

Investigating The Relationship between Body Mass Index and Type 2 Diabetes in Adolescents: A Narrative Review

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Abstract

In recent years, there has been a significant increase in obesity rates among children and adolescents, leading to a corresponding rise in type 2 diabetes cases within this age group. Body mass index (BMI) is a key measure for assessing obesity and is closely linked to various metabolic disorders, including diabetes. This narrative review examines the relationship between BMI and the onset of type 2 diabetes in young individuals. Evidence shows that high BMI levels, particularly those indicating obesity or severe obesity, are significant and independent risk factors for developing type 2 diabetes in pediatric populations. Factors such as insulin resistance, genetic predisposition, and lifestyle behaviors also contribute to this association. These findings emphasize the critical need for preventive strategies, early detection, and effective weight management among children and adolescents.

Key Words: Adolescents, Body mass index, Type 2 diabetes.

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1- INTRODUCTION

Type 2 diabetes is a chronic and complex metabolic disorder characterized by elevated blood sugar levels caused by both insulin resistance and insufficient insulin production. While this condition was once primarily seen in adults (1). Changes in lifestyle, such as increasing obesity rates, decreased physical activity, and poor dietary habits have led to a rise in cases among children and teenagers. As a result, type 2 diabetes is no longer considered an adult-only illness but has become a significant health concern for younger populations (2).

The increasing number of type 2 diabetes diagnoses in adolescents, especially among groups with higher obesity rates or genetic predispositions, presents a major public health issue. Often, the diagnosis in young people is delayed because symptoms develop gradually, and there is limited awareness among families, increasing the risk of severe long-term complications (3).

Early onset of type 2 diabetes significantly raises the chances of developing chronic health problems in adulthood, such as heart disease, kidney damage, and vision disorders. Additionally, there is a well-established connection between childhood obesity and the rise in type 2 diabetes cases among young individuals (4). A high body mass index (BMI) during the developmental years can lead to metabolic issues like insulin resistance and abnormal glucose metabolism. BMI, calculated by dividing a person's weight by the square of their height (5). It is commonly used to assess body weight status. Although BMI does not directly measure body fat, it remains an important tool for evaluating the risks associated with being overweight and obesity (6).

In recent years, the link between BMI and the onset of type 2 diabetes during adolescence has become a key focus of scientific research. This relationship is

significant because many adolescents with type 2 diabetes exhibit insulin resistance before their diagnosis, resulting in ongoing high blood sugar levels and disease progression (7). The prevalence of obesity in children and teenagers is influenced by various factors, including sedentary lifestyles, unhealthy eating habits, psychological stress, and hormonal changes (8). Therefore, implementing targeted interventions during these critical periods is essential for preventing type 2 diabetes. Early prevention efforts are crucial as they can reduce the risk of long-term health complications later in life (9).

Recognizing the importance of this issue, our research examined the relationship between body mass index and the development of type 2 diabetes in children and adolescents. The study aims to compile existing research findings and highlight the need for preventive strategies in this age group, particularly focusing on weight management and increased physical activity. Given the rising incidence of type 2 diabetes and its significant impact on both individual and public health, it is vital to thoroughly investigate risk factors, diagnostic methods, treatment options, and preventive measures tailored for younger populations. Therefore, this article seeks to assess and interpret the impact of body mass index on the development of type 2 diabetes among youth, to enhance our understanding of this complex health issue and discuss effective strategies for its prevention and management.

2- METHODS

2-1. Search Strategy

A comprehensive literature search was conducted using established databases, including PubMed, Scopus, Google Scholar, SID, and ScienceDirect. Various combinations of keywords like "body mass index," "type 2 diabetes," "children," and "adolescents" were used in

different queries. The inclusion criteria were articles published in peer-reviewed scientific journals in English and Persian between 2019 and 2025.

2-2. Article Selection Criteria

Studies were selected based on the following criteria: Study design—cross-sectional, longitudinal, or experimental investigations exploring the relationship between body mass index and type 2 diabetes among pediatric and adolescent

populations. Age range—only studies involving participants aged 6 to 16 years were considered for inclusion.

2-3. Exclusion Criteria

The study excluded articles that were non-scientific or unverified, articles presenting only single-sentence data without comprehensive analysis, and studies investigating the relationship between BMI and type 2 diabetes in age groups other than children and adolescents.

