public, Environmental & Occupational Health | 0.17 | 156 |
| 3 | Obstetrics& Gynecology | 0.09 | 155 |
| 4 | Neuroscience & Neurology | 0.17 | 143 |
| 5 | Psychology | 0.27 | 136 |
| 6 | Nursing | 0.01 | 130 |
| 7 | Neurosciences | 0.09 | 116 |
| 8 | Medicine, General & Internal | 0.02 | 106 |

In Figure 2, a total of 143 nodes and 843 connections are presented. Each node represents a specific discipline, while each connection reflects collaborative relationships between different disciplines. In the figure, the size of the nodes indicates the citation frequency of the respective disciplines, and the purple area surrounding the nodes illustrates the centrality of the disciplines, signifying their importance within the entire research network[20].

From the data in Table 1, it is evident that the discipline with the highest frequency of occurrence in the research field is Psychiatry (203 times), followed by Public Environmental and Occupational Health (156 times), Obstetrics (155 times), Neuroscience and Neurology (143 times), Psychology (136 times), Nursing (130 times), Primary Health Care (32 times), Physiology (30 times), and Sports Science (20 times). Furthermore, we can observe that Psychology (Centrality 0.27) and Nursing (Centrality 0.7) have relatively high centrality within the entire research network.

These findings underscore that research on the impact of physical activity on postpartum depression is a highly interdisciplinary field, encompassing multiple disciplines such as medicine, psychology, sports science, and obstetrics. This interdisciplinary nature contributes to enriching our understanding of postpartum depression issues and the intricate relationship it has with physical activity.

Based on the disciplinary co-occurrence results, we have created a disciplinary timeline chart, as shown in Figure 5. According to the LLR (Log Likelihood Ratio) algorithm score, we found that the average silhouette value (S value) for this clustering is 0.873, indicating a very accurate clustering result. This research field can be primarily divided into four categories of disciplines, which are #0 Medical Informatics, #1 Neurosciences, #2 Clinical Psychology, and #3 Sport Science.

From Figure 5, we can observe that early research primarily focused on areas such as General Internal Medicine (1994), Neuroscience (1994), and Obstetrics and Gynecology (1994). However, from the year 2000 onwards, this research field started to encompass studies in Pediatric Medicine, Nursing, Endocrinology and Metabolism, and Education, among others. Sports Science first appeared in 2010 and was closely linked with disciplines such as Psychology, Psychiatry, and Rehabilitation.

Starting from 2013, disciplines like Social Work, Medical Informatics, and Behavioral Science gradually emerged. After 2016, Education, Science Studies, Biochemistry and Molecular Biology, and other disciplines made their first appearances. This suggests that in recent years, the frontiers of exploration in this research field have been continuously expanding.
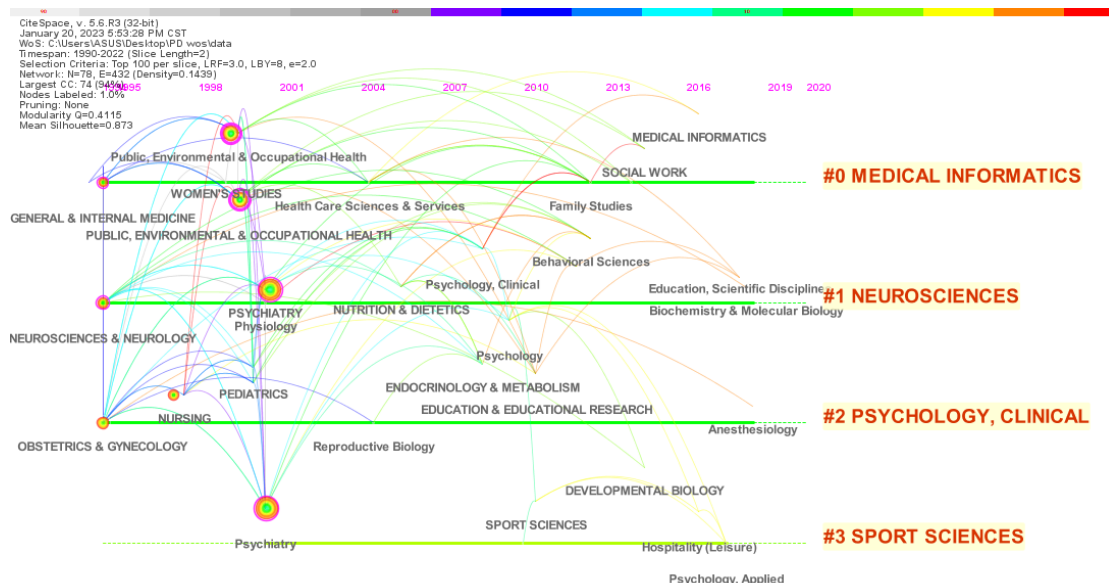
Fig. 5 Disciplinary Keyword Timeline Chart

