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SCIENTOMETRICS

Global research trends and hotspots in overweight/obese comorbid with depression among children and adolescents: A bibliometric analysis

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Abstract

BACKGROUND

Overweight/obesity combined with depression among children and adolescents (ODCA) is a global concern. The bidirectional relationship between depression and overweight/obesity often leads to their comorbidity. Childhood and adolescence represent critical periods for physical and psychological development, during which the comorbidity of overweight/obesity and depression may increase the risk of adverse health outcomes.

AIM

To evaluate the relationship between ODCA, we conduct a bibliometric analysis to aid in formulating prevention and treatment strategies.

METHODS

From 2004 to 2023, articles related to ODCA were selected using the Science Citation Index Expanded from the Web of Science Core Collection. Bibliometric analysis of relevant publications, including countries/regions, institutions, authors, journals, references, and keywords, was conducted using the online bibliometric analysis platforms, CiteSpace, VOSviewer, and bibliometrix.

RESULTS

Between 2004 and 2023, a total of 1573 articles were published on ODCA. The United States has made leading contributions in this field, with Harvard University emerging as the leading contributor in terms of research output, and Tanofsky being the most prolific author. The *J Adolescent Health* has shown

significant activity in this domain. Based on the results of the keyword and reference analyses, inequality, adverse childhood experiences, and comorbidities have become hot topics in ODCA. Moreover, the impact of balanced-related behavior and exploration of the biological mechanisms, including the potential role of key adipocytokines and lipokines, as well as inflammation in ODCA, have emerged as frontier topics.

CONCLUSION

The trend of a significant increase in ODCA publications is expected to continue. The research findings will contribute to elucidating the pathogenic mechanisms of ODCA and its prevention and treatment.

Key Words: Children; Adolescents; Overweight; Obesity; Depression; Bibliometric analysis; Research trends

Core Tip: A total of 1573 articles were published on overweight/obese comorbid with depression among children and adolescents from 2004 to 2023. Through analysis of keywords and references, inequality, adverse childhood experiences, and comorbidities have become hot topics. Moreover, the impact of balanced-related behavior and exploration of biological mechanisms, including the potential role of key adipocytokines and lipokines, as well as inflammation, have emerged as frontier topics. This research can help offer a comprehensive understanding of current and future research hotspots and provide a deeper scientific basis for future prevention and treatment strategies for overweight/obese comorbid with depression in young people.

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INTRODUCTION

The high prevalence of overweight/obesity among children and adolescents represents a global health concern[1]. From 1990-2022, the prevalence of overweight among children and adolescents increased sharply from 8% to 20%, whereas the prevalence of obesity rose from 2% to 8%. By 2022, the global population of children and adolescents aged 5-19 who were overweight exceeded 390 million, with 160 million being obese[2]. While certain high-income countries have witnessed a stabilization in childhood overweight/obesity rates over the past few decades, it is important to note that there are emerging trends of increasing overweight and obesity rates in select Asian countries[3]. Compared with their normal-weight counterparts, overweight/obese children and adolescents are more prone to health issues such as hypertension, dyslipidemia, abnormal glucose metabolism, nonalcoholic fatty liver disease, and orthopedic disorders[4,5].

Moreover, existing data indicate a correlation between overweight/obesity in children and adolescents and various mental health problems, particularly depression[6]. Compared with nonobese children and adolescents, overweight/obese children and adolescents are 1.41 times more likely to experience moderate to severe depression[7]. A meta-analysis revealed that the prevalence rates of overweight/obesity among children and adolescents with depression are approximately 9.0% to 16.9% and 10.1% to 26.7%, respectively, which are higher than those reported in their healthy peers[8]. Therefore, there is a bidirectional relationship between depressive symptoms and overweight/obesity, where one issue often exacerbates the development of the other, and their interaction leads to a propensity for comorbidity[9,10]. The comorbidity of overweight/obesity and depression is linked to an increased risk of noncommunicable diseases. Recent research revealed that compared with individuals without comorbid depression and obesity, individuals with both conditions presented a 6.7-fold increased risk of diabetes and a 7.6-fold increased risk of hypertension[11].

Childhood and adolescence are critical periods for physical and psychological development, and the comorbidity of obesity and depression during these stages may have long-term negative impacts on health, academic performance, social interactions, and psychological well-being. Given the concerning impact of overweight/obesity combined with depression among children and adolescents (ODCA) on global public health, there is an urgent need for scientific bibliometric and visualization analyses of current research trends and future directions in the ODCA field. However, no bibliometric analysis has been conducted to examine the most recent publications in this domain. Bibliometrics enables timely and comprehensive analysis of publications within a specific timeframe, encompassing various aspects such as publications, countries/regions, institutions, journals, authors, references and keywords[12]. To conduct a systematic literature review in this field, the online analysis platform of literature metrology, CiteSpace, VOS viewer, and the R package "bibliometrix" were utilized.

MATERIALS AND METHODS

Sources and retrieval of data

This study utilized data from the Web of Science Core Collection (WoSCC), which was chosen because of its extensive indexing record of numerous influential and top-tier journals globally. Numerous previous bibliometric analyses have used WoSCC as the sole data source[13,14]. The following is a description of how the data were retrieved. In the first step, we searched for relevant publications *via* the following strategy: TS = ("obese" OR "overweight" OR "obesity"); And TS = ("adolescent" OR "child" OR "youth" OR "teen"); And TS = ("depression" OR "depressions" OR "depressive" OR "despondent" OR "depressed"). The time range under consideration spanned from 2000 to 2023, encompassing document types such as articles and reviews, all of which were written in the English language. The Science Citation Index-Expanded (SCI-E) was the only index we selected. The search resulted in 1637 articles. The unprocessed data were subsequently obtained from WoSCC in the form of text files encompassing comprehensive records (retrieved on December 31, 2023). To minimize bias caused by regular database updates, the data were searched for and retrieved within a single day. All the manuscripts were individually screened by two researchers (Wang YQ and Wu TT) after the primary data search. Any disagreement was discussed and judged by other members of the research team (Li Y).

The exclusion criteria were as follows: (1) Withdrawn or duplicate publications; (2) Other metabolic diseases related to the topic of the document (such as diabetes, nonalcoholic fatty liver, and lipid metabolism disorders); and (3) Literature such as letters, proceedings papers, book reviews, editorial materials, meeting abstracts, data papers, corrections, *etc*. As a result, 1573 pieces of literature were included. Figure 1 shows the detailed screening process.

Data analysis

For the purpose of describing all the characteristics of research in ODCA, we converted all the WoSCC data to the TXT format and imported them into the online analysis platform of literature metrology (https://bibliometric.com/app), Citespace 5.8.3 (Drexel University, Philadelphia, PA, United States), VOSviewer 1.6.19 (Leiden University, Leiden, The Netherlands), and used the R package 'bibliometrix' for visual processing.

The online analysis platform of literature metrology was utilized to extract publications from the top 10 countries/regions with publication rates, and to generate a collaboration network of countries/regions. We used CiteSpace for dual map overlays of journals, clustering maps and the timeline cluster analysis of references, and burst detection analysis of the references. Using VOSviewer, we visualized the collaboration networks among countries, authors, institutions, journals, and keywords. Bibliometrix was used to analyze corresponding author countries, author production over time, and keyword trend topics. Our study did not require ethical approval since all data were collected from publicly available databases. Microsoft Office Excel 2019 was used for the data analysis.

