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Mapping scientific knowledge and future directions on exercise and depression: A bibliometric study

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ABSTRACT

Background: Exercise is widely recognized as a supplementary or alternative treatment for depression, yet comprehensive scientific mapping in this area remains limited. This study aimed to explore the current research landscape, key findings, and future trends related to exercise and depression across all age groups.

Methods: We used the Web of Science database to collect articles on exercise and depression from 2002 to 2022. Eligible data were extracted and analyzed using R Studio with the Bibliometrix package to generate descriptive summaries, annual trends, country and institution outputs, journal impact, and research hotspots.

Results: The majority of publications on the subject of exercise and depression originate from the United States and China, with 258 and 161 publications, respectively. Notably, Chongqing Medical University and Harvard University stand out as leading institutions in this field, each contributing 48 publications. The Journal of Affective Disorders, recognized for its high impact and Q1 status, serves as a foundational resource in the exploration of exercise and depression. The thematic map and topic trend analysis highlight aerobic exercise and tai chi as promising exercises, potentially targeting the hippocampus and BDNF in the context of depression. Furthermore, it is noteworthy that PHQ-9 and HADS are frequently utilized measurements in ongoing research endeavors.

Conclusion: This study provides a summary of the field about exercise and depression, highlighting emerging trends, sources, prominent institutions, and key topics using bibliometric analysis and network visualization. Our findings offer valuable insights that can guide future research directions and inform clinical practice.

Keywords: bibliometric, depression, exercises, mood disorders, supplemental therapy.
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INTRODUCTION

Depression is a prevalent and severe mental illness characterized by feelings of sorrow and a loss of interest, potentially leading to self-harming thoughts or suicide.[1,2]

Depression is a multifaceted mental disorder that affects individuals of all ages, with a global prevalence of 1.07% in children,[3] 15.8% in adolescents,[4] 11.3% in adults,[5] and 13.3% in the elderly.[6] The World Health Organization foresees that by 2030, depression will become the primary contributor to the worldwide disease burden, affecting a substantial portion of the population, ranging from 3% to 17%.[6,7] Antidepressant medication remains the most commonly employed clinical method for treating depression. However, around one-third of individuals with depression do not experience positive outcomes with the current antidepressants.[8] Consequently, non-pharmacological approaches like exercise have garnered significant attention in the scientific community.[9]

Exercise, as an affordable and easily accessible approach, has been acknowledged as a promising method for alleviating depression's effects.[9] Previous research has shown that low-intensity physical activity can notably enhance psychological well-being by activating specific brain targets.[10] Engaging in physical activity triggers the release of endorphins, which are natural mood-enhancing chemicals that can alleviate feelings of sadness and enhance overall mental health.[11,12] Exercise also fosters improved sleep patterns, stress reduction, and heightened self-esteem, all of which can be particularly beneficial for individuals grappling with depression.[13-15] Furthermore, the sense of accomplishment and empowerment achieved by setting

and attaining exercise goals can boost self-confidence and motivation, both crucial elements in the battle against depression.[13] The field of exercise and depression have been extensively described in qualitative reviews.[16-19] Nonetheless, there may be potential subjective biases in this approach.[20] Therefore, an alternative quantitative perspective is required to strengthen the summary.

Bibliometric is a systematic method for assessing and quantifying the scholarly impact of research publications, authors, or entire fields of study. It entails a thorough analysis of bibliographic data, encompassing citations, publication trends, and authorship patterns.[21] This methodology also aids in recognizing emerging research trends, influential authors, and key journals or publications within a specific field.[22] Bibliometric has become an indispensable tool for decision-making in academic and scientific contexts, assisting in the evaluation of research productivity and resource allocation.[23] It fosters a deeper understanding of knowledge dissemination dynamics and enables evidence-based strategies for enhancing research impact and collaboration in the academic landscape.[24] Some studies have adopted the bibliometric approach to gain a more comprehensive understanding of their scientific mapping, research hotspots, status, and future challenges in the field.[25-27]

Although a quantitative analysis of bibliometric studies has been conducted on exercise and depression among college students, a comprehensive examination of the distribution and contributions of studies within child, adult, and elderly populations remains pending.[28] In this study, our objective was to offer a systematic overview of the current scientific landscape, scientific accomplishments, and future trends in the research on exercise and depression, encompassing children, adolescents, adults, and the elderly. As we embark on this exploration, we anticipate creating an all-encompassing map of the scientific terrain in exercise and depression research, one that will inform and motivate researchers, policymakers, and healthcare professionals in their ongoing endeavors to address this global public health challenge.