## 3.3.  High-Frequency Citations

We conducted a visual analysis of 1315 core articles using Citespace tool . We set the display field number to 10. Through the data output of the time series of high-frequency citations, we obtained the citation frequency of high-frequency citations. We conducted precise literature searches in the Web of Science database to obtain the DOI, title, and author information of high-frequency citations and compiled them into a table, generating Table 2.

Table 2 High-frequency citation

| Ranking | Literature | Frequency of citation | References |
|---|---|---|---|
| 1 | Detection of Postnatal Depression Development of the 10-Item Edinburgh Postnatal Depression Scale | 343 | [21] |
| 2 | Perinatal Depression A System Review of Prevalence and Incidence | 113 | [22] |
| 3 | Rates and Risk of Postpartum Depression—A Meta-analysis | 104 | [23] |
| 4 | Predictors of Postpartum Depression: An Update | 62 | [24] |
| 5 | Postpartum Depression Help-Seeking Barriers and Aternal Treatment Preferences: A Qualitative Systematic Review | 55 | [25] |
| 6 | Antenatal Risk Factors For Postnatal Depression: A Large Prospective Study | 50 | [26] |

| 7 | Diagnostic Validity of the CES-D (Korean version) in the Assessment of DSM-III-R Major Depression | 46 | [27] |
|---|---|---|---|
| 8 | Elevated Risk of Adverse Obstetric Outcomes in Pregnant Women With Depression | 43 | [28] |
| 9 | The Effects of Exercise and Social Support on Mothers Reporting Depressive Symptoms: A Pilot Randomized Controlled Trial | 42 | [29] |
| 10 | The Effectiveness of A Pram-Walking Exercise Programme in Reducing Depressive Symptomatology for Postnatal Women | 4 | [30] |

From Table 2, we can observe that the document "Discovering statistics using IBM SPSS statistics" has been cited since 1991 and reached its peak in 2018, with an annual citation count as high as 40 times. Additionally, the article "Discovering statistics using IBM SPSS statistics" has been cited since 2007, and its citation frequency continued to rise from 2007 to 2018.

Among the high-frequency citations, "Detection of Postnatal Depression: Development of the 10-item Edinburgh Postnatal Depression Scale" is cited the most, with 343 citations, followed by "Perinatal Depression: A Systematic Review of Prevalence and Incidence" (113 citations) and "Rates and Risk of Postpartum Depression—A Meta-analysis" (104 citations). The consistent citation of these high-frequency citations demonstrates their significance and influence in the field of postpartum depression research, providing solid theoretical and methodological support for research in this field.

### 3.4. Keyword Co-occurrence

Using the Citespace tool, we conducted keyword analysis on 1099 articles from 1973 to 2021. We set the Top to 10, Top% to 50%, and the slicing interval to 1 year. This allowed us to extract the top 30 keywords with relatively high frequencies and create a keyword co-occurrence network (Figure 3).
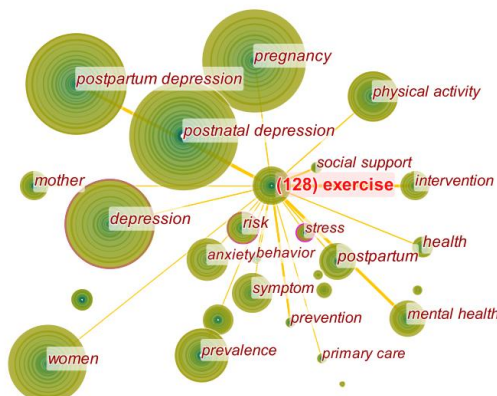


Fig.3 Keyword Co-occurrence

In Figure 3, a total of 172 nodes and 1225 links were generated. Each node represents a keyword, with node size indicating the citation frequency of that keyword[31]. Larger nodes represent keywords that appear more frequently in the literature. The outer purple area represents the centrality of the keywords, where higher centrality indicates a closer association with other keywords.

It's particularly noteworthy that the keyword "exercise" has a very close connection with other keywords, as indicated by the thickness of the lines in the graph. This suggests a strong association between "exercise" and both "postnatal depression" and "mental health." Similarly, "physical activity" is closely linked to keywords such as "pregnancy," "obesity," and "sleep."

