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METABOLIC CHANGES AND IMPACT ON GROWTH AND DEVELOPMENT IN CHILDREN WITH CHILDHOOD OBESITY

Ana Catarina Dantas Gomes

Igor Moreira Miguez Godoy

Leandro Nazareno Almeida da Silva

Vinicius Guilherme Rodrigues Mendes

Marina Lima Lustosa

Maria Luiza Pimentel Barbosa

Ciane Regina Alves Barros

Francisco Miguel da Silva Freitas

Fernanda de Almeida Valério Couceiro

Nina Rafaela Serrão de Souza

Maria Conceição Portela Leal

*Nathália Duarte D K Barcellos de
Albuquerque*

Liana Mayra Melo de Andrade

Carlliane Lins P. Martins

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Abstract: Childhood obesity is one of the main public health challenges of the 21st century, with an increasing prevalence worldwide, characterized by the excessive accumulation of body fat. The aim of this study is therefore to develop a study of metabolic changes and the impact on growth and development in children with childhood obesity. The methodology used in the study was a literature review, based on books and scientific articles from various databases on the subject. The results showed that childhood obesity is a complex and multifactorial condition that has a significant impact on children's growth and development. The metabolic changes associated with obesity, such as insulin resistance, dyslipidemia, chronic inflammation and hormonal dysregulation, not only compromise physiological functioning, but also interfere with physical, cognitive and emotional development. The conclusion emphasizes that combating childhood obesity requires integrated efforts between families, schools, health professionals and public policies, aimed not only at reducing weight, but also at promoting a balanced and sustainable lifestyle. Only in this way will it be possible to mitigate the negative impacts of obesity and guarantee a healthier future for children.

Keywords: Childhood obesity. Metabolism. Growth.

INTRODUCTION

Childhood obesity is one of the main public health challenges of the 21st century, with an increasing prevalence worldwide, characterized by the excessive accumulation of body fat, this condition is associated with a series of metabolic alterations that can compromise children's physical, cognitive and emotional growth and development (Araújo *et al.*, 2024). Understanding these changes and their impact is fundamental to developing effective prevention and treatment strategies.

This type of obesity triggers a series of metabolic imbalances that affect multiple systems in the body. Excess adipose tissue, especially in the visceral region, leads to the release of free fatty acids and inflammatory cytokines, which interfere with insulin signaling, resulting in insulin resistance, a precursor to type 2 diabetes. In children, this condition can impair glucose metabolism and cell growth (Álvarez *et al.*, 2023).

This pathology is often associated with high levels of triglycerides, LDL cholesterol (the "bad cholesterol") and reduced HDL cholesterol (the "good cholesterol"); these alterations increase the risk of early atherosclerosis and cardiovascular diseases (Araújo *et al.*, 2024).

Obesity can alter the hormonal axis, including growth, thyroid and sex hormones. For example, leptin, which regulates satiety, often has high levels, but its action is impaired, leading to a cycle of hunger and weight gain (Carullo *et al.*, 2023).

The metabolic changes associated with childhood obesity have profound consequences for children's growth and development, affecting not only their physical health, but also their emotional and social well-being (Carullo *et al.*, 2023).

This disease can accelerate linear growth in the short term due to high levels of insulin and growth hormones. However, in the long term, it can lead to premature bone maturation, resulting in a final stature that is shorter than potential. Furthermore, excess weight overloads the musculoskeletal system, increasing the risk of joint pain, bone deformities and reduced mobility (Pereira; Xavier, 2024).

Obese children often enter puberty earlier, especially girls. This is due to the increased production of estrogen by adipose tissue, so early puberty can have psychological and social implications, as well as increasing the risk of hormonal disorders (Bueno *et al.*, 2024).

Studies even suggest that childhood obesity may be associated with cognitive deficits, including problems with memory, attention and executive functions. Insulin resistance and chronic inflammation can negatively affect brain development (Pereira; Xavier, 2024; Bueno *et al.*, 2024).

In view of this, it is crucial to adopt integrated prevention and treatment strategies, involving families, schools, health professionals and governments, to ensure a healthier future for children, so investing in research, education and public policies is essential to combat this epidemic and promote the well-being of future generations (Caprio; Santoro; Weiss, 2020).

The aim of this study is to develop a study of metabolic changes and the impact on growth and development in children with childhood obesity.