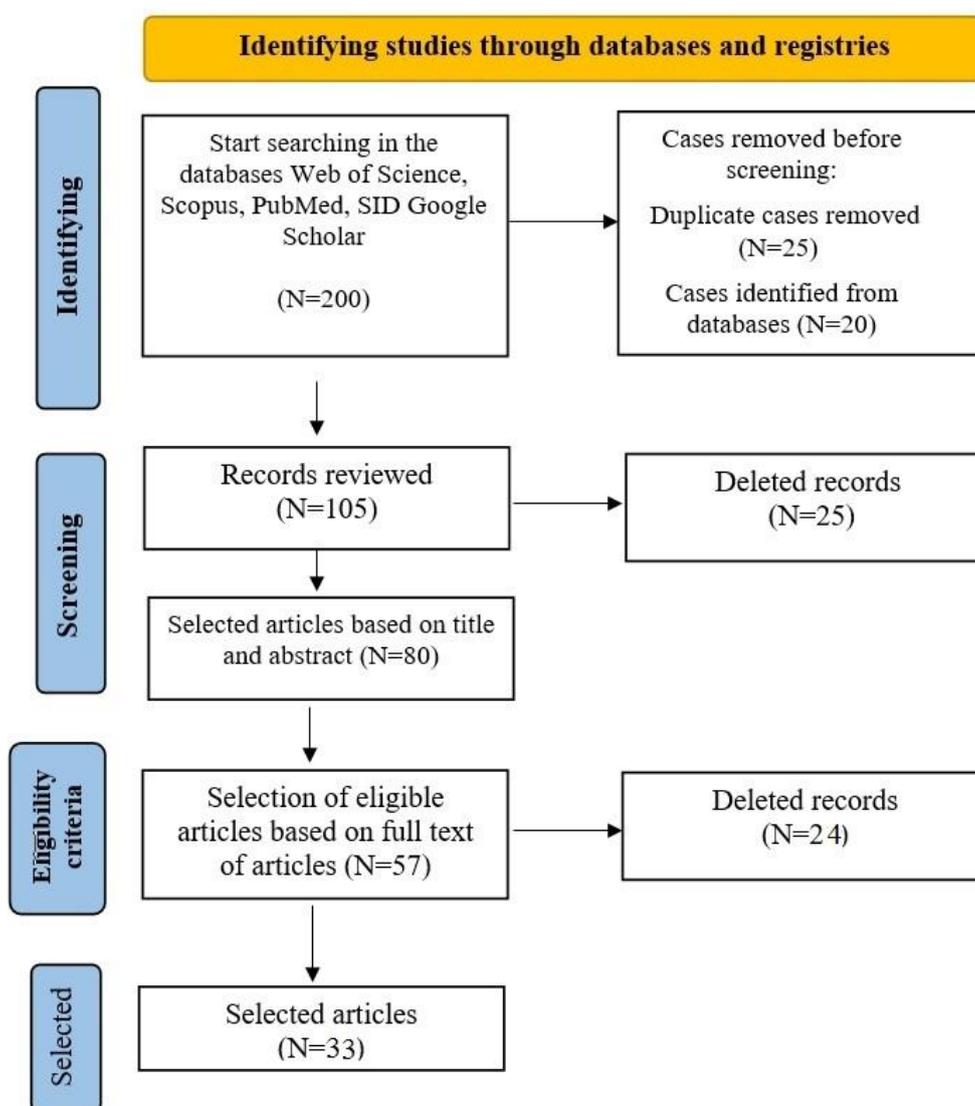


Figure-1. article search flowchart (10).

2-4. Data Extraction

Data collected from each article included demographic variables such as age, sex, nutritional condition, level of physical activity, and overall health status; criteria and methods used to define and assess BMI across studies; reported prevalence of type 2 diabetes within various BMI categories; and synthesis and evaluation of findings regarding the relationship between BMI and type 2 diabetes, through comparative analysis of study outcomes.

2-5. Data Analysis

A descriptive approach was used to evaluate the data, involving comparing findings across studies, assessing general patterns, and identifying variables like gender, age, physical activity, and dietary habits that could influence this relationship.

2-6. Study Quality Assessment

The quality of each study was evaluated based on established criteria. Instruments like the Critical Appraisal Skills Program checklists and the Strengthening the Reporting of Observational Studies in Epidemiology guidelines were used to appraise the quality of both cross-sectional and experimental research.

3- RESULTS

Numerous studies have established a strong link between a high BMI and an increased risk of developing type 2 diabetes (11). In adolescents, a high BMI is a major risk factor for the onset of this condition. Exceeding the normal BMI range during teenage years can lead to insulin resistance and disruptions in how the body processes glucose (12). Obesity, especially central obesity marked by excess belly fat, plays a crucial role in the development of type 2 diabetes in young people, significantly raising their risk (13). In recent years, there has been a notable

increase in type 2 diabetes cases among obese youth, corresponding with the rising rates of overweight and obesity in this age group (14). While this trend is more common in high-income countries, it is also becoming increasingly prevalent in low- and middle-income regions (15). Implementing preventive measures and lifestyle changes is essential. Strategies such as reducing the intake of high-fat and high-calorie foods, encouraging regular physical activity, and managing weight to lower BMI are effective in decreasing the likelihood of developing type 2 diabetes. A high BMI is considered an independent and significant risk factor for type 2 diabetes in adolescents (16).