METHODS

Data sources and search strategy

We performed a thorough search to gather pertinent research papers from the Web of Science (WoS) concerning exercise and depression. Our study exclusively relied on WoS for article retrieval due to its comprehensive coverage of diverse academic journals across various disciplines and its widely recognized authority as a source for citation information. WoS encompasses a range of sources, such as the Science Citation Index Expanded, Social Sciences Citation Index, Arts & Humanities Citation Index, Conference Proceedings Citation Index—Science, Conference Proceedings Citation Index—Social Science & Humanities, Emerging Sources Citation Index, and Current Chemical Reactions.[29,30] In addition, WoS is widely used in the bibliometric analysis.[31-35] The data including author, document type, journal, language, number of cited references, publication year, science categories, title, total citation, affiliation, cited references, corresponding author, abstract, doi, keywords plus, keywords was extracted according to the guideline for conduction bibliometric analysis from WoS.[21,22]

The keyword was applied in searching strategy of relevant articles by combining Depress* OR "Major Depression" OR "Major Depressive Symptoms" OR "Unipolar Depression" OR "Unipolar Depressive Symptoms" OR "Mood Disorder" AND Exercise OR "Cardio Exercise" OR "Cardio Exercises" OR "Walking" OR "Running" OR "Jogging" OR "Treadmill" OR "Free Weight" OR "Weight Exercise" OR "Resistant Exercise" OR "Yoga" OR "Tai Chi" OR "Qigong". We exclusively looked at complete articles that were published in English.

Screening the publications

This study involved screening all articles related to exercise and depression. The selection of articles for subsequent bibliometric analysis was limited to those that (1) were published in the English language, (2) had a primary focus on exercise and depression, and (3) were research articles. Articles that fell into the categories of book chapter, early access, proceedings, retracted, editorial material, letter, news item, note, reviews, meeting abstract were excluded. The decision to limit the articles published 2002-2022 was made due to the substantial growth of exercise and depression studies during those period. The independent screening process was conducted by two researchers (MHSL and MSM). Any discrepancies identified during the screening were resolved through discussion between the two reviewers. In cases where consensus could not be reached, a third researcher (AS) was consulted to adjudicate and provide the final decision.

Data format and preprocessing

We acquired a plain text file containing comprehensive records and cited references from the WoS database. The file was formatted as a _.txt file. Within this file, 2400 articles concerning exercise and depression were initially included. Subsequently, a filtering function was employed based on predefined selection criteria. Finally, the main analysis incorporated 1024 articles, and the data completeness ranged from 82.32% to 100%, indicating an acceptable to excellent level (refer to **Table 1**).

Bibliometric analysis

We utilized Bibliometrix, a statistical software tool integrated into the R environment. The preprocessed data underwent importation into Bibliometrix, where bibliometric analysis was conducted using the information from the data documents.[21] Our aim was to offer a comprehensive overview of exercise and depression, emphasizing the clarification of knowledge structure, identification of influential author and journal, revelation of research trends, determination of the most productive countries and institutions, and pinpointing research hotspots. Parameters such as the total number of publications per year, average annual growth rate during past two decades of publications were calculated.

The average annual growth rate of publications (AAGR) in past two decades can be calculated using the following formula:

$$AAGR = \left(\frac{\left(\frac{P_t}{P_0}\right)^{\frac{1}{n}} - 1}{\frac{1}{n}} \right) \times 100$$

where:

- P_t represents the total number of publications in the final year (t).
- P_0 represents the total number of publications in the initial year.
- n represents the number of years in the period.

RESULTS

Metadata characteristics

Annual summary of publications

Over the last two decades, a total of 1024 articles about exercise and depression have been published in the WoS database. The average age of documents in this field is 7.27 years, accompanied by an average annual growth rate of 10.7%. The quantity of articles in this domain has witnessed a notable increase from 2002 to 2022, reaching its zenith in 2022 with a total of 111 articles (see **Figure 1**). On average, each article is estimated to have contributions from 16 out of 4771 authors. Author collaboration is evident, with 18 single-authored documents, an average of 6.06 co-authors per document, and 21.7% international co-authorships. Additionally, the articles encompass 1804 author's keywords and 2225 keyword plus instances (refer to **Table 2**).

Countries, Institutions, and Journal Analysis

From 2002 to 2022, research on the correlation between exercise and depression was conducted by 48 nations, as indicated in Table 3. The table reveals the top 10 contributors, with the United States leading with 258 publications, followed by China (161), Australia (52), Germany (48), and Brazil (46), as detailed in **Table 1**. Examining the collaborative network among countries, it is evident that the United States, China, Germany, and Brazil have robust connections with other significant contributors (see **Figure 2**).

