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Visualization Analysis of International Adolescent Obesity Intervention Status: A Study Based on Vosviewer

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Abstract. Objective: To systematically analyze the current status, hotspots, and trends in international adolescent obesity intervention research from 2018 to 2025, aiming to provide theoretical reference for related research in China. Methods: Based on the Web of Science Core Collection database, a total of 1300 articles published between January 1, 2018, and July 31, 2025, were retrieved. vosviewer software was used to conduct visual analysis of countries, institutions, authors, and keywords. Results: (1) The publication output in adolescent obesity intervention research remained relatively stable, consistently representing a hot topic in public health. (2) The main research outputs primarily originated from North America, Europe, and China, with the United States occupying a central position in this field, having established a comprehensive research network. Its domestic research institutions demonstrated outstanding achievements and close collaboration. (3) Keyword analysis revealed that adolescent obesity intervention in recent years has shown a pattern of deepening traditional intervention models alongside empowerment by emerging digital technologies, with traditional methods and mobile health devices integrating symbiotically. (4) "Physical activity" appeared with the highest frequency in keyword analysis, serving as an effective intervention method through three pathways: improving body composition, regulating endocrine function, and positively impacting mental health. (5) There is a need to build international research networks in this field, establish long-term collaboration platforms, focus on special populations, regional disparities, and potential negative impacts of interventions, and deepen the integration of traditional models with new digital technologies.

Keywords: Obesity, Adolescent, Intervention, Visualization

1. Introduction

In recent years, the global rate of adolescent obesity has continued to rise, posing a severe international public health challenge. According to a survey cited by the World Health Organization and the NCD Risk Factor Collaboration, the number of obese adolescents worldwide increased from 31 million in 1990 to 160 million in 2022 [1]. A study in The Lancet indicated that in many countries, including the United States, obesity and obesity-related diseases have led to a continuous increase in mortality rates among the 15-69 age group [2]. Another study pointed out that the incidence of type 2 diabetes is rising significantly among adolescents and young adults globally,

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with the adolescent obesity epidemic being the primary risk factor driving this trend [3]. Facing this challenge, developed countries have begun to focus on obesity intervention. The U.S. Centers for Disease Control and Prevention initiated the "Adolescent Healthy Weight Program" in 2020, resulting in a 5.2% decrease in adolescent overweight rates; the UK government implemented a "sugar tax" starting in 2018, leading to a 31% reduction in high-sugar beverage consumption among adolescents; the European Union listed curbing childhood obesity as a priority action area under the "Healthy Europe 2030" framework. In contrast, the situation regarding adolescent obesity prevention and control in China is also concerning and exhibits unique characteristics. The 2020 Report on Chinese Adolescent Health indicated that the obesity rate among 7-18 year-olds is close to 20%, with the annual growth rate of obesity in rural areas significantly higher than in urban areas [4], highlighting regional disparities in the occurrence and intervention of obesity and underscoring the urgency of intervention. To actively address this issue, China's National Health Commission proposed the first three-year Weight Management Year Plan in 2025, aiming to curb the rapid rise in adolescent obesity rates through multiple measures including health education, dietary guidance, exercise intervention, and key population management. However, current research on adolescent obesity intervention, both domestically and internationally, still has several limitations: firstly, research findings are fragmented, making it difficult for traditional literature reviews to integrate data from multiple disciplines such as medicine, psychology, and sociology; secondly, research exhibits a lag, lacking real-time grasp of rapidly emerging frontier hotspots. Given this, to comprehensively understand existing research and clarify future research directions, this study utilizes vosviewer software to conduct a visual analysis of 1300 international publications from 2018-2025, analyzing the publication volume, publishing institutions, research subjects, practical methods, and intervention strategies in international adolescent obesity intervention research during this period, thereby expanding perspectives and providing references for global adolescent obesity intervention research.