In the research field, frequently occurring keywords are often considered key terms for exploring hot topics in that field. We have categorized the top 30 keywords extracted from the data into four categories, including research subjects, research topics, research methods, and research approaches, to gain a better understanding of the key themes in this research area （table 3）.

Table3  Research Focus and Methods in the Study of Postnatal Depression

| Research Object | Research Content | Research Approach | Research Method |
|---|---|---|---|
| Women | Postnatal Depression | Physical Activity | Randomized Controlled Trial |
| Mothers | Depression Disorder Symptoms | Intervention Exercise | Validation |
| Pregnant Population | Anxiety Postpartum Mental Health Risk Factors Scale Impact Depressive Symptoms | | |

## 3.5.   Keyword Clustering

Based on keyword co-occurrence analysis, we conducted keyword clustering using the log-likelihood ratio (LLR) algorithm and citations from article titles to obtain relevant clusters[32]. CiteSpace software automatically labels clusters in the format "# + number + label," where clusters labeled #0 and #1 in the graph represent larger clusters.

Two important parameters for measuring cluster quality are modularity and average silhouette. Modularity reflects the overall structural properties of clusters, and a higher average silhouette value indicates greater separation among cluster nodes[33]. When the silhouette value exceeds 0.6, it suggests a high degree of separation within the cluster.

Using LLR algorithm scores, we identified a total of 8 clusters, labeled and categorized them based on indexing terms found in the citations, and then sorted them by cluster size. We conducted keyword clustering by selecting keywords with higher frequencies,Generated Table 4.

Table 4 Keyword Clusters

| Squence number | Clustering tags | High frequency keywords |
|---|---|---|
| #0 | postpartum depression | Postpartum birth, depression, pregnancy, depression, symptoms, and anxiety |
| #1 | postpartum | Physical activity, stress, depression system, obesity, association, meta-analysis, quality of life as well as low-income groups |
| #2 | hippocampus | Behaviour, brain, major depression, experimental mice, animal models, antidepressants, memory, physical exercise |
| #3 | nursing | Care, experience, support, management, and depression and mental health |
| #4 | treatment | Postpartum women, perineal reflex, anxiety confusion, date of preterm birth、aerobic exercise |
| #5 | self-management | Sleep, effectiveness, early postpartum natal, health care, continuity and education, middle income countries |
| #6 | meta-analysis | Mental disorder, US, prenatal depression, postpartum stress anxiety, quality, systemic, place of birth as well as yoga exercise |
| #7 | glycemic index | Control trials, labor depression, birth weight, medical nutrition therapy |
| #8 | shout-term depression | Neurotransmitter release, brain systems, neuroemitters, internal nuclei, AMPA receptors as well as prominent development |

From Figure 4, it can be seen that the modularity value (Q value) of the clusters is 0.357, indicating significant clustering structure. The average silhouette value (S value) of the clusters is 0.612, indicating a high level of reliability in the clustering results. According to Table 3, we can see that the largest cluster labeled #0 is related to postpartum depression, and high-frequency keywords in this cluster include pregnancy, depression, and anxiety. This suggests that research on exercise interventions for postpartum depression and research related to pregnancy and depression are relatively popular topics. The next cluster, #1, is related to postpartum issues and encompasses research on postpartum topics such as stress, obesity, and meta-analysis. Cluster #2 is related to the hippocampus, with high-frequency keywords including behavior, brain, mouse experiments, and animal models, indicating that research involving animal model experiments in this thematic area is also popular.

