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Review Article

A Comprehensive Review of Sarcopenic Obesity in Children with Neurodisability

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Abstract

Sarcopenic obesity, the concurrent presence of excess adiposity and reduced muscle mass, has been increasingly recognized in children with neurodisability. This phenomenon has been linked with a range of negative health consequences, including increased metabolic and cardiovascular risks, reduced physical function, and diminished quality of life. However, there is a significant gap in the literature regarding the prevalence, causes, diagnosis, and management of this condition in the paediatric neurodisability population. This review article seeks to collate current knowledge on sarcopenic obesity in children with neurodisability, aiming to stimulate further research and enhance clinical practice in this area.

Introduction

Sarcopenic obesity, a complex medical condition characterised by the confluence of decreased muscle mass (sarcopenia) and increased adiposity (obesity), has recently drawn substantial attention in the field of paediatric healthcare. This condition has garnered interest due to its multi-factorial origin, complex pathophysiology, and significant impact on health outcomes, particularly among children with neurodisability [1,2].

Neurodisability is a term used to describe a group of congenital or acquired long-term conditions that result from impairments of the brain, spinal cord, or peripheral nerves. These conditions often lead to functional limitations, influencing a child's mobility, cognition, and overall health. Some common forms of neurodisability include cerebral palsy, spina bifida, and various types of neuromuscular disorders [3].

As a population, children with neurodisability are predisposed to health complications that include, but are not limited to, problems with nutrition, mobility, and musculoskeletal health. Recently, emerging research has identified a concerning rise in the incidence of sarcopenic obesity within this population. It appears that the combination of decreased physical activity, altered nutritional intake, and the side effects of specific medications are contributing to the development of this condition [4,5].

This increase in the prevalence of sarcopenic obesity among children with neurodisability carries with it the potential for an array of adverse health outcomes. These include an elevated risk of cardio-metabolic diseases, compromised physical function, and impaired quality of life. Therefore, understanding the complexities of sarcopenic obesity in this vulnerable population is not just important but critical for the development of effective interventions and overall healthcare improvement [6,7].

The objective of this review is to synthesize current evidence linking sarcopenic obesity and neurodisability, underscore its implications, and elucidate the need for novel preventive and therapeutic strategies.

Prevalence of Sarcopenic Obesity in Children with Neurodisability

Sarcopenic obesity is a relatively novel concept in pediatric healthcare that carries substantial implications. This condition is characterized by a paradoxical coexistence of excess adiposity and deficient muscle mass, representing an intersection of two seemingly opposite entities - obesity and sarcopenia. The complexity of sarcopenic obesity arises from its unique pathophysiology and the broad range of potential influences, including genetic factors, dietary intake, physical activity levels, and the impacts of chronic illnesses and medications [1,2].

Children with neurodisability present a higher risk for developing sarcopenic obesity. The inherent challenges related to their neurologic condition - including mobility limitations, muscle weakness, and often altered nutritional status - contribute to both sarcopenia and obesity [3]. For instance, limited mobility may lead to a sedentary lifestyle and subsequent muscle atrophy, while difficulties in feeding and diet management can lead to malnutrition or overnutrition, both of which are significant risk factors for sarcopenia and obesity [4,5]. Furthermore, specific medications used in this population, such as certain antiepileptic drugs, have been associated with weight gain and altered body composition [8].

The prevalence of sarcopenic obesity in children with neurodisability is challenging to quantify due to variations in the diagnostic criteria and methods used for body composition assessment. However, several studies have indicated a higher prevalence in this population compared to their neurotypical peers. A study by Zhang et al., reported sarcopenic obesity in up to 30% of children with neurodisability, significantly exceeding rates reported in the general pediatric population [4].

It is crucial to highlight that the real prevalence of sarcopenic obesity may be underestimated due to the lack of routine screening and standardized diagnostic criteria. Given the potential negative impact on health outcomes and quality of life, addressing this gap in healthcare practice is of the utmost importance.

Consequences of Sarcopenic Obesity

The consequences of sarcopenic obesity are multifaceted and extend beyond mere physical health, affecting overall well-being and quality of life. For children with neurodisability, these effects can further compound the challenges they already face due to their underlying conditions.

Cardiometabolic Consequences

Sarcopenic obesity poses a significant risk for cardiometabolic diseases, even in the pediatric population. The coexistence of high fat mass and low muscle mass can contribute to insulin resistance, dyslipidemia, and hypertension [9]. In a study by Baumgartner et al., adults with sarcopenic obesity were found to have three times the risk of developing metabolic syndrome compared to those without [10]. While such research on children is limited, it can be postulated that similar risks might exist given the common pathophysiological underpinnings.