2. Research methods

The literature used in this study was sourced from the Web of Science (WoS). Due to its authority, comprehensiveness, standardization, structured data, and broad academic influence, the WoS core journal database was selected as the data source. The search period was from January 1, 2018, to July 31, 2025, and the literature type was limited to articles. The search strategy was (All Fields: obesity) AND (All Fields: intervention) AND (All Fields: adolescent). After screening, 1300 articles were retrieved. Based on these 1300 articles, this study used vosviewer software to collect textual data from the literature on international adolescent obesity intervention status research from 2018 to 2025. vosviewer, a knowledge mapping tool developed by researchers Nees Jan van Eck and Ludo Waltman from the Centre for Science and Technology Studies (CWTS) at Leiden University, was used for visual analysis. The literature from Web of Science was imported into vosviewer in text format. Analysis was conducted using filtering methods such as "Author," "Author Keywords," "Organization," and "Country." The minimum number of occurrences for keywords was set to 25, and synonyms were filtered to ensure map readability and the focused presentation of core information, obtaining key details such as researchers, organizations, nationalities, links between countries and organizations, and frontier hotspots in international adolescent obesity intervention research.

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3. Results and analysis

3.1. Analysis of publication volume in international adolescent obesity intervention research

Annual publication volume is an important indicator measuring the research activity and development trends in a specific field; the publication volume reflects the overall situation and changing trends in international adolescent obesity intervention research in recent years. As shown in Figure 1, from 2018 to 2025, research activity in this field remained generally stable, showing a relatively clear trend of "first rising then falling." Specifically, the annual publication volume began to grow steadily from 2018, peaking at 198 articles in 2020, indicating a continuous increase in global attention to adolescent obesity intervention during this phase. After 2020, the publication volume declined year by year, a change likely closely related to the global outbreak of the COVID-19 pandemic. Nevertheless, the overall publication volume remained at a relatively high level, indicating that the international community consistently views adolescent obesity intervention as an important issue in public health and health promotion. During this period, numerous research teams and scholars continued to invest efforts in this field, constantly producing research results with theoretical and practical value, reflecting the complexity and long-term nature of the adolescent obesity problem and the gradual maturation of interdisciplinary collaboration mechanisms.

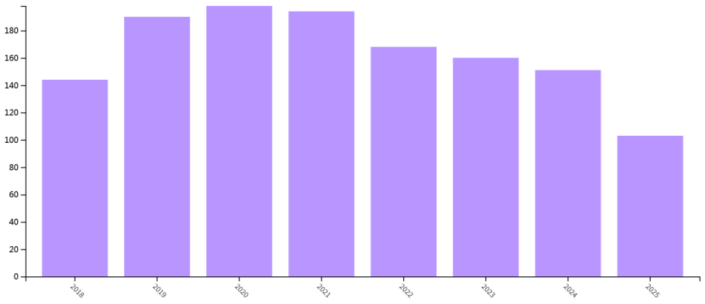

Figure 1. Publication volume in international adolescent obesity intervention research (2018-2025)

3.2. Global landscape of international adolescent obesity intervention research

Countries with high publication volumes often indicate higher research activity and are an important manifestation of innovation and technological development in that field within the country. Through statistical analysis of the national publication volume in adolescent obesity intervention research globally from 2018 to 2025 (Figure 2), the level of research investment and academic influence of different countries in this field can be clearly discerned. Figure 2 shows that from 2018 to 2025, the United States (USA) performed prominently in international adolescent obesity intervention research, publishing 608 articles during this period, accounting for nearly 47% of the total publications, far exceeding other countries. This fully demonstrates the global core status of the United States in this field, with its absolute advantages in public health research investment, the number of top academic institutions such as Duke University, Harvard University, and Johns Hopkins University (Figure 3), and its interdisciplinary collaboration network, making it the primary contributor to knowledge output in this area.

Australia, China (Peoples R China), and the United Kingdom (England) formed the second tier in terms of publication volume. Among them, China's outstanding performance in recent years is

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particularly noteworthy, with its publication volume closely following the UK. This indicates that China's research focus and investment in adolescent health issues have been unprecedented in recent years, with rapid advancement in research capabilities, making it an important force in this field. Traditional research powerhouses like Australia and the UK maintained stable and high-level research output. Australia, China, and the UK ranked second, third, and fourth, respectively. The publication volume of these four countries exceeded 100 articles from 2018 to 2025.