### 3.6.   Keyword Burst Detection

Building upon the previous Citespace keyword co-occurrence analysis, we conducted keyword burst detection. Firstly, we clicked on the "View" option in Burstness and set the "Top" value to 15, to obtain the top 15 keywords with the highest burst strength in research literature from 1973 to 2022. Finally, we generated the graph shown in Figure 6.
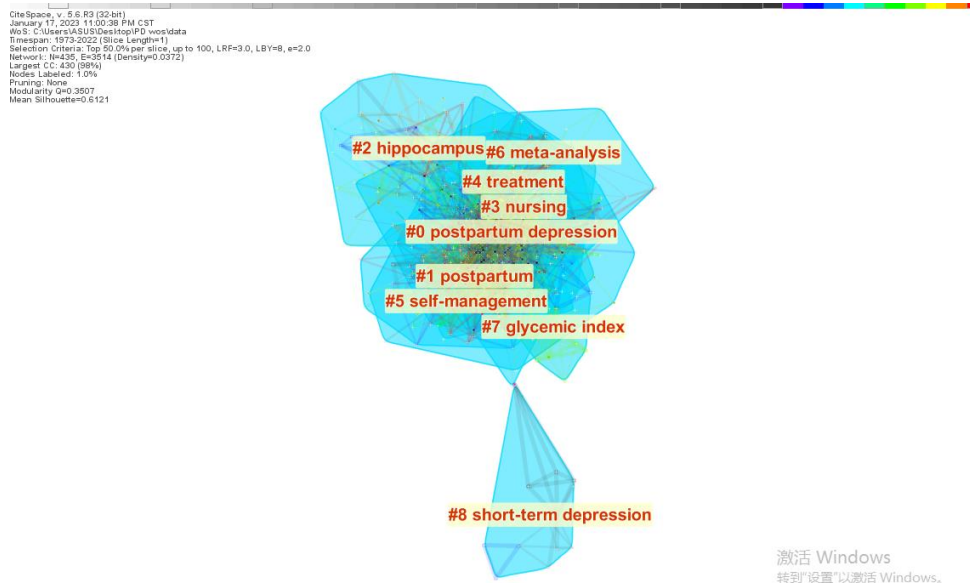
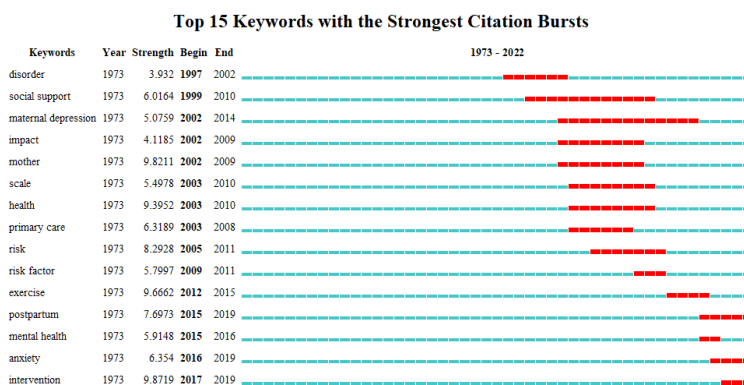Fig. 4  displays the knowledge map of keyword clustering.



Fig.6 Keyword Burst Detection

Keyword burst detection is used to identify terms that have experienced a rapid increase in occurrence or significantly higher usage frequency over a relatively short period of time. These keywords can reflect emerging research frontiers and future development trends in a specific topic. The burstiness of keywords measures their temporal changes, and keywords with strong burstiness are highlighted in red, indicating a significant increase in citation frequency during specific time periods[34].

Among the top 15 keywords with the highest burst strength, we can see that the keywords "Mother" (9.821), "Exercise" (9.666), and "Health" (9.395) have the strongest burst strength. The keywords with the longest burst duration include "Maternal Depression" and "Social Support." Additionally, the most cutting-edge keywords in burst detection include "Postpartum," "Anxiety," "Intervention," and "Mental Health."

It's worth noting that in the past 5 years, some keywords still maintain high burst values, such as "Postpartum" (7.69), "Anxiety" (6.354), and "Intervention" (9.8719). This indicates that research related to the impact of exercise on postpartum depression will continue to focus on topics related to postpartum issues, anxiety, interventions, and related themes in the coming years.

## 4. Discussion

This study conducted an analysis of 1099 articles spanning from 1973 to 2021 using the Citespace tool, which highlighted the connections between keywords. Among these, the associations among 30 high-frequency keywords are presented in the keyword co-occurrence graph, emphasizing their close relationships with keywords such as "mental health," "physical activity," "obesity," and "sleep." Additionally, the study identified eight thematic clusters, including topics related to the hippocampus, blood glucose index, short-term depression, and more.

Burst analysis revealed significant increases in keywords like "health," "postpartum," and "anxiety" during different time periods, highlighting the research frontiers and future trends in this field. Through the keyword timeline graph, the study indicates that research related to pregnancy, postpartum depression, and physical activity will continue to grow, providing important insights into the research dynamics and future developments in the field. Moreover, this study underscores the importance of highly cited references, listing the top 10 highly cited articles, further supporting the core foundational research in this area.