RESULTS

Publication trends and country/region collaborative network

Researchers' concerns in a specific field can be reflected in the number of publications to some extent. The first study in this area was published in 2004. In 2016, the number of studies surpassed 100 for the first time due to sustained growth. Since 2019, the pace of growth has accelerated significantly, reaching a maximum of 154 in 2021 (Figure 2A). The annual growth rate of publications was 12.04%. Additionally, a growth trend model was developed using Microsoft Excel 2019: $F(x) = 0.0034x^2 - 6.7781x$ ($R^2 = 0.9553$). By 2025, nearly 216 articles will be published, and increased research will be conducted in this field as it receives greater attention.

Distribution and cooperation between countries/regions

To identify which countries/regions dominated ODCA research in the past two decades, the online analysis platform of bibliometrics was used to determine the number of articles published across countries/regions. The histogram in Figure 2B and Table 1 illustrates the details of publications in the top 10 countries/regions. Over the last two decades, the United States has dominated ODCA research, contributing 844 scholarly articles which represented a majority, exceeding 50% of the literature on the subject. Contributors ranking second to fifth were the United Kingdom (148, 9.4%), Canada (125, 7.9%), Australia (118, 7.5%), and China (89, 5.7%). The United States had the highest total number of citations of all countries (32022), and the Netherlands had the most average citations globally (81.9). This noteworthy achievement highlighted the significant contributions made by the United States. Moreover, research from the Netherlands received the most citations *per* article, indicating that these studies were regarded as significant reference standards by other countries and regions in this field.

By analyzing publications from various countries and regions, we can gain insight into a country's influence and importance within a field of research. Six clusters were identified based on VOS clustering, with Spain, Norway, the United States, the United Kingdom, Australia, and Canada being the key notes of the clusters. In terms of total link strength, the United States had the strongest cooperation with other countries, notably China and South Korea (Figure 2C). The collaborative network between European countries was common (Figure 2C and D). Cooperation among nations was primarily concentrated within high-income countries, notably the United States, the United Kingdom, Australia, and Canada, with the United States being the most significant contributor. Moreover, a few middle-income countries have demonstrated potential in this realm, exemplified by China's collaboration with the United States and India's partnership with Germany.

Table 1 Top 10 productive countries/regions from 2004 to 2023, *n* (%)

Rank	Country	Continent	Output	Percentage (*n* = 1573)	TC	AC
1	United States	North America	844	53.7	32022	37.9
2	United Kingdom	Europe	148	9.4	6249	42.2
3	Canada	North America	125	7.9	7413	59.3
4	Australia	Oceania	118	7.5	5386	45.6
5	China	Asia	89	5.7	1922	21.6
6	Germany	Europe	68	4.3	1681	24.7
7	South Korea	Asia	54	3.4	722	13.4
8	Netherlands	Oceania	54	3.4	4421	81.9
9	France	Europe	42	2.7	1489	35.5
10	Italy	Europe	38	2.4	708	18.6

TC: Total citations; AC: Average citations.

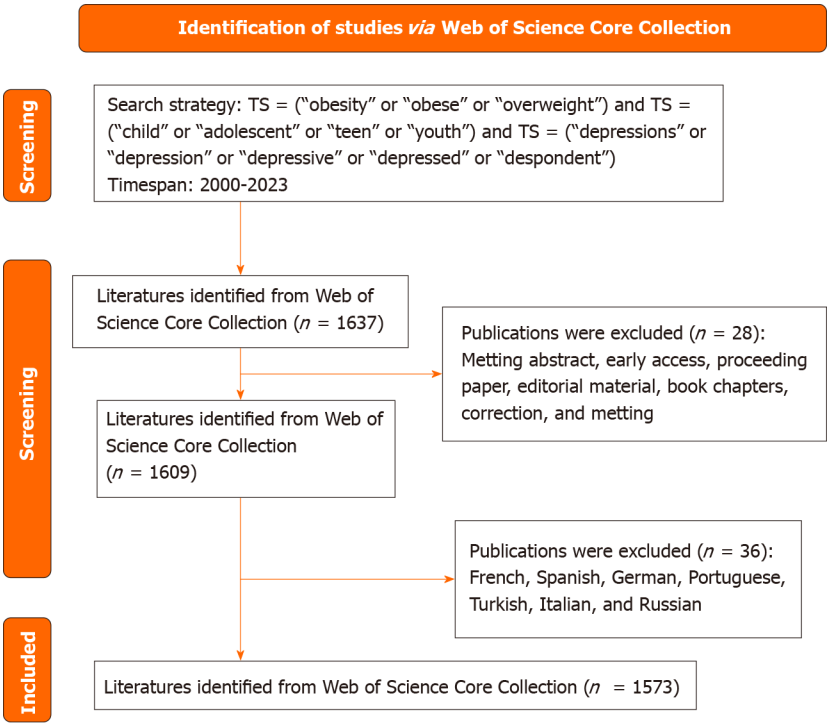


Figure 1 A flowchart outlining the process of incorporating and excluding literature.

Contribution of academic institutions and authors

According to Figure 3A and B, over 2000 institutions participated in this study, which lists the 10 most effective institutions and affiliations' production over time. With 175, 11.1% of scientific publications, Harvard University ranked first, followed by the University of Minnesota, Twin Cities (102, 6.5%), and the University of California System (98, 6.2%). Figure 3C shows the institutional collaboration co-occurrence map, which reveals the collaborative relationships among the 209 contributing organizations. Co-citations within the same color group were more strongly correlated. A total of nine clusters belonged to collaborative networks, whereas the University of Pittsburgh, Karolinska Institute, University of Toronto, University College London, University of Michigan, Columbia University in the city of New York, Eunice Kennedy Shriver National Institute of Child Health, Harvard University, and Yale University had the highest total link strength, which indicated that they were the keys to these collaborative clusters.

The publications included 7399 authors in total. Table 2 summarizes the basic information about the top 10 productive and co-cited authors. Among the 10 authors with the highest productivity and co-citation, all were Americans. Tanofsky KM of the Uniformed Services University of Health Sciences published the most publications (38) in this field between 2004 and 2023, followed by Yanovski JA (36), Shomaker LB (25), Neumark SD (21), and Brady SM (19). A co-citation

Table 2 Top 10 productive authors and co-cited authors from 2004 to 2023

Rank	Author	TP	Country	Rank	Author	TC	Country
1	Tanofsky KM	38	United States	1	Neumark SD	927	United States
2	Yanovski JA	36	United States	2	Tanofsky KM	900	United States
3	Shomaker LB	25	United States	3	Taveras EM	821	United States
4	Neumark SD	21	United States	4	Yanovski JA	790	United States
5	Brady SM	19	United States	5	Rich-edwards JW	779	United States
6	Wilfley DE	18	United States	6	Rifas-shiman SL	705	United States
7	Kelly NR	17	United States	7	Shomaker LB	566	United States
8	Shank LM	15	United States	8	Field AE	556	United States
9	Yanovski SZ	14	United States	9	Boynton JR	541	United States
10	Lumeng JC	13	United States	10	Yanovski SZ	537	United States

TP: Total publications; TC: Total citations.

author is the author who appeared in the references of two or more articles simultaneously. In the field of research, these authors were often leading figures with considerable achievements. Table 2 lists the top 10 co-citation authors, Neumark SD (927), Tanofsky KM (900), Yanovski JA (790), and Shomaker LB (566) also ranked among the top 10 authors in the list of highly co-cited authors.

