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OVERWEIGHT AND OBESITY IN CHILDHOOD CANCER SURVIVORS: A LITERATURE REVIEW

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ABSTRACT

Introduction: Overweight and obesity have become a widespread problem in modern society, influenced by multiple factors, including oncological diseases and their treatment. A diagnosis of cancer at a young age, combined with adverse lifestyle patterns, may lead to significant challenges in maintaining healthy Body Mass Index (BMI). A BMI ≥ 30 kg/m² is classified as obesity and may lead to multiple health complications, posing an additional burden for cancer survivors. The aim of this review is to present the current state of knowledge on the association between early-onset cancer and excessive weight gain.

Methods: This study presents current knowledge on overweight and obesity in childhood cancer survivors. A narrative literature review was conducted using PubMed and Google Scholar, focusing on recent studies and cardiometabolic risk factors.

Key findings: Survivors of childhood cancer are at risk of developing obesity compared to their peers. Studies show that they often face greater difficulties in maintaining normal body weight than their healthy siblings. Excessive body weight is associated with comorbidities such as hypertension, hyperglycemia, dyslipidemia, chronic inflammation, which require further treatment and can affect long-term health. Preventive strategies focusing on nutrition and physical activity are crucial for this group.

Conclusion: Despite the widespread prevalence of obesity, limited research focuses on its determinants in childhood cancer survivors. The maintenance of a healthy body weight is particularly important in this group to prevent secondary health complications. Therefore, supporting the development of healthy lifestyle patterns in this vulnerable population is vital for improving their long-term outcomes.

KEYWORDS

BMI, Cancer, Cancer Survivors, Lifestyle, Nutrition, Obesity

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Introduction

Advances in the diagnosis and treatment of childhood cancer have significantly increased the number of survivors. However, patients with a history of cancer have an elevated risk of premature mortality and morbidity. These risks include a higher likelihood of developing cardiovascular disease, dyslipidemia, hypertension, insulin resistance, diabetes as well as obesity at a young age (Zhang & Parsons, 2015). Overweight and obesity, characterized by excessive fat accumulation that impairs health, has become a global problem. Since 1975, worldwide obesity has nearly tripled. More than 1.9 billion adults were overweight in 2016, and over 650 million of them were obese (Smith & Smith, 2016). Such individuals have an increased risk of developing chronic diseases as well as subsequent mortality. Excess body weight is also associated with poorer survival outcomes in cancers such as pediatric acute lymphoblastic leukemia (survival rate 80-90%) and oral cancer compared to their non-obese counterparts (Devilli et al., 2021; Greenlee et al., 2017). The aim of this study is to summarize the state of knowledge on excessive weight gain in relation to early-onset cancer, as well as strategies for its prevention.

Methodology

A literature search was conducted in PubMed, ScienceDirect, and Google Scholar, focusing on the most recent studies on overweight and obesity in childhood cancer survivors. Keywords included “childhood cancer survivors”, “obesity”, “overweight”, and “cardiometabolic risk”, with emphasis on metabolic and long-term health outcomes.

Results

Epidemiology:

Globally, approximately 20% of children and adolescents are overweight. Body Mass Index (BMI) is used to classify overweight and obesity in adults. Overweight and obesity are defined as follows: overweight is a $BMI \geq 25$, and obesity is a $BMI \geq 30$ (Smith & Smith, 2016). Childhood obesity is also measured on the basis of BMI, but its interpretation differs due to age-specific and sex-specific percentiles. Based on standardized pediatric anthropometric references, a child is considered overweight if their weight-for-height exceeds two standard deviations above the reference population median. Epidemiological data show a striking increase in the prevalence of overweight and obesity among individuals aged 5-19, rising from 4% in 1975 to 18% in 2016. According to statistical data, children aged 2 to 4 years in many countries, every third or fourth child is classified overweight, and approximately one in five children and adolescents worldwide is affected by overweight or obesity, with prevalence rates varying by geographic region, income level, and Human Development Index (HDI) (Reinehr & Wabitsch, 2011; Zhang et al., 2024). Elevated BMI during childhood is a major risk factor for the development of cardiovascular diseases, diabetes, chronic kidney disease and musculoskeletal disorders later in life (Kivimäki et al., 2022). In a cohort of 1713 adult survivors of childhood cancer, the identified attributable fraction for cancer was below 50%, ranging from 9.3% for hypertension to 15.5% for dyslipidemia, 41.7% for diabetes, to 42.1% for obesity (Hudson et al., 2013). Other studies indicate that childhood cancer survivors have significantly higher prevalence of obesity compared to their healthy siblings (13.5% vs. 7.5%) (Garmey et al., 2008). Similarly, a Dutch study reported that 26% of survivors were classified as overweight and 14% as obese, with risk factors including male sex, younger age at diagnosis, lower education level, physical activity, and migration background. Moreover, individuals who survived cancer in childhood are significantly more likely to exhibit insufficient level of physical activity when compared to their healthy siblings, with 30.0% of cancer survivors not meeting recommended guidelines for physical exercise, in contrast to only 19.3% of their siblings control (Bouwman et al., 2024). Therefore, obesity represents an additional risk factor for numerous health conditions in patients who experienced cancer at an early age, and it may also serve as a potential prognostic factor associated with cancer survival (Petrelli et al., 2021; Kivimäki et al., 2022).