3-1. Prevalence of Type 2 Diabetes in Adolescents with High Body Mass Index

Research shows that the prevalence of type 2 diabetes is much higher among adolescents who are classified as "overweight" (BMI above the 85th percentile for their age and sex) or "obese" (BMI above the 95th percentile) compared to their peers with a normal weight (17).

3-2. Insulin Resistance and Obesity

There is a direct relationship between a high BMI and insulin resistance, which is a key underlying mechanism of type 2 diabetes. Increased accumulation of visceral fat, particularly in the abdominal area, is associated with higher levels of inflammatory cytokines and reduced insulin sensitivity, ultimately leading to impaired glucose tolerance and the progression to type 2 diabetes (18).

3-3. Significant Association at Younger Ages

Evidence also indicates that a higher BMI in early childhood, including preschool ages (3–5 years), may predict the development of type 2 diabetes during adolescence. This underscores the importance of early screening and

interventions focused on nutrition and physical activity from a young age (19).

3-4. Racial and Gender Differences

Additionally, research has shown that race and gender can influence this relationship. For instance, African American and Hispanic adolescents have higher rates of type 2 diabetes compared to white adolescents at similar BMI levels. Furthermore, some data suggest that obese adolescent girls may be at greater risk than boys (20).

3-5. The Effect of Reducing Body Mass Index on Prevention

Intervention studies have demonstrated that reducing BMI through balanced diets, regular physical activity, and health education can significantly lower the risk of type 2 diabetes among children and adolescents. School-based programs that emphasize exercise and nutritional awareness have proven effective in reducing insulin resistance and improving metabolic health outcomes (21).

4- DISCUSSIONS

Type 2 diabetes, once primarily seen in adults, has increasingly been diagnosed in adolescents over recent decades, paralleling the rise in youth obesity (22). A high BMI is a major risk factor for this disease and serves as a clear indicator of obesity (23). This narrative review aims to clarify the connection between elevated BMI and the increased risk of type 2 diabetes in young people by compiling findings from relevant studies. Consistent evidence shows a strong positive relationship between high BMI and the early onset of type 2 diabetes. Central adiposity, in particular, significantly reduces insulin sensitivity and promotes insulin resistance both key factors in the development of type 2 diabetes. Adolescents with a BMI above the 95th percentile are especially vulnerable to impaired glucose tolerance

and elevated fasting insulin levels. Additionally, the development of insulin resistance before puberty in overweight children, if not addressed, may lead to type 2 diabetes (24).

Youth with elevated BMI are more likely to develop diabetes and other metabolic disorders later in life, including during adulthood. This relationship is influenced by a combination of genetic, environmental, and behavioral factors (25). For instance, Zimmerman et al (2017) examined childhood BMI and its link to adult-onset type 2 diabetes, finding that higher BMI was strongly associated with an increased risk of diabetes in adulthood, particularly among females; birth weight did not affect this association (26). Similarly, Tanamas et al (2018) reported that severe obesity significantly raised the incidence of type 2 diabetes among young individuals, supporting these findings (27).

Research by Abbasi et al (2017) further indicated a continuous rise in both type 1 and type 2 diabetes cases among British children and adults from 1994 to 2013 across both sexes and those older than 15 years. The increase in type 2 diabetes was especially notable among overweight and obese groups, with obese individuals experiencing a fourfold higher incidence compared to those with normal BMI. No direct link was found between childhood BMI and type 1 diabetes rates (28). Twig et al (2020) also showed that obesity during adolescence significantly heightened the risk of developing type 2 diabetes in early adulthood, with severe obesity leading to higher rates in both males and females (6).

Contributing factors such as excessive calorie intake, lack of physical activity, disrupted sleep patterns, and psychological stress are implicated in weight gain and the subsequent risk of diabetes. Additionally, differences in insulin sensitivity and diabetes prevalence among various ethnic and racial groups should be considered

when interpreting these findings (29). Preventive strategies including adopting healthy eating habits, increasing physical activity, and implementing family-based educational programs are effective in reducing metabolic risks in children (30) with elevated BMI. Overall, these findings highlight the urgent need for early identification of at-risk youth and comprehensive intervention efforts to combat childhood obesity and address the rising incidence of type 2 diabetes among children and adolescents (31).

5- CONCLUSION

Extensive research has demonstrated a strong connection between BMI and the development of type 2 diabetes in children and adolescents (32). Early onset overweight and obesity significantly increase the risk of this condition. Excess body weight heightens insulin resistance, disrupting normal glucose regulation and potentially triggering diabetes (33). The growing prevalence of obesity among younger populations, especially in urban and industrialized areas, highlights the importance of early detection and management of these risk factors. Interventions focusing on lifestyle changes such as improved nutrition, increased physical activity, and family education are crucial for preventing type 2 diabetes and promoting the overall well-being of young individuals. Therefore, BMI serves not only as a simple indicator of weight status but also as an important tool for predicting the likelihood of developing diseases like type 2 diabetes. Regular monitoring of BMI during childhood and adolescence is essential for effective health promotion and preventive strategies.

6- CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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