The network visualization map of author collaboration depicted the collaborative relationships among the top 302 contributing authors, which were divided into 13 clusters according to VOS (Figure 4A). Thirteen authors have become the keys of the co-citation network diagram, and they are Boynton JR, Tanofsky KM, Rich EJ, Hebebrand J, Neumark SD, Brady SM, Wilfley DE, Crosby RD, Hamer RM, Lumeng JC, Baur LA, Belcher BR, and Schvey NA. Tanofsky KM had the highest total link strength (275), indicating that this author had the closest collaborations. Further analysis of the corresponding author's country revealed that the United States had the highest publication volume and established extensive international cooperation (Figure 4B). After a decade of significant growth from 2004 to 2013, there has been an explosive growth in the publications of several major authors in this field since 2014 (Figure 4C).

Analysis of main journals

It was estimated that 1573 original papers have been published by 473 scholarly journals in the last 20 years. In terms of publications, Table 3 shows the top 10 journals. Journals with more than 30 articles included the *J Adolescent Health*, *Appetite*, *BMC Public Health*, *Int J Eat Disorder*, and *Pediatrics*, with 59, 39, 37, 33, and 31 articles, respectively.

The global science portfolio pattern was revealed by a dual map overlay analysis of scientific journals globally. Figure 5 shows the ODCA dual map from 2004 to 2023, which comprises two parts, each representing a journal: The journals cited on the left are represented on the left side, and the journals cited on the right side are represented on the right side. A color curve on the map represents a citation linkage line, indicating the path of the citation linkage. A higher Z score is indicated by a thicker curve line and a stronger impact, resulting in a higher function value. Figure 5 shows that medicine/medical/clinical (Green line, Z = 4.8081875, f = 8590, Z = 5.8243747, f = 10290, and Z = 2.1314301, f = 4112, respectively) and psychology/education/health (blue line, Z = 3.8015642, f = 6906 and Z = 3.0017668, f = 5868, respectively) were influenced by psychology/education/social, health/nursing/medicine, and molecular/biology/genetics.

Analysis of references

Highly cited references pertain to publications that receive a substantial number of citations and possess a broad scope of influence. The collective number of citations for this set of articles within the WoSCC database was 3225. Among the five most cited articles, Ogden *et al*[15] ranked first in *JAMA* in 2014 (44 times), whereas Luppino *et al*[16] ranked second in 2010 in the *Arch Gen Psychiatry* (39 times). Six of the top 10 most cited articles were published in *JAMA*, with the remaining articles originating from the *Arch Gen Psychiatry*, *Pediatrics*, *Lacent*, and *Obes Rev*.

Figure 6A shows the CiteSpace clustering of co-cited references from 1573 cited articles (Q = 0.7655, S = 0.8302). In this case, Q value was greater than 0.3, and S value was much greater than 0.7. The reference clustering map revealed 15 clusters, including: 0: Balanced-related behavior; 1: Control eating; 2: Preventing excessive weight gain; 3: Major depression; 4: Maternal stress; 5: Health-related quality; 6: Psychological predictor; 7: Health weight; 8: Maternal antenatal inflammation; 9: Maternal depressive symptom; 10: Childhood maltreatment; 11: Polycystic ovary syndrome; 12: Experiencing food insecurity; 13: Maternal symptom; and 14: Suicide pattern. The basic characteristics of the 10 main clusters in the co-cited reference clustering diagram are presented in Table 4.

Figure 6B illustrates the specific details of 15 frontier fields. The aggregation of variables preventing excessive weight gain, health-related quality, psychological predictor, health weight, polycystic ovary syndrome, maternal symptom, and suicide pattern, which emerged between 1999 and 2001, progressively declined and ceased between 2009 and 2012.

Table 3 Details of the top 10 prolific journals based on the number of published papers from 2004 to 2023

Rank	Journal	Count (*n*)	TC	AC	2023 IF[1]	Category quartile
1	*J Adolescent Health*	59	172	2.92	7.6	Q1
2	*Appetite*	39	80	2.05	5.4	Q1
3	*BMC Public Health*	37	32	0.86	4.5	Q2
4	*Int J Eat Disorder*	33	89	2.70	5.5	Q1
5	*Pediatrics*	31	245	7.90	8.0	Q1
6	*Obesity*	27	143	5.30	6.9	Q1
7	*Int J Obesity*	24	70	2.92	4.9	Q2
8	*Pediatric Obesity*	24	63	2.63	3.8	Q1
9	*Childhood Obesity*	24	29	1.21	2.5	Q2
10	*Eat Wei Disord-ST*	24	12	0.50	2.9	Q3

[1]Journal citation reports (Clarivate, 2023).
TC: Total citations; AC: Average citations; IF: Impact factor.

Table 4 Basic characteristics of the 10 main clusters of co-cited references from 2004 to 2023

Cluster	Size	Silhouette	Average year	Label
0	143	0.924	2018	Balanced-related behavior
1	115	0.934	2012	Control eating
2	102	0.833	2005	Preventing excessive weight gain
3	98	0.85	2009	Major depression
4	89	0.87	2016	Maternal stress
5	72	0.956	2002	Health-related quality
6	67	0.86	2006	Psychological predictor
7	43	0.915	2007	Health weight
8	39	0.988	2016	Maternal antenatal inflammation
9	37	0.926	2010	Maternal depressive symptom
10	32	0.94	2012	Childhood maltreatment
11	22	0.996	2003	Polycystic ovary syndrome
12	17	0.989	2018	Experiencing food insecurity
13	9	0.993	2004	Maternal symptom
14	8	0.999	2006	Suicide pattern

Similarly, the aggregation of variables control eating, major depression, maternal depressive symptom, and childhood maltreatment, which emerged between 2007 and 2009, has gradually diminished and ceased between 2014 and 2017. In contrast, the co-citations related to balanced-related behavior, maternal stress, maternal antenatal inflammation, and experiencing food insecurity, established between 2013 and 2015, have remained steady, indicating their continued importance.

The co-cited references with the strongest citation bursts are shown in Figure 6C. The term "Begin" denotes the initial citation of the reference, whereas "end" signifies the year in which the final reference was identified. Notably, the research by Ogden *et al*[15] published in *JAMA* had the highest burst intensity (16.42), pointing to the high prevalence of obesity in both children and adults in the United States during the years 2011-2012.

Analysis of keywords

The utilization of keywords in an article can effectively capture the central research point, condensing the essence of a specific research field. Figure 7A shows that a high frequency of keywords indicates the prominence of topics and research areas within the field. The minimum threshold for keyword occurrence was set at 10, resulting in the identi-