Brazil, Germany, Canada, Spain, the Netherlands, and Italy constituted the third tier. Their publication volume, while not matching the first two tiers, still held significant weight. Particularly, Brazil, as a developing country, provides valuable cases for obesity intervention applications within the socioeconomic contexts of developing nations through its research findings.

The dominant forces in international adolescent obesity intervention research are highly concentrated in North America, Western Europe, and East Asia (China). This distribution is closely related to the economic strength, research investment, and public health policies of these countries. It fully demonstrates the high level of importance and massive investment placed on global health research by the United States, Australia, the United Kingdom, China, and others.

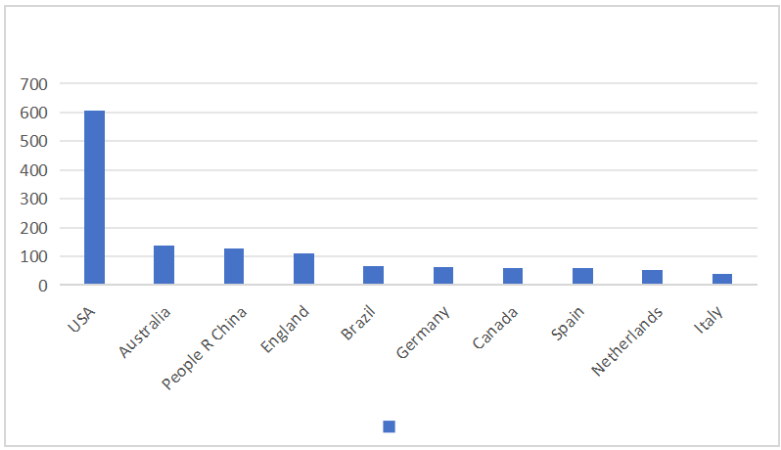

Figure 2. Publication volume by country in international adolescent obesity intervention research

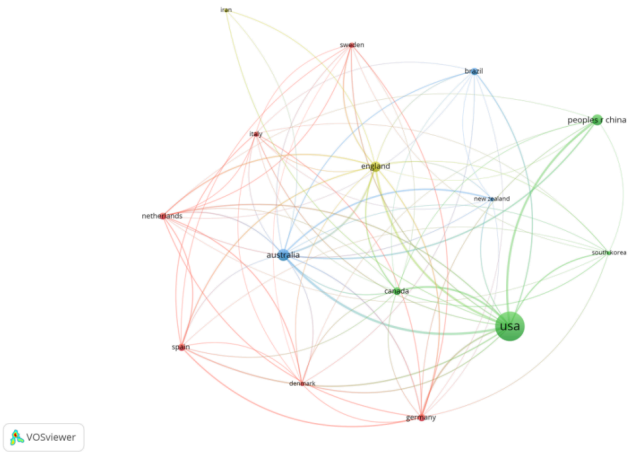

Figure 3. Countries and collaboration density in international adolescent obesity intervention research publications

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3.3. Institutional distribution in international adolescent obesity intervention research

Research has indicated that statistical analysis of research institutions can provide crucial information references for government policymakers and science and technology management departments, facilitating policy formulation and optimizing research resource allocation. Therefore, the 1300 articles were imported into vosviewer. After running the software, maps were generated, resulting in charts showing institutional publication volume and connection density (Figure 4). In the figure, node size signifies the publication count of an institution, while connecting lines between nodes indicate inter-institutional links, with line thickness representing the closeness of collaboration.