Childhood obesity is a complex condition that requires immediate attention due to its serious metabolic, physical, cognitive and emotional consequences. The metabolic changes associated with obesity, such as insulin resistance, dyslipidemia and chronic inflammation, have a profound impact on children's growth and development, with repercussions that can last a lifetime.

METHODOLOGY

This study is a literature review with a qualitative approach, the aim of which is to analyze and synthesize the available knowledge on the impact of screen use on the worsening mental health of adolescents. The review is exploratory and descriptive in nature, seeking to understand the relationship between the excessive use of digital devices and their psychological and behavioral repercussions in this age group.

The search strategy was carried out in recognized scientific databases such as PubMed, Bireme, Scopus, SciELO and PsycINFO.

Controlled descriptors were used according to the Health Sciences Descriptors

(DeCS), in Portuguese: "childhood obesity", "metabolic changes", "child development", "insulin resistance", "chronic inflammation". In English: "*childhood obesity*", "*metabolic changes*", "*child development*", "*insulin resistance*", "*chronic inflammation*", "*growth disorders*".

The inclusion criteria were studies published in the last 5 years (2019-2025); articles in Portuguese, English or Spanish; studies that address metabolic changes in children with childhood obesity; research that explores the impact of obesity on physical growth, cognitive and emotional development and observational studies, clinical trials, systematic reviews and meta-analyses.

The exclusion criteria were based on studies that do not focus on children (adult or elderly population); articles without *peer review* and research that does not directly address the proposed topic.

The data collected was analyzed using thematic analysis, seeking to identify patterns, relationships and main trends in the scientific findings. The results were interpreted critically, considering possible methodological biases and limitations of the studies reviewed.

As this is a literature review, the study did not involve any experimentation on human beings, thus dispensing with the need for approval by an ethics committee. However, the principles of scientific rigor and research ethics were followed, ensuring that all sources used were properly cited.

RESULTS AND DISCUSSIONS

Several authors contribute to the scientific discourse around strategies for managing and preventing childhood obesity, as well as its metabolic complications, for example, Leong *et al.* (2020) highlight insulin resistance as a significant metabolic consequence of childhood obesity, emphasizing the importance of early detection to avoid secondary problems such as type 2 diabetes.

This aligns with research by Bjornstad *et al.* (2020), which highlights the effects of childhood obesity on kidney function, indicating the need for regular kidney health assessments within pediatric care guidelines. Meanwhile, Solito *et al.* (2021) explored the effects of probiotic supplementation in obese young people, noting improvements in insulin sensitivity, although they observed limited impacts on other metabolic factors.

The promising potential for microbiome-based interventions is suggested by these findings, although further research is needed to evaluate long-term advantages and adjust therapeutic approaches. The importance of interventions targeting the components of metabolic syndrome and vascular health was emphasized by Rajakumar *et al.* (2020) and Marti *et al.* (2021), respectively.

The decrease in LBP levels linked to weight loss indicates that inflammatory markers may serve as effective targets for therapy. In addition, the benefits of vitamin D3 supplementation on blood pressure and insulin sensitivity highlight the need to address specific nutritional deficiencies in the treatment of childhood obesity.

The research conducted by Santos *et al.* (2024) on the application of alirocumab in children diagnosed with heterozygous familial hypercholesterolemia (HeFH) highlights the importance of personalized therapies for specific conditions. The observed decrease in LDL cholesterol and various lipid metrics suggests that targeted strategies may be safe and effective in pediatric populations.

In Brazil, the South and Southeast regions have the highest rates of childhood obesity, a trend driven by higher levels of economic development that shape children's lifestyles, this is evident in eating patterns characterized by increased consumption of ultra-processed foods, along with greater access to screens and the internet (Bjornstad *et al.*, 2020). In addition,

it has been observed that female children are more significantly impacted by obesity, with a prevalence rate of 16.2%, compared to 14.4% for male children (Bjornstad *et al.*, 2020).

The quality of children's health is closely linked to their growth and contemporary lifestyle habits, indicating a nutritional transition. However, the negative consequences of this lifestyle have negatively affected children's health, with excessive consumption of inappropriate foods recognized as a primary factor contributing to childhood obesity. Research shows a link between the consumption of processed foods rich in calories, sugars and saturated fats and the prevalence of obesity among children (Guedes; Mello, 2021).