### 4.1. High-Frequency Keywords

Several intertwined key factors contribute to the close associations between keywords such as "mental health," "physical activity," "obesity," and "sleep" with postpartum depression. Physical activity plays a crucial role in postpartum depression research[35]. Numerous studies suggest that moderate physical activity can stimulate the release of neurotransmitters like dopamine in the brain, improving mood, reducing anxiety, and helping alleviate symptoms of postpartum depression[35]. Exercise can also enhance the body's immune system and reduce chronic inflammation levels, which are closely related to emotional stability[36].There is a complex biological link between obesity and postpartum depression. Obesity can lead to hormonal imbalances, such as an increase in pro-inflammatory cytokines, which have adverse effects on mood and mental health[36]. Additionally, obesity is often accompanied by sleep issues, such as sleep apnea, which can lead to decreased sleep quality and increase the risk of postpartum depression. Therefore, reducing obesity symptoms through physical activity and healthy dietary management is crucial for improving mental health and preventing postpartum depression[37].Sleep plays a critical role in this connection as well. New mothers often face sleep problems such as insomnia and staying up late to care for their infants, which can disrupt their circadian rhythms and lead to mood swings. Sleep deprivation negatively affects the immune and nervous systems, increasing the risk of postpartum depression[38]. Therefore, improving sleep quality and cultivating healthy sleep habits are essential strategies for reducing postpartum depression symptoms.

The interplay among these factors is complex and closely related, providing rich research material for the field of postpartum depression. The connections between keywords such as mental health, physical activity, obesity, and sleep with postpartum depression are explained not only at the biopsychological level but have also been validated in clinical practice. However, despite significant research progress, further in-depth studies are needed to uncover the intricate relationships between these factors and determine how to more effectively apply them to the prevention and treatment of postpartum depression.

### 4.2. Cluster Analysis

The keyword cluster analysis results highlight several noteworthy keywords in the research field related to postpartum depression and physical activity improvement, including "hippocampus," "blood glucose index," "self-management," "meta-analysis," and "short-term depression." These keywords not only appear frequently in the literature but also exhibit close connections.

The emergence of the "hippocampus" cluster is related to its biological significance. The hippocampus is an important structure in the brain closely associated with memory and emotional regulation[39]. Studies have shown that postpartum depression often involves emotional issues and cognitive dysfunction, and the hippocampus may play a crucial role in these aspects[40]. Therefore, researchers naturally focus on this structure to explore its relationship with postpartum depression. Additionally, physical activity has been shown to improve brain function, including increasing the volume of the hippocampus, providing biological support for research on the relationship between the "hippocampus" and "physical activity"[40].Exploration of Treatment Approaches: The appearance of keywords such as "self-management," "meta-analysis," and "short-term depression" may reflect researchers' exploration of treatment approaches for postpartum depression. "Self-management" involves a patient's ability to self-manage their illness and emotional state, while "meta-analysis" is a statistical method used to synthesize the results of multiple studies to enhance research credibility[41]. These methods may contribute to the development of more effective interventions for postpartum depression. "Short-term depression" may also serve as an important indicator for assessing the effectiveness of these interventions.

Postpartum depression is a complex issue influenced by various factors, including biology, psychology, and clinical practice[42]. To gain a more comprehensive understanding of the relationship between postpartum depression and physical activity, interdisciplinary research methods are essential. Integrating knowledge from biomedical sciences, psychology, statistics, and other fields holds the promise of providing deeper insights and improving the prevention and treatment of postpartum depression.

This close association reflects the complex relationship between postpartum depression and physical activity improvement. The existence of this connection is not only biologically grounded but also supported by clinical practice and research evidence. In-depth exploration of these associations will offer us a more profound understanding and contribute to the development of more effective intervention measures.

## 4.3.  Burst Keyword Analysis

The burst term analysis in Citespace reveals that the three currently prominent burst keywords in the field related to postpartum depression are "social support," "anxiety," and "intervention." The frequent appearance of these three keywords reflects their significance in research, driving postpartum depression studies towards hot topics and critical research directions.

The burst in the keyword "social support" highlights its crucial role in postpartum depression research. Women in the postpartum period often require support from their families, friends, and society to cope with new life challenges[43]. Insufficient social support has been linked to an increased risk of postpartum depression. Therefore, researchers are increasingly focused on finding effective ways to provide social support to alleviate depressive symptoms in new mothers. The emergence of "anxiety" as a burst keyword reveals the close association between anxiety and postpartum depression. These two conditions often intertwine, with postpartum anxiety not only increasing the risk of depression but also negatively impacting maternal and infant health. Consequently, researchers are keen to investigate the causes of anxiety and therapeutic approaches to better understand the relationship between these two mental health issues.The appearance of "intervention" as a burst keyword indicates the urgent need for postpartum depression interventions. Postpartum depression has adverse effects on the health of both new mothers and infants. Therefore, researchers are actively exploring various intervention methods, including psychotherapy, medication, and the establishment of social support systems, to improve the psychological well-being and quality of life of patients.