As seen in Figure 4, during 2018-2025, the institution with the highest number of publications in international adolescent obesity intervention research was the University of Sydney, reaching 45 articles. This high output aligns closely with Australia's global ranking as the second-largest contributor by publication volume in this field, fully reflecting the University of Sydney's deep accumulation, sustained research investment, and professional leading position in adolescent health intervention research. Furthermore, the vosviewer-generated chart shows that U.S.-based research institutions such as the University of Pennsylvania, Children's Hospital of Philadelphia, Johns Hopkins University, Stanford University, and Harvard University all held high publication volumes and collaborated closely, forming multiple highly productive and interconnected research clusters. These tight inter-institutional links generated significant synergistic effects: promoting the flow and sharing of core knowledge, key technologies, and talented personnel, thereby enhancing research efficiency and innovation capacity. In contrast, Peking University, which also ranked among the top globally in publication volume, showed relatively fewer and weaker direct collaborative links with international leading institutions, particularly those in North America, in the collaboration map, having only a weaker link with the University of Melbourne. The University of Sydney, ranked first globally in publication volume, faced a similar issue. This relatively isolated collaborative status might, to some extent, limit the influence of their research, preventing deep integration into the most cutting-edge global academic research networks like the U.S. institutional clusters. For top Chinese institutions like Peking University, while maintaining high output, they should proactively seek and deepen cooperation with these international core research networks, establishing equal partnership relations.

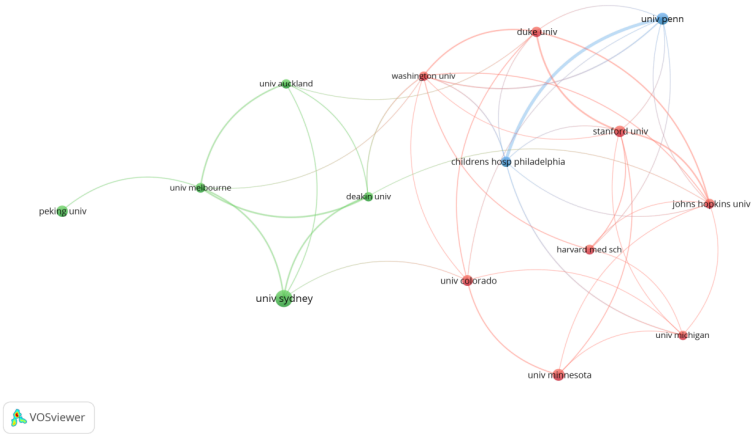

Figure 4. Publishing institutions and collaboration density in international adolescent obesity intervention research

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3.4. Keyword analysis in international adolescent obesity intervention research

Analyzing the frequency of keywords related to research directions can help track research hotspots and frontier trends in a field, analyze changes in research hotspots from 2018 to 2025, and predict future research directions. According to Figure 5, the research focus in this field centers on "physical activity," "overweight," "weight loss," "mhealth," "prevention," "nutrition," among others. Among these, physical activity, weight loss, mhealth, and nutrition appeared with the highest frequencies and had the strongest connections with other keywords; emerging digital health technologies like mhealth began to appear frequently in recent years. Based on this, adolescent obesity interventions can be categorized into two main types: the deepening of traditional intervention models and the integration and innovation of digital health technologies.

3.4.1. Deepening of traditional intervention models

Keywords such as "physical activity," "weight loss," and "nutrition" constitute the most fundamental research cornerstone of this field. This type of research, having undergone long-term development, has formed a relatively complete theoretical system and practical pathway, but its connotations continue to deepen. Firstly, intervention settings have shifted from single to diverse. Early research often focused on single settings, whereas current research increasingly emphasizes multi-setting coordinated interventions. The high-frequency appearance of keywords like "family," "school," and "parenting" demonstrates the diversification of intervention settings in recent years. Secondly, intervention goals have shifted from weight loss to health. The high-frequency appearance of keywords like "mental health" and "depression" indicates a certain shift in research focus towards adolescent mental well-being. Successful interventions aim to promote the comprehensive physical and mental health development of adolescents, avoiding psychological trauma and other issues caused by inappropriate weight loss measures.

3.4.2. Integration, innovation, and empowerment of digital health technologies

Keywords centered around "mhealth" represent the most active frontier direction in this field. Digital technology does not replace traditional models but serves as a tool to empower traditional research methods. Digital mHealth tools can enhance the dynamism and personalization of interventions; digital platforms can provide multi-dimensional real-time data. By combining artificial intelligence and machine learning algorithms, researchers can predict individual weight change trends and intervention risks, thereby enabling dynamic adjustment and optimization of intervention plans.