Over the past two decades, 1,466 institutions have conducted research on exercise and depression. The top 10 contributing institutions produced 291 articles, representing 28.4% of the total published works (**Figure 3**). Notably, Chongqing Medical University and Harvard University were the leading contributors, each publishing 48 articles, followed by Karolinska Institutet (n=45), University of Copenhagen (n= 37), and the University of California System (n= 30) (**Figure 3**). In **Figure 4**, the collaboration network among institutions was examined, highlighting Harvard

Table 1. The completeness of bibliographic metadata (n= 1024)

Metadata	Description	Missing Counts	Missing %	Status
AU	Author	0	0.00	Excellent
DT	Document type	0	0.00	Excellent
SO	Journal	0	0.00	Excellent
LA	Language	0	0.00	Excellent
NR	Number of cited references	0	0.00	Excellent
PY	Publication year	0	0.00	Excellent
WC	Science categories	0	0.00	Excellent
TI	Title	0	0.00	Excellent
TC	Total citation	0	0.00	Excellent
C1	Affiliation	2	0.20	Good
CR	Cited references	2	0.20	Good
RP	Corresponding author	3	0.29	Good
AB	Abstract	14	1.37	Good
DI	DOI	36	3.52	Good
ID	Keywords plus	43	4.20	Good
DE	Keywords	181	17.68	Acceptable

n, number of articles

Table 2. Data characteristics (n= 1024)

Description	Results
General information	
Timespan	2002:2022
Sources (journals, books, etc.)	452
Documents	1024
Annual growth rate %	10.17
Document average age	7.27
Authors	
Authors	4,771
Authors of single-authored docs	16
Authors collaboration	
Single-authored docs	18
Co-authors per doc	6.06
International co-authorships %	21.78
Document contents	
Keywords plus (ID)	2,225
Author's keywords (DE)	1,804

n, number of articles

University, the University of California System, and Brown University as the most collaborative institutions in the field of exercise and depression.

Between 2002 and 2022, a total of 452 journals have issued articles concerning exercise and depression. We have identified the top 10 contributing journals, as illustrated in the **Figure 3**, which collectively published 178 articles, constituting 17.4% of the entire body of literature on exercise and depression. Thus, examining articles from these journals provides a comprehensive overview of the current research frontiers in this domain. The Journal of Affective Disorders stands out not only for its substantial publication volume but also for its high impact factor in this field, establishing it as a crucial knowledge source on exercise and depression. The three-field diagram, linking authors, keywords, and sources, reveals through our analysis several authors and journals that have significantly contributed to the field of exercise and depression (**Figure 5**).

A co-citation network for journals was generated to visually represent the connections among the most frequently cited journals in the field of exercise and depression. In the resulting **Figure 6**, the citation network is presented in two major clusters. In the left cluster (depicted in blue), the most co-cited journals, namely Journal of Affective Disorders and Medicine and Science in Sports and Exercise, are highlighted with larger words and nodes. Conversely, in the right cluster (depicted in red), Plos One and Biological Psychiatry emerge as the most co-cited journals. Furthermore, the findings suggest that research published in the journals Journal of Affective Disorders, Medicine and Science in Sports and Exercise, Plos One, and Biological Psychiatry consistently receive frequent citations between 2002 and 2022.

Table 3. Top 10 countries' scientific production and citation about exercise and depression

Country	Freq	TC	AAC
United States of America	258	11,221	43.50
China	161	3,367	20.90
Australia	52	1,148	22.10
Germany	48	1,227	25.60
Sweden	38	1,062	27.90
Brazil	46	1,865	40.50
Canada	34	1,285	37.80
United Kingdom	37	1,680	45.40
Japan	39	703	18.00
Korea	34	585	17.20

AAC, average article citation; Freq, frequency; TC, total citation

Table 4. Top 10 sources' scientific production and citation about exercise and depression

Sources	Freq	TC	IF	Q
Journal of Affective Disorders	41	891	6.6	Q1
International Journal of Environmental Research and Public Health	26	97	3.2	Q2
Behavioural Brain Research	19	323	2.7	Q2
Frontiers in Psychiatry	19	124	4.7	Q2
Mental Health and Physical Activity	15	179	4.7	Q2
Complementary Therapies in Clinical Practice	14	23	2.0	Q2
Journal of Psychiatric Research	12	364	4.8	Q2
American Journal of Cardiology	11	221	2.8	Q2
Plos One	11	466	3.7	Q1
BMC Psychiatry	10	119	4.4	Q2

AAC, average article citation; Freq, frequency; IF, impact factor 2022; TC, total citation; Q, quartile of journal

Research hotspots and frontiers

Word analysis

The analysis revealed that the term "depression" appeared most frequently, indicating its prominence in the corpus. Following closely were terms such as "exercise," "anxiety," "physical activity," "yoga," "quality of life," "aerobic exercise," "physical exercise," "mental health," and "depressive symptoms," as illustrated in the **Figure 7**. This distribution suggests that these terms are key focal points within the analyzed content, highlighting their significance in the context under consideration.