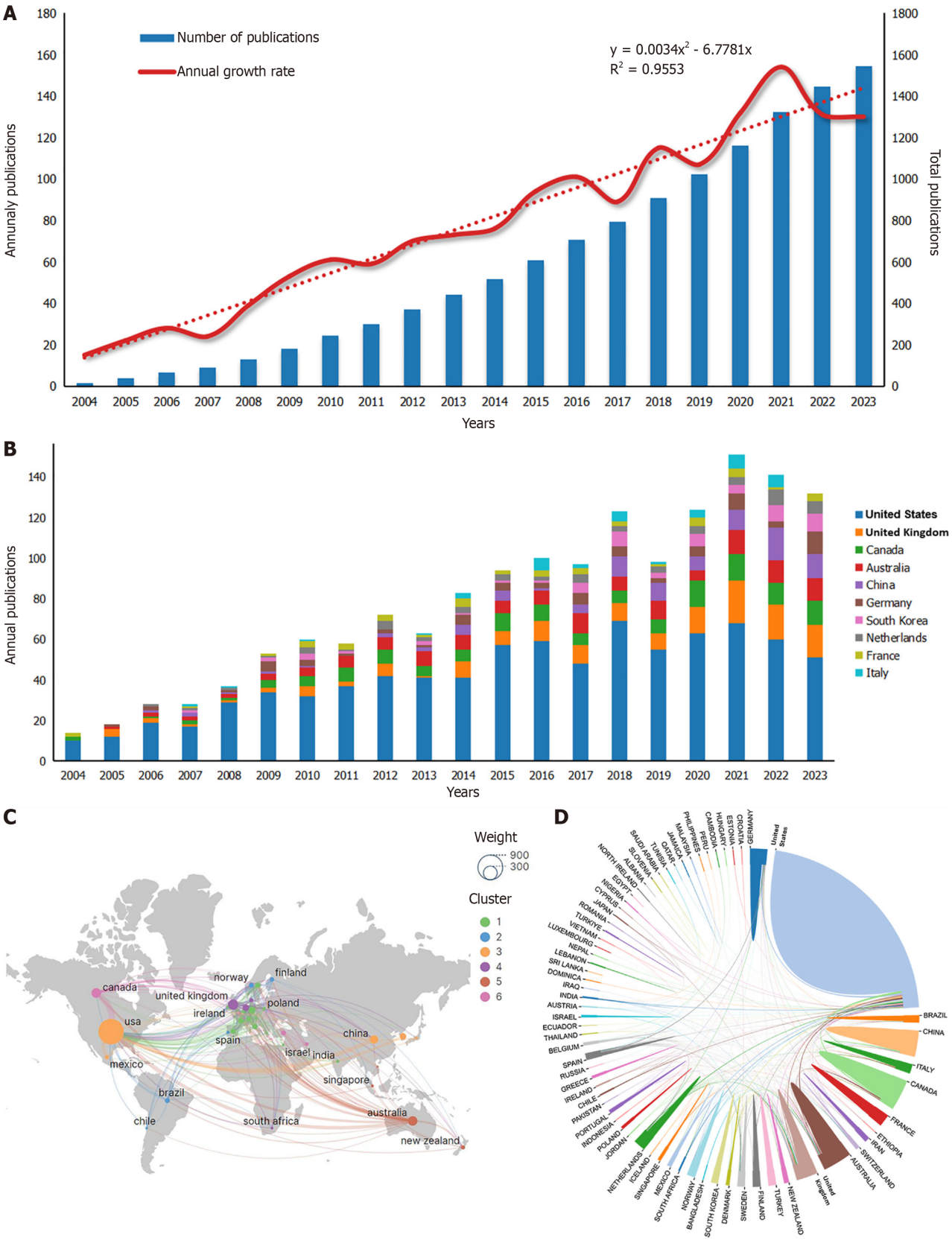


Figure 2 Publication growth trends and country/region collaborative networks from 2004 to 2023. A: Publications' growth trends in annual research; B: Top 10 countries/regions for research publications (number and growth trend); C: Country/regional collaboration network diagram. Different colors denote different clusters, which correspond to different sizes of nodes. The connecting lines indicate the degree of cooperation; D: Collaboration network of countries/regions.

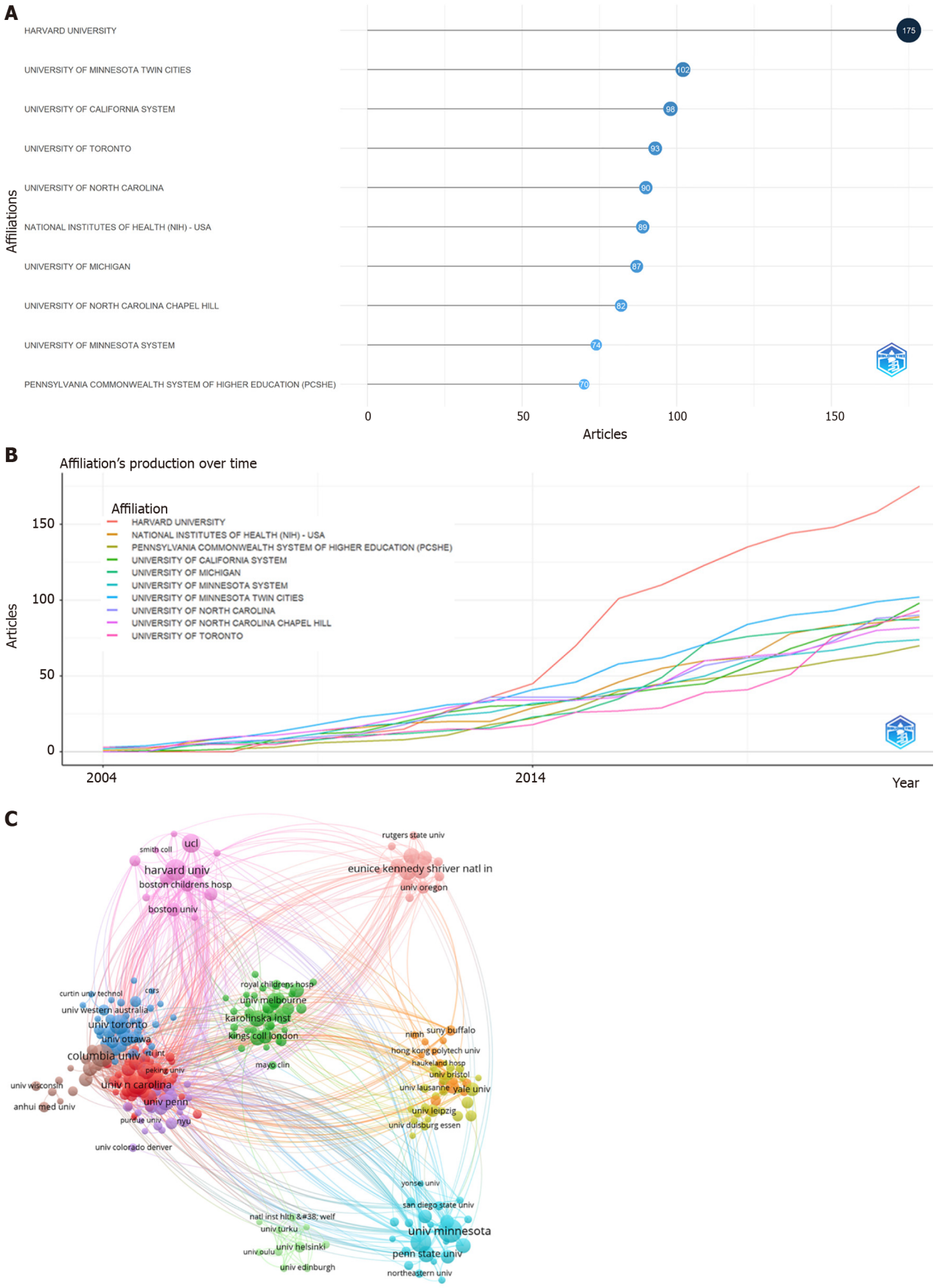


Figure 3 Affiliation analysis from 2004 to 2023. A: The top 10 relevant affiliations; B: Over time, the top 10 most relevant affiliations, with circle sizes reflecting the number of publications and color gradients indicating the number of citations *per* year; C: Co-occurrence network of institutions. The size of each node corresponds to the number of publications, and different colors represent different clusters. The thickness of the lines indicates the degree of cooperation.

fication of 239 keywords that met the specified criteria within the relevant literature.