In 2021, data from the Unified Health System (SUS) indicated a 13.2% increase in obesity rates among children aged 5 to 9, with 28% classified as overweight. This serves as a worrying indicator of potential future increases in obesity rates. In the same year, 14.8% of children aged 1 to 5 were considered overweight, and 7% were already classified as obese (Brazil, 2021).

In light of these circumstances, it is crucial that children receive guidance on how to adopt healthy eating habits, including balanced meals that provide sufficient nutrients for energy replenishment. Parents should also diligently supervise their children's eating routines, particularly in relation to school meals, to ensure that they get the essential nutrients needed for healthy development (Capistrano *et al.*, 2022).

Being overweight or obese during childhood greatly increases the risk of developing metabolic diseases in adulthood, highlighting the importance of preventive measures aimed at reducing or preventing obesity altogether in youth, which can lead to positive health outcomes later in life (Szczyrska *et al.*, 2023).

In 2020, the Commission to End Childhood Obesity (ECHO), supported by the WHO, set ambitious targets for weight control and reduction among young populations by 2025, but these targets remain unmet. The growing prevalence of overweight and obesity in children highlights the need to identify early biochemical markers that can predict future occurrences of metabolic and cardiovascular diseases (Kivelä *et al.*, 2022).

It is well established that plasma levels of amino acids (AAs) are modified in obese adults. In particular, a unique increase in branched-chain amino acids (BCAAs) has been identified as a distinguishing factor between lean individuals and those with obesity, and this pattern has been suggested as a potential factor in the development of insulin resistance (Bacha *et al.*, 2024).

Obesity and related conditions, such as non-alcoholic fatty liver disease, type 2 diabetes and polycystic ovary syndrome, are characterized by an increase in aromatic amino acids (AAAs) and a decrease in glycine (Corbin *et al.*, 2024).

The adolescent diabetic demographic was also the subject of these observations, where a correlation was found between decreased glycine levels and increased BCAA and AAA levels, leading to impaired insulin sensitivity and reduced adiponectin secretion. In a randomized trial focused on nutritional intervention for weight loss, a simultaneous decrease in the BCAAs leucine and isoleucine was observed, along with an increase in insulin resistance (Sawicki *et al.*, 2023).

Other metabolic indicators, including the glutamine (Gln)/glutamic acid (Glu) ratio and the proline (Pro)/citrulline (Cit) ratio, have demonstrated their ability to predict future metabolic or cardiovascular risk. In addition, the global arginine bioavailability ratio (GABR), which is defined as arginine divided by the sum of ornithine and citrulline, serves

as a predictor of cardiovascular risk. This ratio more accurately reflects the presence of impaired NO synthetic capacity than the individual serum levels of the amino acids involved in its calculation (Campos *et al.*, 2024).

Therefore, metabolic alterations in childhood increase the risk of chronic diseases in adulthood, such as type 2 diabetes, hypertension, cardiovascular diseases and metabolic syndrome. In addition, childhood obesity is associated with lower life expectancy.

FINAL CONSIDERATIONS

Childhood obesity is a complex, multifactorial condition that has a significant impact on children's growth and development. The metabolic changes associated with obesity, such as insulin resistance, dyslipidemia, chronic inflammation and hormonal dysregulation, not only compromise physiological functioning, but also interfere with physical, cognitive and emotional development. These changes can lead to immediate complications, such as precocious puberty and musculoskeletal disorders, and long-term ones, such as cardiovascular disease and type 2 diabetes.

Throughout the work, it was also observed that childhood obesity can negatively affect self-esteem and socialization, impacting psychosocial development, so it is essential to adopt a preventive and interventional approach that includes nutritional education, promotion of physical activities and psychological support. Early intervention is crucial to minimize the adverse effects of metabolic alterations and ensure healthy growth and development.

In summary, combating childhood obesity requires integrated efforts between families, schools, health professionals and public policies, aimed not only at reducing weight, but also at promoting a balanced and sustainable lifestyle. Only in this way will it be possible to mitigate the negative impacts of obesity and guarantee a healthier future for children.

Therefore, future studies into metabolic changes and the impact on growth and development in children with childhood obesity are extremely important in order to advance our understanding of this condition and to develop more effective prevention and treatment strategies. Childhood obesity is a global

health problem on the rise, and its short- and long-term consequences are not yet fully understood. Therefore, additional research can fill critical gaps in knowledge and provide valuable insights to address this issue more comprehensively.

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