Clinical presentation

Overweight and obesity are clinical conditions defined by an excessive accumulation of adipose tissue in the body, primarily resulting from a long-term imbalance between caloric intake and energy expenditure, where daily energy consumption exceeds the amount expended (Romieu et al., 2017). This metabolic imbalance contributes to increased fat mass leading to intra-abdominal adiposity, which is strongly associated with adverse health outcomes. Most patients typically exhibit increased measurements of waist circumference, hips circumference and arm circumference, reflecting peripheral and central fat distribution. Obesity induces structural and functional alterations in multiple organ systems, including cardiovascular, hepatic, renal, pulmonary, gastrointestinal, vascular and central nervous system (Jiang et al., 2016). In particular, exposure of the pituitary gland to radiation doses exceeding 5 Gy has been associated with a significantly increased likelihood of developing obesity later in life, as reported in clinical studies (Delacourt et al., 2023).

In the kidneys, obesity-associated hemodynamic changes such as renal vasodilatation and glomerular hyper filtration may initially serve as compensatory mechanisms. However, persistent exposure to this alteration can contribute to progressive renal injury and functional decline, representing a significant concern in populations with pre-existing health vulnerabilities, such as cancer survivors (Zbrzeźniak-Suszczewicz et al., 2025). These individuals are predisposed to long-term metabolic complications, including excess body weight and the development of metabolic syndrome. Recent studies have identified that disruptions in lipid metabolism- specifically involving altered concentrations of certain free fatty acids- may contribute to the early manifestation of metabolic syndrome in this population (Konończuk et al., 2025). Moreover, elevated triglyceride levels are frequently reported issue in individuals with overweight, potentially progressing to hypertriglyceridemia- a prevalent lipid abnormality associated with excess adiposity. These elevated levels frequently co-occur with hypertension, which constitutes an additional risk factor for development of atherosclerotic vascular disease (Jiang et al., 2016). Advanced atherosclerotic lesions may lead to critical luminal obstruction, increasing the risk of ischemic events such as myocardial infarction or cerebrovascular accidents (Jebari-Benslaïman et al., 2022). Cardiovascular and renal pathologies are frequently implicated in the pathogenesis of multiple concomitant systemic disorders (Jiang et al., 2016). Commonly observed

conditions include hypertension, hyperglycemia, chronic inflammation, and dyslipidemia. Collectively, these factors may contribute to the development of metabolic syndrome, particularly in the presence of excess visceral adiposity (Koopman et al., 2009). The cumulative burden of these conditions poses a substantial threat to long-term health outcomes in cancer survivors. Moreover, a variety of sociodemographic factors have been identified as contributors to the elevated risk factors of overweight and obesity among survivors of childhood cancer. These include being married or in a long-term partnership, having lower levels of educational attainment. Each of these variables, individually and cumulatively, may predispose individuals to an increased BMI (Bouwman et al., 2024). Several well-established risk factors for overweight and obesity among childhood cancer survivors are similar to those identified in the general population. However, the prolonged duration and intensity of cancer treatment constitute a unique and significant contributor specific to this group (Gance-Cleveland et al., 2020). Prolonged therapeutic exposure may distribute metabolic regulation, necessitating tailored follow-up care for this vulnerable group (Konończuk et al., 2025). These lifestyle- and health-related determinants may act synergistically, placing survivors at greater risk of metabolic complications. Diabetes mellitus frequently emerges as a comorbid condition in this context. Numerous patients with a history of cancer diagnosis during childhood subsequently develop diabetes, either as a direct result of oncological therapies or through the exacerbation of pre-existing glycemic dysregulation. A notably high prevalence of prediabetes has been observed among adult survivors of childhood cancer, with evidence indicating an independent link to elevated risk of subsequent cardiovascular and renal complications (Dixon et al., 2024). An analysis of a hospital-based cohort of individuals treated for childhood and young adult cancer revealed an elevated long-term risk of diabetes, with temporal variations linked to specific treatment modalities (Cromie et al., 2025). This may, in part, be explained by the fact that a considerable number of modern targeted anti-cancer molecules may interfere with glucose metabolism acting at different levels on the signaling substrates shared by insulin receptors and insulin-like factor I (IGF-I) (Vigneri et al., 2009). These disruptions can alter insulin sensitivity, pancreatic β -cell function, or hepatic glucose production, ultimately leading to impaired glucose tolerance or the onset of overt diabetes (Friedman et al., 2019). Therefore, the image of a cancer survival patient with obesity, it is not only a patient with excessive adipose tissue but also with internal diseases.