The study of ODCA encompassed five types of hotspots (Figure 7B), including physical activity (PA), overweight, depression, obesity and childhood, with a primary focus on three key aspects. Cluster 1 focuses on PA, and the primary keywords were childhood obesity, mental health, stress, United States, pregnancy, woman, socioeconomic status, diet, sleep, and food insecurity. Clusters 2, 4, and 5 are related to children who are overweight/obese, and the primary keywords were body mass index (BMI), epidemiology, meta-analysis, major depression, anxiety, self-esteem, psychopathology, adolescent girls, eating disorders, insulin resistance, metabolic syndrome, inflammation, attention deficit hyperactivity disorder (ADHD), cardiovascular disease (CVD), and blood pressure. Cluster 3 represented the keywords related to depression, and the primary keywords were health, depressive symptoms, youth, adults, BMI, gender differences, peer victimization, school, abuse, and social support.

The keyword theme trend displayed a chronological perspective on the progression of studies in the field of ODCA, demonstrating the evolution of different research topics over time. This finding aids in comprehending both historical and contemporary research patterns, providing a guide for future research endeavors. Keyword trend theme analysis revealed that before 2016, research focused mainly on self-esteem, gender differences, childhood overweight, adolescent girls, socioeconomic status, and other aspects. Since 2016, researchers have been actively exploring psychometric properties, illness, anxiety, pregnancy, samples, and questionnaires, among others. Since 2021, the main keywords have been mediating roles, generalized anxiety disorders, and cytokines (Figure 7C).

DISCUSSION

The development tendencies in the ODCA field

Between 2004 and 2023, the WoSCC database documented 1573 articles on ODCA research, showing a steady increase in publications. Notably, interest surged notably from 2019 onward, potentially influenced by the coronavirus disease (COVID)-19 pandemic. The pandemic significantly increased overweight/obesity rates because of reduced PA opportunities for young people[17]. It also intensified psychological issues such as fear, anxiety, and loneliness, increasing the risk of depression[18]. Consequently, there has been a growing focus on the ODCA field, which has driven a notable increase in research, ultimately leading to a historical record of the number of publications in 2021.

Global cooperation and productivity representatives

Our findings show that the United States led in publications among the top 10 institutes and authors in ODCA research. This dominance can be attributed to three key factors, which we analyze below.

First, the high prevalence rates of obesity and depression among American children and adolescents exceed global averages[19-22]. Second, proactive public health policies, such as the 2023 clinical guidelines from the American Academy of Pediatrics, demonstrate a targeted approach to address these issues[23]. Finally, the United States benefits from a robust research ecosystem with substantial funding and advanced facilities, fostering extensive interdisciplinary collaboration and providing a premier platform for global scientific exchange[24].

Currently, international collaboration on research concerning ODCA is mostly among high-income countries, with emerging participation from middle-income nations such as China and India. This trend is supported by several factors as follows: (1) Population size: China's and India's large populations provide extensive research subjects and data sources for studying ODCA-related issues; (2) Prevalence of illness: Both countries are witnessing increasing rates of childhood overweight/obesity and depressive symptoms despite stabilization in some high-income nations[25-30]; (3) Rapid economic growth: Rapid economic development in China and India has led to significant changes in the lifestyle and dietary habits of children and adolescents[31,32]; and (4) Development of research infrastructure: China and India are actively enhancing their research infrastructures and resources, investing in scientific research and talent development.

The *J Adolescent Health* emerged as the most prolific journal among the top 10 highly referenced journals in this area. Additionally, *Appetite*, *BMC Public Health*, *Int J Eat Disorder*, and *Pediatrics* have garnered considerable favor within this domain, warranting researchers' attention to stay abreast of the latest research developments. Notably, *Pediatrics* stood out for its remarkable average number of citations *per* paper, indicative of its commendable scholarly contributions. Research on ODCA spans medicine/clinical and psychology/health/education, with interdisciplinary studies in molecular biology/immunology, mathematics/systems theory, and economics/politics. These diverse approaches investigate the biological, predictive, and societal aspects of ODCA[19,20,23,33].

Trends and frontiers

Based on the keyword analysis and references, current ODCA research focuses on six main areas. Among them, balanced-related behavior, and investigations of the biological mechanisms, including cytokines and inflammation, have emerged as the future frontiers of the ODCA field and merit special attention from researchers.

The impact of balanced-related behavior in ODCA: Balanced-related behavior encompasses aspects such as PA, dietary habits, and sleep quality. This topic not only examines behavioral patterns among children and adolescents but also explores the influence of maternal health-related behaviors on their offspring. Childhood obesity presents a pressing public health challenge and is often linked to inadequate PA[34]. Robust evidence suggests that moderate to vigorous PA can yield positive outcomes for both physical and mental well-being[34-36], by regulating the hypothalamic-pituitary-adrenal (HPA) axis and cortisol secretion[37,38]. Increasing PA thus plays a vital role in maintaining overall health.