In summary, traditional intervention models and emerging digital technologies are not fragmented or opposed but show a trend of integration and symbiosis. The optimal intervention strategy involves the organic combination of traditional intervention methods and digital technologies, i.e., leveraging digital technology tools based on nutrition and exercise science to achieve personalized and sustainable interventions for adolescent obesity.

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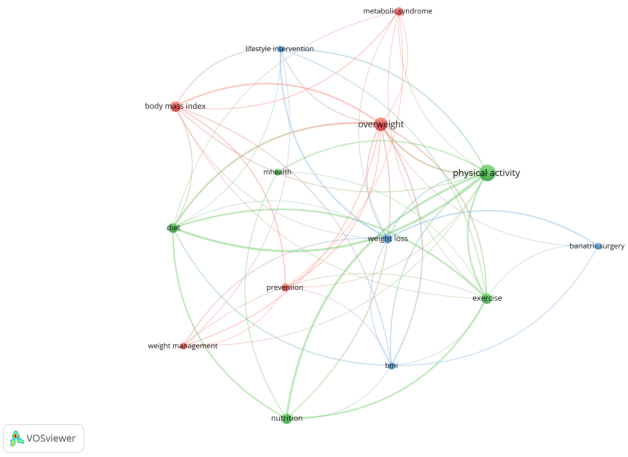

Figure 5. Keyword co-occurrence map in international adolescent obesity intervention research (2018-2025)

4. Discussion

4.1. General overview

Within the field of adolescent obesity intervention research, the United States occupies the core position of the research network with an absolute advantage; this dominant position results from the combined effect of its domestic high obesity rates and its globally leading scientific research and public health capabilities.

Firstly, the adolescent obesity problem in the United States is extremely severe, constituting a major public health crisis. According to CDC data, the obesity rate among its 12-19 year-old exceeds 20%, significantly higher than the average in many developed countries [5]. This high obesity rate is influenced by its socio-economic and cultural environment: the dietary structure is highly industrialized, with deeply processed foods high in sugar, fat, and salt holding a large market share; physical activity levels among adolescents are generally insufficient due to academic pressure and lifestyle habits; socio-economic inequality is prominent, with low-income and communities of color bearing a particularly heavy obesity burden. Therefore, obesity in the U.S. is a complex issue encompassing food industrialization, urban ailments, and social equity. This complexity makes the demand for research in this field particularly acute. Secondly, the United States possesses the world's top-tier research network for addressing obesity. Its strong economic capacity supports the world's highest social healthcare expenditure; simultaneously, a large number of world-class research institutions and talent, such as Duke University, Harvard University, Johns Hopkins University, and the Children's Hospital of Philadelphia, form a complete research network spanning from traditional intervention models to public health policies and new digital technology research. This positive cycle between demand and supply establishes the U.S. as the core producer of research outcomes in this field. In contrast, while European developed countries face similar obesity challenges, their overall research scale still lags behind the U.S.; and although adolescent obesity rates in China and other developing countries are rising rapidly, their not yet fully mature research and public health networks, coupled with complex social conditions, create a gap compared to the U.S.

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4.2. Physical activity and obesity intervention

The keyword analysis in this paper showed that "physical activity" is one of the core keywords with the highest frequency and strongest connections, confirming the important role of exercise in adolescent obesity intervention. Its scientific basis primarily stems from the principle of energy balance: the essence of obesity is a long-term energy intake exceeding expenditure, and regular physical activity is the most direct and controllable way to increase energy expenditure. Modern medical research on the mechanisms of exercise for weight loss mainly focuses on three aspects: First, improving body composition. Exercise, particularly resistance training, not only consumes fat but also increases lean body mass (muscle mass), and muscle is a primary determinant of basal metabolic rate [6]. Increasing muscle mass means the individual consumes more energy even at rest, thus fostering a "lean-prone constitution" conducive to long-term weight maintenance. Second, regulating endocrine function and appetite. A review published in 2023 indicated that exercise can suppress ghrelin and increase the secretion of satiety hormones like glucagon-like peptide-1 (GLP-1) and peptide YY (PYY), aiding in better appetite control and reducing energy intake at the source [7]. Third, positive impacts on mental health. Exercise alleviates stress and improves mood through mechanisms such as increasing brain-derived neurotrophic factor (BDNF) and regulating hypothalamic-pituitary-adrenal (HPA) axis function, thereby reducing emotional eating, a significant behavioral factor contributing to obesity [8].