Diagnosis:

The assessment of overweight and obesity commonly employs the Body Mass Index (BMI) and Body Impedance Analysis (BIA). BMI is calculated by dividing an individual's weight in kilograms by the square of their height in meters (kg/m^2) and serves as a general indicator of nutritional status in adults. According to the World Health Organization, a BMI between 25.0 to 29.9 kg/m^2 is classified as overweight (pre-obesity), while a BMI of 30 kg/m^2 is considered obese. Obesity is further categorized into three classes: Class I (BMI 30.0-34.9 kg/m^2), Class II (BMI 35.0-39.9 kg/m^2), and Class III (BMI $40 \geq \text{kg/m}^2$) (Panuganti et al., 2023).

These BMI categories are closely associated with the health impact of excess adipose tissue, including increased morbidity and mortality. As BMI increases, the risk of developing serious conditions such as cancer, diabetes, premature death, cardiovascular diseases, high blood pressure and osteoarthritis also rises (Wadden et al., 2020). In addition to BMI, Body Impedance Analysis (BIA) serves as a valuable method for assessing body composition. BIA distinguishes between fat mass (FM) and fat-free mass (FFM), with fat mass representing the water-free body component and fat-free mass indicating skeletal muscle, internal organs, and interstitial fat tissue (Marra et al., 2019). Body Impedance Analysis is considered a more precise index for estimating body composition, especially given that the correlation between BMI and the percentage of adipose tissue is not linear and can vary significantly between men and women. Moreover, assessment of body composition in childhood cancer survivors has revealed that an increased fat-to-lean mass ratio is associated with a dysmetabolic profile, serving as a potential marker for identifying individuals at higher risk of metabolic syndrome. This underscores the importance of comprehensive evaluations that go beyond traditional anthropometric measurements to include detailed body composition analyses (Casirati et al., 2023). Relying solely on Body Mass Index may lead to misclassification of individual's weight status, potentially underestimating or overestimating obesity and its health consequences. This can, in turn, influence how the impact of obesity on clinical outcomes is interpreted (Rothman, 2008). Therefore, for patients with a history of cancer, accurate assessment of body composition is particularly important, as early identification of overweight or obesity can facilitate timely intervention and improve long-term outcomes.

Management strategies:

Physical activity combined with calories deficit remains the most effective strategy for achieving and maintaining a healthy body weight. Studies have shown that childhood cancer survivors are 60–70% more likely to be physically inactive than their siblings or healthy controls. Research also indicates that adolescent (11–18 years) and younger adult (19–25 years) with a history of a cancer frequently did not adhere to guidelines for physical activity. A lack of physical activity is one of the primary contributors to the development of obesity, particularly important for cancer survivors to increase their overall level of movement.

Physical activity in the context of obesity management can be categorized into spontaneous daily activities and structured, intentional exercises. Everyday activity includes routine movements related to household responsibilities, school tasks, and commuting (Jakicic et al., 2018). These forms of activity contribute significantly to overall energy expenditure and are considered essential components of daily physical activity (Bratteteig et al., 2024).

In addition to physical activity, caloric intake constitutes a fundamental determinant in weight management. However, there is a limited body of research specifically addressing dietary guidelines for individuals who developed cancer at an early age. This may be due to the fact that nutrition intake is often associated with chronic health conditions (Zhang et al., 2024). Nevertheless, a healthy and balanced diet is always recommended for individuals with overweight or obesity. Individualized nutritional care is essential for childhood cancer survivors. Dietary strategies should be tailored to meet the specific needs of each patient, while also addressing access to nutritional counseling (Feit et al., 2024). Adopting and maintaining a healthy lifestyle may be particularly challenging for younger patients. Therefore, involving the entire family in the process of obesity prevention and treatment is essential to provide adequate support (Brown et al., 2015). Targeted assistance in modifying dietary habits is especially important for young cancer survivors, as the use of pharmacological weight-loss interventions during childhood and adolescence should be limited to clinical trials. In exceptional cases, bariatric surgery may be considered. However, such procedures must be conducted by experienced multidisciplinary teams with the appropriate resources to ensure for long-term follow-up and comprehensive care. Importantly, even after undergoing surgical weight reduction, patients require continuous monitoring, structured lifestyle modifications, and psychosocial support to maintain long-term outcomes (Styne et al., 2017).

Discussion and Conclusion

Individuals who were diagnosed with cancer during childhood face an increased risk of developing obesity and a range of associated health complications in later life. Reduced levels of physical activity and unhealthy dietary habits contribute substantially to difficulties in maintaining a healthy body weight in this population. Furthermore the limited availability of dietary guidelines specifically tailored for childhood cancer survivors represents an additional barrier, often leading to excessive intake of calories and dietary fats. Unhealthy lifestyle behaviors, when combined with a history of a cancer, significantly contribute to the elevated prevalence of obesity in this patient population. As a consequence of excess body weight, cancer survivors are at risk of developing comorbid conditions such as cardiovascular disease, dyslipidemia, diabetes mellitus, which further exacerbate their health burden. Addressing obesity in this group can be particularly challenging, especially considering since pharmacological treatment options for weight loss are generally not recommended for young individuals. Therefore, promoting sustainable, health-oriented lifestyle changes from an early stage remains essential. Encouraging the adoption of healthy eating habits and regular physical activity should be a central component of long-term follow-up care for childhood cancer survivors.

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