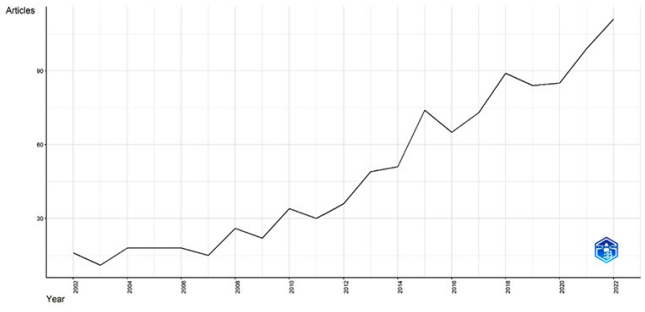

Figure 1. Trend of publication about exercise and depression every year

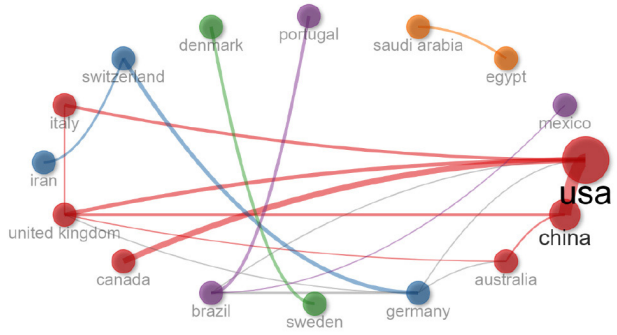

Figure 2. The collaboration network of countries

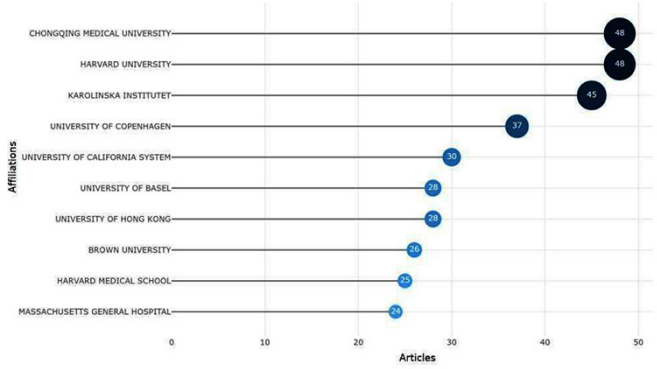

Figure 3. The top 10 university related exercise and depression publication

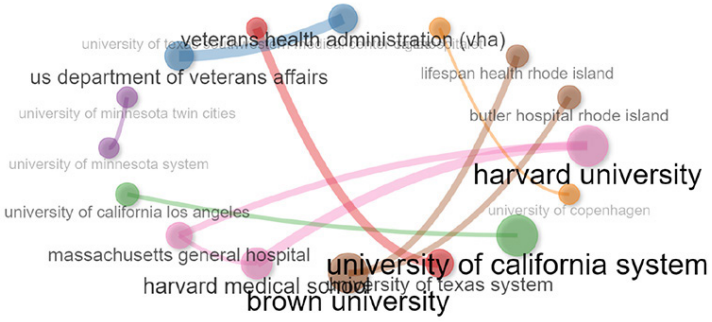

Figure 4. The collaboration network of university

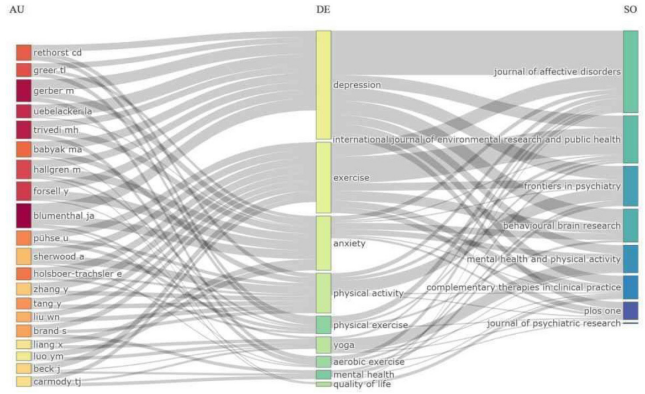

Figure 5. The three-field plot of top authors (AU), keywords (DE), and journals (SO)