4.3. Emerging obesity intervention models

The integration of digital health technologies has fundamentally transformed traditional obesity intervention methods. The core advantages of mHealth interventions lie in their real-time nature, scalability, personalization, and precision. Through smartphone apps, wearable devices, etc., interventions can transcend time and space limitations, enabling all-day health behavior monitoring, real-time feedback, and personalized guidance. The introduction of artificial intelligence goes a step further, allowing systems to dynamically adjust based on users' real-time data (e.g., activity levels, dietary records), achieving personalized intervention.

5. Conclusion

Adolescent obesity receives high international attention and has remained a hot topic in the global health field in recent years. Publication volume in this field is led by the United States, followed closely by Australia, China, and the United Kingdom, with developing countries like Brazil showing annual increases, presenting a clear "core-periphery" distribution pattern. The United States holds the core position in the research network with an absolute advantage (608 articles, 47%); Australia, China, and the UK, as the second tier, show a continuous growth trend, with China, in particular, achieving rapid catch-up; developing countries like Brazil, while limited in total volume, provide important cases for intervention strategies in diverse cultural contexts. Furthermore, collaboration networks among high-output institutions show significant imbalance, with U.S. institutions forming tight cooperative networks, while non-North American institutions like the University of Sydney and Peking University exhibit noticeably insufficient international collaboration intensity. Research hotspots in international adolescent obesity intervention primarily focus on "physical activity," "overweight," "weight loss," "mhealth," "prevention," "nutrition," etc. These can be divided into two main aspects: the deepening of traditional intervention models and the integration, innovation, and empowerment of digital health technologies. On one hand, traditional intervention models continue

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to deepen, shifting from single-setting interventions to multi-dimensional "school-family-community" collaborative settings, and expanding from solely focusing on weight control to comprehensively enhancing mental health and quality of life. On the other hand, digital health technologies bring revolutionary changes, with mHealth, wearable devices, and AI technology deeply integrating with traditional intervention models, enabling real-time monitoring and dynamic adjustment of the intervention process. The two directions show a trend of integration and symbiosis, i.e., leveraging digital technology tools based on nutrition and exercise science to achieve personalized and sustainable interventions for adolescent obesity.

6. Prospects and limitations

6.1. Prospects

Strengthen the construction of international collaboration networks. It is recommended that research institutions in China, Australia, and other countries proactively enhance cooperation with research teams in North America and Europe, establish long-term stable international collaboration platforms, and conduct cross-cultural comparative studies to explore the adaptability and effectiveness of intervention strategies under different socio-economic and cultural backgrounds.

Focus on special populations and regional disparities. Future research should pay more attention to the intervention needs of rural areas, low-income groups, and adolescents from different cultural backgrounds such as ethnic minorities, designing culturally sensitive intervention plans tailored to local conditions and individual circumstances.

Deepen the integration and innovation of digital technologies with traditional intervention models. Further explore and develop the role of digital technologies like artificial intelligence and big data analytics in obesity intervention, developing intelligent and personalized therapies.

Emphasize research on the potential negative effects of interventions. Future work needs to focus on risks that interventions might bring, such as psychological stress and eating disorders, ensuring that interventions promote the physical and mental health development of adolescents while controlling weight.

6.2. Limitations

The research data in this paper all originate from literature in the WoS core journal database, potentially missing important findings published in other databases, and the data type is relatively singular; additionally, the source literature is all in English, which may introduce biases related to research perspective and culture.

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