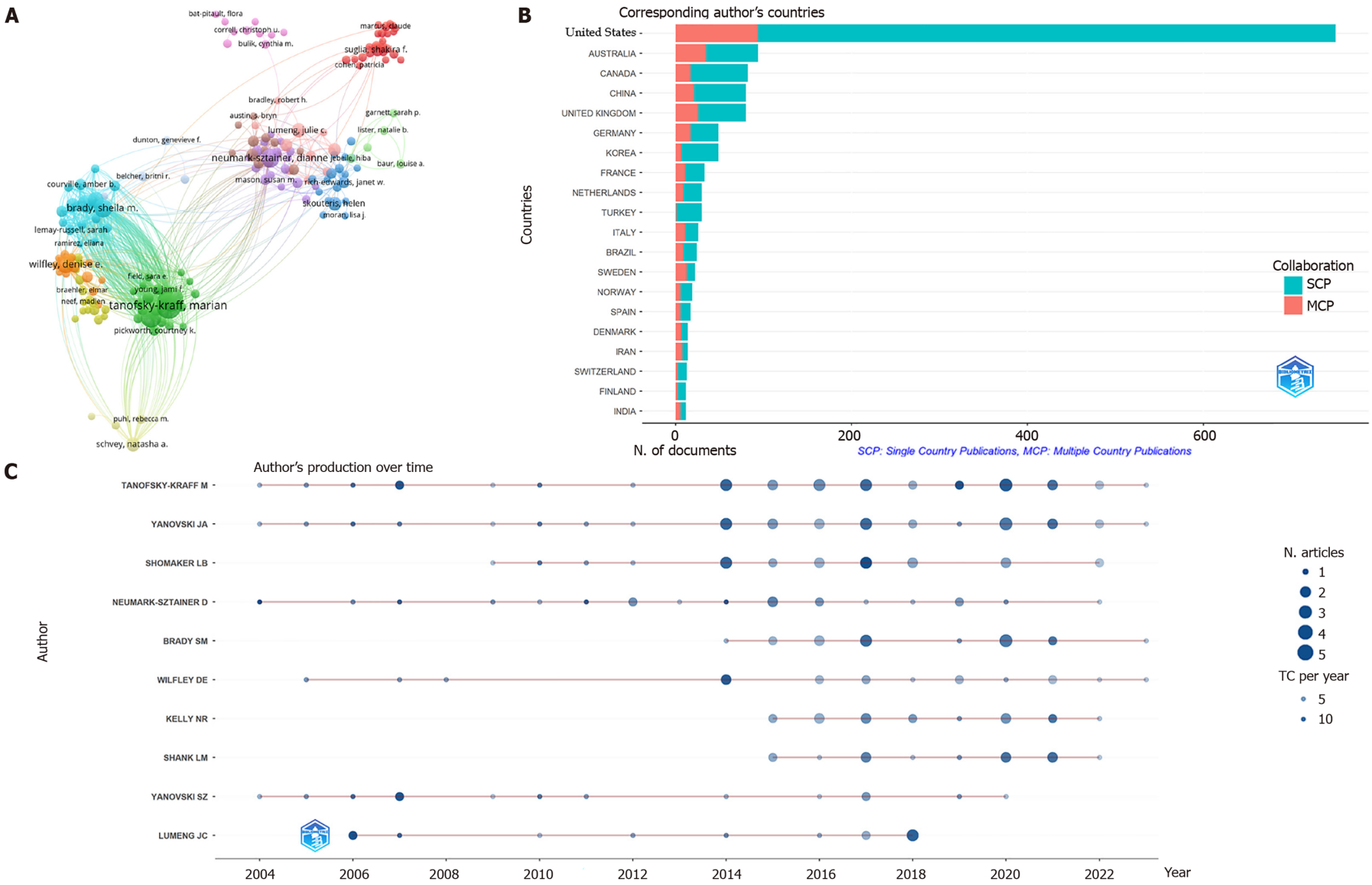


Figure 4 Author analysis from 2004 to 2023. A: Visualization networks of author collaborations; B: Country distribution of the productive corresponding authors; C: Over time, the top 10 most productive authors. SCP: Single country publications; MCP: Multiple country publications; TC: Total citations; N: Numbers.

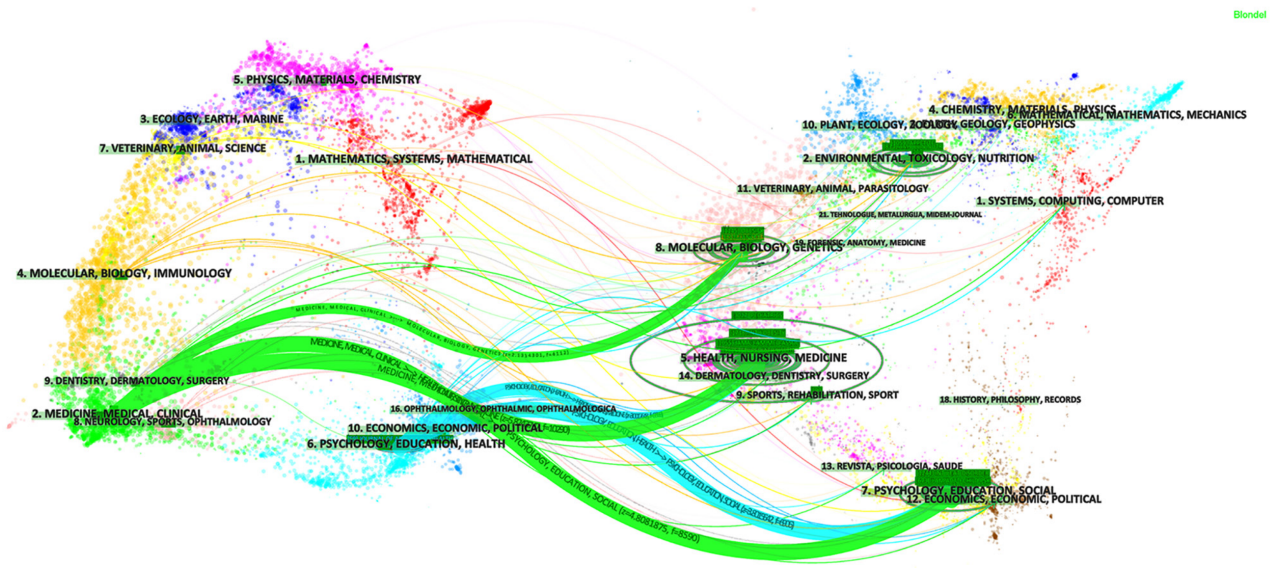


Figure 5 A dual map overlay of overweight/obesity combined with depression among children and adolescents journals from 2004 to 2023.

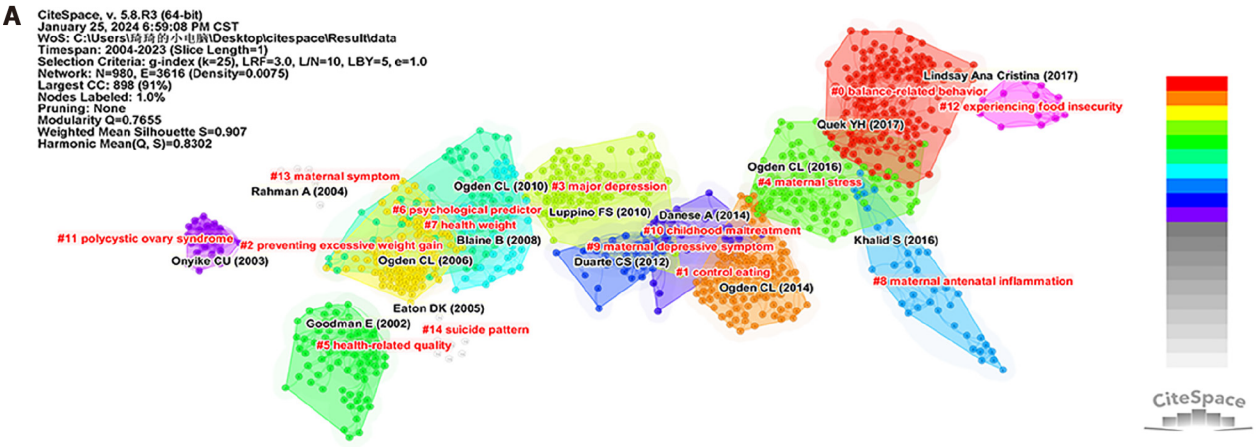
Excessive consumption of foods and drinks high in fat and sugar is a major contributor to overweight/obesity in children and adolescents[39]. Research indicates that a high-sugar diet can affect brain circuits involved in reward and impulse control, weakening resistance to foods and drinks high in fat and sugar[40], and worsening obesity in youth. High-fat diets induce obesity in mice by altering synaptic plasticity in the hippocampus[41,42], whereas behaviors akin to depression and chronic stress are associated with impaired neuronal plasticity in areas such as the prefrontal cortex and hippocampus[43]. Disordered eating, especially binge eating (BE) disorders, is prevalent among obese children[44], and is linked to depression, anxiety, and poor treatment outcomes[45]. Adhering to PA and a mediterranean diet during pregnancy benefits maternal and child health, reduces the risk of premature birth and childhood obesity, and enhances mental well-being[46].

Inadequate sleep in young people is correlated with obesity, which is linked to hormonal disruptions that increase appetite and affect brain structure[47]. Moreover, insomnia is linked to stress, low mood, and depressive symptoms[48], potentially due to disruptions in brain chemicals and increased stress hormone release[49]. Balanced-related behavior highlights the importance of behavior modification to prevent or mitigate ODCA, a focal point in modern medical and psychological research.