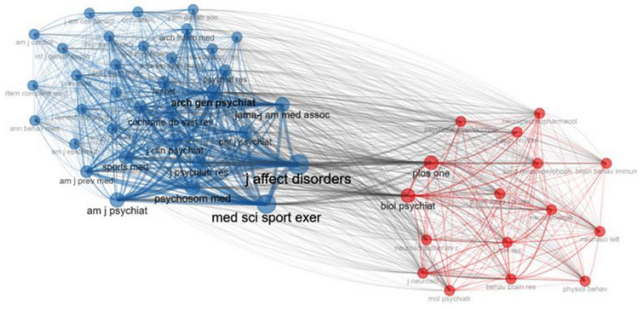

Figure 6. Sources co-citation journal network

Figure 7. The most frequent word about exercise and depression

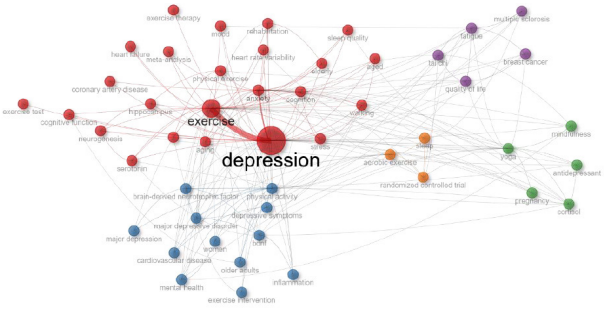

Figure 8. Co-occurrence words network of keywords about exercise and depression

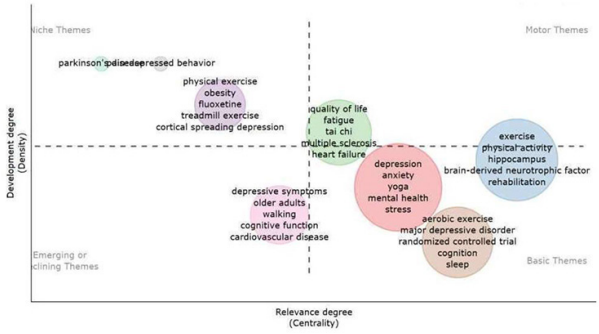

Figure 9. The thematic map of keyword related exercise and depression

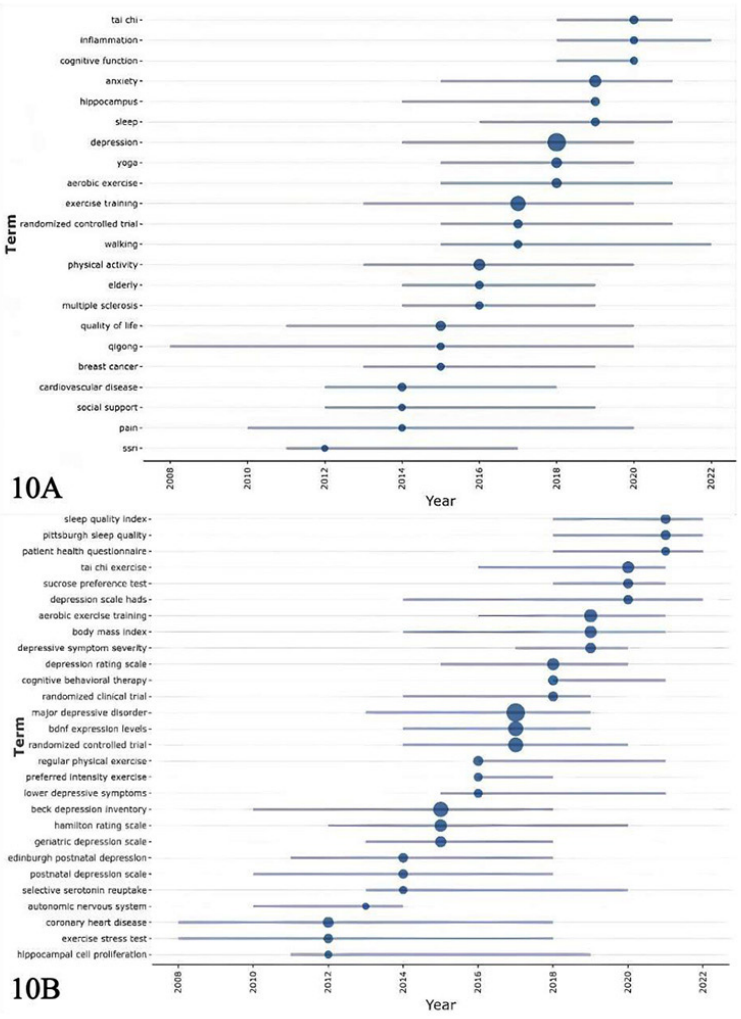

Figure 10. The trend topic about exercise and depression; 10A, The trend topic based on the author's keywords; 10B, The trend topic based on the abstract's terms trigram