The necessity of social support, the close relationship between anxiety and depression, and effective intervention methods have all sparked widespread research interest. These hot topics

reflect the scientific community's and clinical practice's desire to better understand and address postpartum depression. Future research should continue to delve into these key issues to enhance the effectiveness of interventions and treatments for postpartum depression, thereby improving the mental health and overall quality of life for new mothers.

## 4.4.  Classic literature analysis

Scholar Holderconducted used the Edinburgh Postnatal Depression Scale (EPDS), a 10-item self-report measure, on 84 postpartum women. They applied diagnostic criteria from the Goloberg Standard Psychiatric Interview and concluded that the effectiveness of using EPDS for postpartum depression health assessment in primary care was as high as 90%. Therefore, EPDS can serve as a screening tool for postpartum depression, but further validation of its effectiveness is needed for other clinical treatments[21]. On the other hand, the CES-D scale is a self-report depression scale suitable for the general population, developed by Radloff (1977)[44]. The scale has been widely used in epidemiological studies of depression and is primarily employed for diagnosis during clinical admissions and assessment during treatment.

Postpartum depression patients typically exhibit symptoms of emotional distress, accompanied by disturbances in areas such as appetite, sleep, mood, and activity, as well as symptoms like fatigue, excessive self-blame, and suicidal thoughts[45]. Research has also found that prenatal depression may lead to conditions in newborns such as preeclampsia, preterm birth, intrauterine growth restriction, and low birth weight[46]. Social factors play a significant role in postpartum depression. O'hara found in their meta-analysis that low-income or socially isolated women and marital issues are associated with a higher incidence of postpartum depression[47]. Additionally, Beck conducted a meta-analysis of 84 articles published in the 1990s and identified 13 significant predictors of postpartum depression[48]. These factors include prenatal depression, self-esteem, childcare stress, and prenatal anxiety, among others.

Regarding the treatment of postpartum depression, past research has shown that patients from different cultural backgrounds tend to prefer talk therapy over medication[49]. Furthermore, exercise interventions and social support have been proven to have a positive impact on alleviating postpartum depression symptoms [29]. Dr. Armstrong's research demonstrated that a stroller walking program, as an adjunctive treatment method, can be combined with traditional strategies such as medication and cognitive-behavioral therapy to improve postpartum depression symptoms[42].

## 4.5.  Limitations of the Study

While this study conducted an extensive bibliometric analysis of the relationship between postpartum depression and physical activity, there are several limitations to consider:

1.The literature search was restricted to the Web of Science database, potentially excluding relevant studies from other sources.

2.The assessment of study importance relied primarily on quantitative metrics, and the research did not evaluate the specific research methods or quality of individual studies. Additionally, bibliometric analysis cannot establish causality; it can only reveal associations between keywords.

3.The study did not conduct an in-depth analysis of the various types and intensities of physical activity and their specific effects on postpartum depression. Future research could explore this area more comprehensively to understand the mechanisms and effects of different physical activities.

## 5. Conclusions

Research on the relationship between exercise and postpartum depression is a multidisciplinary endeavor, involving fields like neuroscience, obstetrics and gynecology, psychology, and sports science. Assessment tools, such as the EPDS and CES-D scales, are essential for self-assessment and clinical evaluation in identifying postpartum depression. Various factors, including anxiety, stress, depression, psychiatric history, and life events, contribute to its onset. Exercise interventions, like stroller walking programs and yoga, are commonly used to improve physical health, sleep, mental well-being, and stress reduction. Ongoing research explores different exercise types and intensities.

The past few decades have witnessed substantial growth in research on postpartum depression and exercise, reflecting a growing academic interest in this critical area. Interdisciplinary collaborations will continue to drive progress, while randomized controlled trials and meta-analysis methods remain crucial for investigation. Future research could delve deeper into mechanisms and effects by considering keywords like blood glucose index, hippocampus, brain systems, neurotransmitters, and limbic nuclei.Exercise as an adjunctive treatment offers promising research prospects and vital support for postpartum depression patients. These fields hold great promise for enhancing the understanding of complex mechanisms, providing more effective treatments, and ultimately improving the quality of life and mental health of those affected by postpartum depression.

## Acknowledgements

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