The potential role of key adipocytokines and lipokines in ODCA: Adipose tissue and adipocytes are pivotal for both energy storage and the secretion of adipokines and lipokines, which are essential for regulating energy balance. They are integral components of the endocrine system. Recent research highlights their influence on mental health, particularly in depression and anxiety regulation, although the exact mechanisms are not fully understood[50]. Adipocyte-secreted adipokines may play a crucial role in traversing the blood-brain barrier, potentially establishing a physiological link between depression and obesity[51]. Leptin reduces appetite and regulates body weight and insulin secretion[52]. Studies have shown that maltreated children have blunted leptin responses, possibly due to stress and inflammation[53]. Adverse family environments in young individuals are correlated with obesity and altered hormone levels[54]. Interventions such as spirulina administration during adolescence have shown promise in modulating leptin levels in the brain, thereby potentially alleviating anxiety-like and depressive-like behaviors stemming from chronic high-fat intake[55]. Adiponectin enhances insulin sensitivity and reduces inflammation, crossing the blood-brain barrier to impact stress responses[33]. Research in adults suggests an inverse correlation between self-reported adverse family environments during early life and adiponectin levels in adulthood[56], with protective family environments linked to beneficial adiponectin characteristics in children[57].

The potential role of inflammation in ODCA: Obesity triggers the release of proinflammatory cytokines from adipocytes and macrophages that cross the blood-brain barrier, inducing neuroinflammation[58]. Inflammatory markers such as interleukin (IL)-1β, IL-6, IL-2, and tumor necrosis factor-α contribute to the adverse effects of obesity and are linked to depression[59-61]. Social stressors can lead to increased C-reactive protein levels in children[62]. Prenatal environmental adversity affects neurodevelopment through induced inflammation[63], which can be mitigated by anti-inflammatory diets[64]. A comprehensive understanding of these factors is crucial for elucidating the pathogenesis of ODCA and their importance in its prevention and treatment.

The impact of inequality in ODCA: Low socioeconomic status and food insecurity unfairly impact children's health, leading to overweight/obesity and depression. COVID-19 pandemic stressors further affect the mental health of young individuals in disadvantaged areas. Income disparity has widened due to the pandemic, influencing obesity rates, especially among the socioeconomically disadvantaged individuals[65,66]. Obesity leads to the risk of social exclusion



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Top 25 references with the strongest citation bursts

References	Year	Strength	Begin	End	2004 - 2023
Goodman E, 2002, PEDIATRICS, V110, P497, DOI 10.1542/peds.110.3.497, DOI	2002	11.57	2004	2007	
Schwimmer JB, 2003, JAMA-J AM MED ASSOC, V289, P1813, DOI 10.1001/jama.289.14.1813, DOI	2003	9.45	2004	2008	
Ogden CL, 2002, JAMA-J AM MED ASSOC, V288, P1728, DOI 10.1001/jama.288.14.1728, DOI	2002	6.7	2004	2006	
Eisenberg ME, 2003, ARCH PEDIAT ADOL MED, V157, P733, DOI 10.1001/archpedi.157.8.733, DOI	2003	6.29	2004	2008	
Erermis S, 2004, PEDIATR INT, V46, P296, DOI 10.1111/j.1442-200x.2004.01882.x, DOI	2004	6.76	2005	2009	
Ogden CL, 2006, JAMA-J AM MED ASSOC, V295, P1549, DOI 10.1001/jama.295.13.1549, DOI	2006	11.75	2007	2011	
Anderson SE, 2006, ARCH PEDIAT ADOL MED, V160, P285, DOI 10.1001/archpedi.160.3.285, DOI	2006	6.93	2007	2011	
Franko DL, 2005, PSYCHOL MED, V35, P1505, DOI 10.1017/S0033291705005386, DOI	2005	7.46	2008	2010	
Ogden CL, 2008, JAMA-J AM MED ASSOC, V299, P2401, DOI 10.1001/jama.299.20.2401, DOI	2008	10.37	2009	2013	
Herva A, 2006, INT J OBESITY, V30, P520, DOI 10.1038/sj.ijo.0803174, DOI	2006	6.73	2009	2011	
Anderson SE, 2007, PSYCHOSOM MED, V69, P740, DOI 10.1097/PSY.0b013e31815580b4, DOI	2007	6.21	2009	2011	
Blaine B, 2008, J HEALTH PSYCHOL, V13, P1190, DOI 10.1177/1359105308095977, DOI	2008	6.57	2010	2013	
Luppino FS, 2010, ARCH GEN PSYCHIAT, V67, P220, DOI 10.1001/archgenpsychiatry.2010.2, DOI	2010	15.62	2011	2015	
Ogden CL, 2010, JAMA-J AM MED ASSOC, V303, P242, DOI 10.1001/jama.2009.2012, DOI	2010	10.57	2011	2014	
Belue R, 2009, PEDIATRICS, V123, P697, DOI 10.1542/peds.2008-0687, DOI	2009	6.41	2011	2014	
Ogden CL, 2012, JAMA-J AM MED ASSOC, V307, P483, DOI 10.1001/jama.2012.40, DOI	2012	15.42	2013	2017	
**AmericanPsychiatricAssociati ..... al of mental disorders, V0, P0, DOI	2013	9.28	2014	2018	
Ogden CL, 2014, JAMA-J AM MED ASSOC, V311, P806, DOI 10.1001/jama.2014.732, DOI	2014	16.42	2015	2019	
Sonneville KR, 2013, JAMA PEDIATR, V167, P149, DOI 10.1001/2013.jamapediatrics.12, DOI	2013	7.51	2015	2018	
Ogden CL, 2016, JAMA-J AM MED ASSOC, V315, P2292, DOI 10.1001/jama.2016.6361, DOI	2016	9.07	2017	2019	
Rankin J, 2016, ADOLESC HEALTH MED T, V7, P125, DOI 10.2147/AHMT.S101631, DOI	2016	7.05	2018	2021	
Ezzati M, 2017, LANCET, V390, P2627, DOI 10.1016/S0140-6736(17)32129-3, DOI	2017	9.24	2019	2023	
Quek YH, 2017, OBES REV, V18, P742, DOI 10.1111/obr.12535, DOI	2017	9.24	2019	2023	
Skinner AC, 2018, PEDIATRICS, V142, P0	2018	7.28	2019	2023	
Lindberg L, 2020, BMC MED, V18, P0, DOI 10.1186/s12916-020-1498-z, DOI	2020	6.54	2021	2023	

Figure 6 Reference analysis from 2004 to 2023. A: Clustering map of co-cited references; B: A timeline view of the top 15 largest clusters of co-cited references; C: Analysis of the top 25 references with the strongest citation bursts.