The co-occurrence word network analysis revealed the presence of five prominent thematic clusters, each distinguished by a unique color code (**Figure 8**). In Cluster 1, represented by the color red, the central term with the highest co-occurrence was "depression." This was closely followed by associated terms such as "exercise," "anxiety," "physical exercise," "stress," "hippocampus," "cognition," "aging," "rehabilitation," "elderly," and "walking." Moving to Cluster 2, denoted by the color blue, the focal term was "physical activity," accompanied by a constellation of related terms including "mental health," "depressive symptoms," "major depressive disorder," "brain-derived neurotrophic factor (BDNF)," "older adults," "major depression," and "inflammation." Cluster 3, represented by the color green, was centered around the term "Yoga." This cluster featured co-occurring terms such as "cortisol," "mindfulness," "pregnancy," and "antidepressant." In Cluster 4, depicted in purple, the primary co-occurrence term was "quality of life," accompanied by terms such as "fatigue," "Tai Chi," "multiple sclerosis," and "breast cancer." Lastly, Cluster 5, marked by the color yellow, revolved around the term "aerobic exercise," with additional co-occurring terms including "randomized controlled trial" and "sleep."

Thematic map and topic trend analysis

Figure 9 depicts the thematic map of the keyword and the dataset under examination in this research. The map is partitioned into four quadrants: Niche themes, Motor themes, Basic themes, and Emerging themes, determined by their degree of relevance (centrality) and level of development (density). For the analysis, parameters were set as follows: a word count of 250, a minimum cluster frequency of 5 per thousand documents, a limit of 5 labels, and the application of the "Louvian" algorithm for clustering.

According to the insights gleaned from **Figure 10**, greater attention should be directed towards the subject located in the upper right quadrant, considering its notable density and relevance. This quadrant highlights topics such as exercise, physical activity, hippocampus, brain-derived neurotrophic factor, rehabilitation, all exhibiting high density and relevance, indicating a need for thorough examination and research. Conversely, topics situated in the upper left quadrant display a high degree of development but a low centrality (i.e., relevance). In the lower right quadrant, representing basic themes, topics like aerobic exercise, major depressive disorder, randomized control trial, cognition and sleep demonstrate relatively high levels of both developments. While the trending topics in the upper right quadrant are deemed the most promising for future research, it's noteworthy that the topics in the lower right quadrant (basic themes) also present favorable research prospects and warrant in-depth exploration. Additionally, the lower left quadrant encompasses subjects characterized by low development and relevance degrees.

As per the information presented in Figure 10A illustrating the trend of topics based on keywords, the foremost subject of discussion in 2018 was "depression," while "exercise training" took precedence in 2017. Over the past five years, twelve distinct topics have emerged, comprising walking and randomized control trial in 2017, followed by aerobic exercise, yoga, and depression in 2018. In 2019, the focal topics were sleep, hippocampus, and anxiety, while in 2020, cognitive function, inflammation, and tai chi became prominent themes.

Furthermore, Figure 10B, illustrating the topic trend based on abstract terms (trigrams), primarily delves into discussions related to measurement, treatment, and pathways. Examples of measurement terms include the sleep quality index, Pittsburgh sleep quality, patient health questionnaire, hospital anxiety and depression scale (HADS), body mass index (BMI), and depression rating scale. Treatment-related terms encompass tai chi exercise, aerobic exercise training, and cognitive-behavioral therapy. Pathway-related terms involve the expression level of brain-derived neurotrophic factor (BDNF), autonomic nervous system, selective serotonin reuptake, and hippocampal cell proliferation.

Following an analysis of the thematic map and topics trend within keywords and abstracts, it became evident that both aerobic exercise and tai chi stand out as potential exercises warranting further exploration. Additionally, terms associated with exercise and depression, including sleep and cognitive function, surfaced and are deemed worthy of future investigation. Notably, the consistent appearance of the hippocampus and BDNF suggests their potential as significant targets in the study of exercise and depression. Aligning with current trends, common measurements such as PHQ and HADS have gained prominence in recent studies.

DISCUSSION

In this study, the researchers utilized the WoS database to conduct a comprehensive bibliometric analysis focused on the intersection of field exercises and depression over the past two decades. Our main findings revealed a notable surge in annual publications within this field from 2002 to 2022. Developed countries and their representative universities predominantly contributed in building the knowledge about the relationship between exercise and depression. Mostly the journals with the scope of psychiatry or clinical psychology were publishing research articles about exercise and depression. In addition, we captured the most trending and potential exercises, factors associated exercise and depression, pathway target, and measurement tools. Our study not only underscores the present state of the field but also offers a guide for future research and identifies potential topics that may necessitate additional exploration and investigation.

The United States and China emerged as the primary countries at the forefront of exploring the relationship between exercise and depression, with Harvard University and Chongqing Medical University being particularly prominent institutions in each respective country. Even though, the contribution of developed countries was predominant in this field compared to developing countries (8 of top 10 countries). This finding was consistent with the top 10 of universities which mostly located in developed countries. Developing countries play a crucial role in conducting studies on the relationship between exercise and depression. These studies can provide valuable insights into how different cultural, social, and economic factors may influence the effectiveness of exercise interventions for depression in diverse populations. By conducting research in developing countries, we can better understand the unique challenges and opportunities for implementing exercise interventions for depression in these settings. This can help to ensure that the benefits of exercise for mental health are accessible to all, regardless of geographical location or socioeconomic status. In addition, the network collaboration among countries and universities showed a few number of contribution was observed for developing countries and universities located in developing countries, suggesting potential gap of equitable distribution of resources and knowledge in the field of exercise and depression. This accentuates the importance of cultivating collaborations that extend beyond geographical boundaries. Multi-country collaboration is crucial for the knowledge development of the relationship between exercise and depression. By pooling resources and expertise from different countries, researchers can conduct larger and more diverse studies that provide a more comprehensive understanding of how exercise impacts depression across different populations. Some findings

highlighted the potential benefits of different types of exercise can impact depression in various populations.[36-39]

In term of sources, some journals focusing on the scope psychiatry or clinical psychology were publishing significant number of scientific articles in the field of exercise and depression. The Journal of Affective Disorders is a high impact and outstanding journal contributed numerous publications as well as high total citation. Our finding suggested that the scientific community considers Journal of Affective Disorders as a key platform for disseminating significant insights and advancements in the field. We speculated the applicable of exercise as adjuvant or alternative therapy on depression was a promising field for further investigation in the scope of psychiatry or clinical psychology.

Leveraging keywords and abstract of studies, discovering potential and trending topics during past two decades. First, aerobic exercise and tai chi are two kinds of exercise that worth for further investigation. Aerobic exercise has emerged as a potential treatment for depression, with several studies exploring its effects on mental health outcomes. A randomized controlled trial is currently underway to investigate the effect of online aerobic exercise training in patients with bipolar depression, highlighting the growing interest in this area.[40] Additionally, perceptions of cognitive behavioral therapy (CBT) and aerobic exercise for depression are underexplored, despite evidence that both interventions can improve depression.[41] Furthermore, acute aerobic exercise-based cognitive and motor priming has been proposed as a promising approach for enhancing treatment outcomes associated with depression through neural plasticity-promoting mechanisms.[42] Several studies have investigated the effectiveness of Tai Chi as a treatment for depression, with promising results. A pilot study conducted among Chinese Americans found trends toward improvement in the Tai Chi intervention group, compared with the control group, in positive treatment-response rate and remission rate, although the differences in the small sample did not reach statistical significance.[43] Another study conducted a comprehensive systematic review and found that Tai Chi has been widely used to relieve the symptoms and complications of patients with postpartum depression (PPD), although its clinical efficacy is still questioned.[44] Furthermore, a randomized controlled trial is currently underway to investigate the effect of Tai Chi on the depressive symptoms of young adults with subthreshold depression.[45] These findings suggest that both aerobic exercise and tai chi may hold promise as treatments for depression, and further research in this area could provide valuable insights into the potential mechanisms and optimal approaches for using exercise to manage depression.

Second, our study found sleep and cognitive function are promising factors in the field of exercise and depression. The relationship between exercise, sleep, cognitive function, and depression is complex and interconnected. Several studies have explored the impact of exercise on cognitive function, depression, and sleep. A pilot study on the effect of a cognitive rehabilitation program combined with physical exercise on cognitive function, depression, and sleep in chronic stroke patients found that exercise can have a positive impact on cognitive function and depression in this population.[46] Another systematic review and meta-analysis suggested that exercise could significantly improve global cognitive function, balance, depression symptoms, and sleep quality in patients with mild cognitive impairment.[47] Additionally, a study on the effect of the frequency of exercise on cognitive function in older adults found that a higher frequency of exercise was associated with better quality of sleep, which in turn was associated with fewer symptoms of depression and better cognitive function.[48] These findings suggest that exercise can have a positive impact on cognitive function, depression, and sleep, and that the relationship between these factors is complex and multifaceted. Further research is needed to fully understand the mechanisms underlying these relationships and to identify the most effective strategies for using exercise to improve cognitive function and sleep and to reduce symptoms of depression.