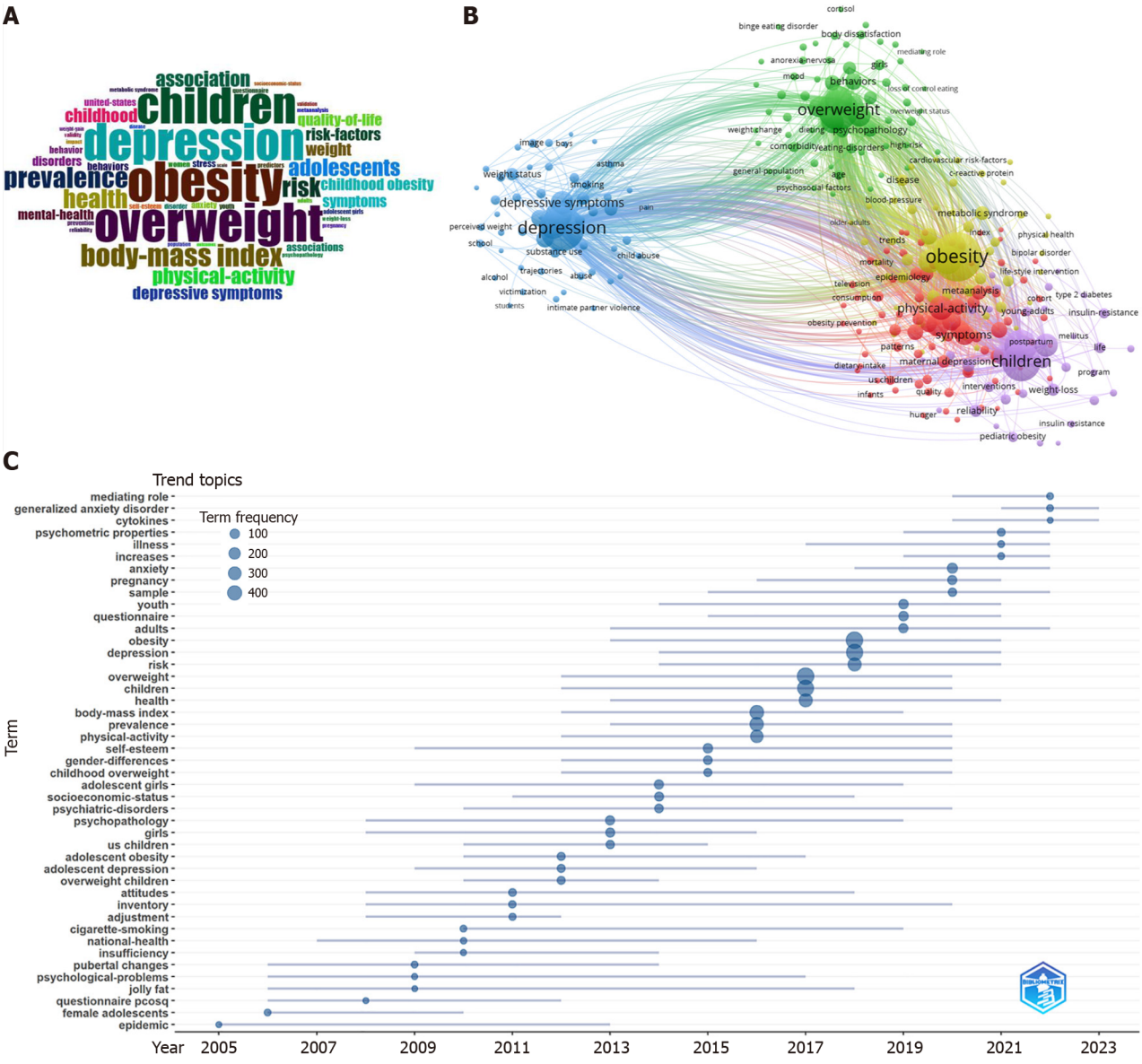

Figure 7 Keyword analysis from 2004 to 2023. A: Word cloud of relevant keywords; B: Clustering analysis of high-frequency keywords; C: Analysis of the keyword trend topics.

and depression risk[67]. Food insecurity causes psychological stress, anxiety, and unhealthy eating, which often coexist with obesity[68,69]. It is also correlated with a higher pregnancy BMI[70]. Targeted intervention and prevention strategies are imperative to address these disparities, fostering advancements in children's dietary well-being, and bolstering their mental health and overall quality of life.

The impact of adverse childhood experiences on ODCA: Adverse childhood experiences (ACEs), including ridicule, bullying, discrimination, and abuse in family or school settings, can trigger eating disorders such as BE, affecting weight control[71]. Children and adolescents with overweight/obesity often face ridicule and bullying, leading to social exclusion and discrimination, which impact their mental health by increasing their vulnerability to anxiety and depression[72]. Gender differences are evident in the relationship between obesity and bullying, with obese boys relying on physical strength and obese girls being primary targets of peer victimization[73]. Moreover, a history of childhood maltreatment increases susceptibility to major depressive disorder (MDD), particularly among females[74]. Childhood sexual abuse also correlates with higher adult obesity rates, potentially influenced by disruptions in the HPA axis and cortisol levels[75,76]. Conversely, social support acts as a protective factor, buffering against the adverse impacts of depression by providing emotional solace and alleviating external pressures[77]. These findings underscore the long-term impact of ACEs on health, particularly in terms of mental health and weight management.

The comorbidities associated with ODCA: ODCA can lead to various comorbidities, such as anxiety, ADHD, insulin resistance, metabolic syndrome, CVD, and hypertension[78]. Mental disorders frequently accompany overweight/obesity in young individuals[79,80]. BE significantly contributes to overweight/obesity and is linked to anxiety[45]. ADHD is more common in overweight/obese children and adolescents compared to those who are normal-weight[81]. Surveys

have revealed that among overweight/obese children and adolescents, 42.5% have ADHD, 31.3% have anxiety disorders, and 24.3% have depression[78]. ADHD has been identified as a risk factor for childhood and adolescent overweight/obesity, whereas anxiety and depression are considered intermediate factors in the ADHD-obesity relationship[82]. Managing ADHD in young people requires attention to emotional issues to prevent overweight/obesity. Chronic low-grade inflammation in overweight/obesity can lead to insulin resistance and metabolic syndrome[62]. Obese children who are metabolically unhealthy have a lower quality of life and experience higher levels of depression and stress compared to metabolically healthy obese children[83]. Early screening for metabolic syndrome in children is crucial to prevent its development and mitigate its impact on mental health and quality of life[84]. A study of children and adolescents with MDD revealed that 25% had prehypertension (14%) or hypertension (11%), and over half (52%) had at least two CVD risk factors[85], underscoring the need for routine cardiovascular screening in this group to detect and prevent future CVD[86,87].

The primary strength of this study lies in its integrated quantitative and qualitative approach, which uses visual maps and detailed data to depict the research findings in the field. This strategy facilitates a rapid understanding of the current status of ODCA research, facilitates collaboration, and provides valuable insights into current research trends and emerging frontiers for relevant researchers. This study has several limitations: (1) It focused solely on co-citation diagrams from the SCI-E dataset in WoSCC, excluding data from databases such as PubMed and Embase; (2) It also only considered English articles, potentially limiting the findings; and (3) Publication bias may have influenced the results due to researchers' tendency to publish positive outcomes in specific journals. Despite increased publications in this field, the overall quantity remains limited. However, we have gathered enough publications to offer a representative overview. Future research should minimize these constraints for a more comprehensive analysis.

CONCLUSION

Research on ODCA has recently become a hot topic, with the number of articles increasing annually. The United States has been a prominent nation in the ODCA field. However, there is an imbalance in the collaboration distribution among different countries/regions. Currently, international collaboration and exchange are primarily concentrated among high-income countries. Moreover, emerging nations such as China and India have demonstrated potential for development. In the future, fostering diversity in international collaboration will have a positive impact on advancing the global ODCA domain of academia. Additionally, we predict that exploring the impact of balanced-related behavior and complex biological mechanisms of ODCA will become frontier topics. This research can help offer a more comprehensive understanding of the present hotspots, and to provide deeper scientific basis for future prevention and treatment strategies.

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FOOTNOTES

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P-Editor: Yu HG

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