Third, the potential pathway of BDNF and the hippocampus in the association between exercise and depression has been studied in animal models. Exercise has been shown to increase BDNF expression in the hippocampus, which may play a role in the prevention or amelioration of depression.[49-53] BDNF and proBDNF play an opposite role in hippocampal neurogenesis, and the balance between BDNF and proBDNF in the ischemic hippocampus is likely to play an important role in the pathogenesis of post-stroke depression.[51] Chronic running-wheel exercise from adolescence led to increased anxiety and depression-like phenotypes in adulthood in rats, and it was associated with increased BDNF expression in the hippocampus.[50] Treadmill exercise after social isolation was shown to increase the levels of NGF, BDNF, and synapsin I, induce the survival of neurons in the hippocampus, and improve depression-like behavior.[52] Furthermore, aerobic exercise was found to prevent depression by alleviating hippocampal injury in chronic stressed depression rats, and it was associated with upregulation of BDNF in the hippocampus.[53] These findings suggest that exercise can impact BDNF expression and hippocampal function, which may play a role in the prevention or amelioration of human depression.

Finally, the fourth was most trending measurement tools in observing depression severity after exercise therapy. The Patient Health Questionnaire (PHQ-9) and the Hospital Anxiety and Depression Scale (HADS) are commonly used questionnaires to assess depression in various populations, including cancer patients, cardiac populations, and primary care patients. Studies have shown that the PHQ-9 has comparable sensitivity and slightly higher specificity than the HADS-D and the Center for Epidemiologic Studies Depression Scale (CES-D) in detecting depression in cancer patients receiving radiotherapy.[54] In cardiac populations, the BDI-II and the HADS-D are among the most widely used questionnaires, with the BDI-II and the HADS-D showing the best sensitivity and negative predictive values for detecting depression.[55] However, there is evidence that changes in scores on self-

administered depression questionnaires often differ from patients' own views of changes in their mood, and over 50% of people evidenced some form of disagreement between their questionnaire scores and self-rated mood.[56] In a study of Chinese outpatients with atypical chest pain, the GAD-7 and PHQ-9 were found to be useful screening instruments for anxiety and depression, respectively.[57] In a representative sample of patients with cancer, the PHQ-9 and HADS-D were found to have comparable diagnostic accuracy for depression screening.[58]

In our study, using bibliometric analysis is suitable approach to provide a quantitative analysis of research output, which can be used to identify key researchers, institutions, and journals in exercise and depression field. In our study can also be used to identify emerging research trends. However, the nature limitations of our study was not avoided. By using bibliometric analysis may not capture the full range of research activity in exercise and depression field, as they are limited to the publications that are indexed in WoS database. Additionally, our study may not capture the quality of research, as they are based solely on quantitative measures such as citation counts.

Despite these limitations, our findings provide valuable guidance for future investigations, including the need for rigorous clinical trials on aerobic exercise and Tai Chi, integrative approaches that link exercise with psychological therapies, validation of measurement tools across diverse populations, and multidisciplinary research to elucidate biological mechanisms. Taken together, these insights demonstrate the utility of bibliometric analysis as a foundation for shaping research priorities, informing policy and funding strategies, and advancing the role of exercise as an adjunct or alternative therapy for depression across diverse contexts

CONCLUSION

In general, this study illuminates the trends in the field spanning the last two decades and holds potential for a deeper comprehension of the scientific correlations between depression and exercise. Firstly, there has been a growing interest among researchers in exploring exercise therapy and depression over the past 20 years. This interest has persisted in recent times, indicating that the field is still evolving and is likely to continue developing in the future. Secondly, in using bibliometric, we were able to map the base countries, institute, journal, and top authors in this field. Thirdly, a substantial portion of the research topics in this field is conducted by scholars related potential kind exercises on depression treatment, Depression related factors, most used measurements, as well as recent concern of depression pathway. Comprehensive longitudinal studies and expanded randomized controlled trials are imperative to solidify the existing research findings. In conclusion, our study serves as a guide and reference for researchers to contemplate and determine research directions, streamlining efforts in exploring the boundaries of the field, and laying a theoretical foundation for further investigations in this field.

ETHICAL CONSIDERATION

No ethical clearance needed.

CONFLICT OF INTEREST

Authors declared no conflict of interest.

AUTHOR CONTRIBUTIONS

MHSL, RP, and AS conceptualized the study, collected data, performed literature reviews, and drafted the manuscript. MSM, DNAN, HS, IH, VLA, MM and MHC assisted with data collection, literature searches, and manuscript revision.

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