Musculoskeletal and Physical Function

Sarcopenic obesity can lead to a decline in musculoskeletal health and physical function. Muscle weakness and increased load due to obesity often result in mobility issues and difficulties in performing daily activities [11]. This can further restrict participation in physical activities, leading to a vicious cycle of decreased activity, increasing sarcopenia, and escalating obesity [12].

Bone Health

Research has shown an association between sarcopenic obesity and decreased bone mineral density, likely due to the adverse mechanical effects of obesity and the influence of muscle mass on bone strength [13]. Reduced bone density predisposes children to fractures, adding another layer of complexity to their health status and potentially further limiting their mobility [14].

Psychosocial Impacts

Lastly, the psychosocial impacts of sarcopenic obesity should not be overlooked. Appearance changes due to obesity, coupled with physical limitations from sarcopenia, can contribute to social isolation, decreased self-esteem, and mental health problems such as anxiety and depression [15,16].

Sarcopenic obesity in children with neurodisability can significantly impair their health status and quality of life. Recognizing and addressing this complex condition requires a multifaceted approach that encompasses medical, rehabilitative, nutritional, and psychosocial interventions.

Causes of Sarcopenic Obesity

The pathogenesis of sarcopenic obesity is multifactorial and complex. It reflects a combination of lifestyle and physiological factors, many of which are exacerbated in children with neurodisability.

Physical Inactivity

Physical inactivity plays a substantial role in the development of sarcopenic obesity. Lack of exercise leads to progressive loss of muscle mass and strength (sarcopenia), as well as increases in fat mass (obesity) [17]. In children with neurodisability, physical activity may be reduced due to motor impairments, mobility issues, or lack of accessible opportunities for exercise [18].

Malnutrition

Malnutrition, in the form of both undernutrition and overnutrition, can also contribute to sarcopenic obesity. Insufficient protein intake can accelerate muscle protein breakdown, leading to sarcopenia [19]. Simultaneously, excessive caloric intake, particularly in the form of high-fat and high-sugar foods, can lead to weight gain and obesity[20]. In children with neurodisability, nutritional issues are common due to feeding difficulties, altered satiety signals, or side effects of medication [21].

Chronic Inflammation

Chronic inflammation, a common feature in individuals with neurodisability, is another important factor. Inflammatory mediators such as cytokines can stimulate muscle protein degradation and inhibit protein synthesis, leading to sarcopenia [22]. Moreover, adipose tissue can produce pro-inflammatory cytokines, linking obesity with systemic inflammation [23].

Hormonal Changes

Hormonal changes are another contributor to sarcopenic obesity. Insulin resistance, often associated with obesity, can impair muscle protein synthesis and exacerbate sarcopenia [24]. Cortisol, a stress hormone, can also promote muscle breakdown and fat accumulation [25].

Medication

Certain medications used for the treatment of neurodisabilities, such as antiepileptic drugs, can contribute to weight gain and altered body composition, thereby playing a role in the development of sarcopenic obesity [8].

In conclusion, the causes of sarcopenic obesity in children with neurodisability are multifactorial and interconnected, necessitating a comprehensive approach for effective prevention and management.

The diagnosis and management of sarcopenic obesity in children with neurodisability are particularly challenging due to the unique characteristics of this population. However, understanding the specific criteria for diagnosis and creating personalized, comprehensive management strategies are essential to mitigating the adverse effects of this condition.

Diagnosis of Sarcopenic Obesity

The diagnosis of sarcopenia is more complex. There is no universally accepted diagnostic criterion for sarcopenic obesity. In general, it requires evidence of both obesity and sarcopenia. Obesity is typically assessed by weight charts or using body mass index (BMI), although this measure does not distinguish between fat and muscle mass [26].

Method of Obesity Assessment

Although tibial length is considered is ideal standard for growth measurement in neurodisabled children due to length measurement in spastic children, it is not easily available. Also it doesn't determine obesity and hence traditionally obesity is identified using BMI, which is calculated by dividing a person's weight in kilograms by the square of their height in meters. For children, BMI percentiles are used, with obesity being defined as a BMI at or above the 95th percentile for children of the same age and sex [26].

However, BMI does not distinguish between muscle and fat mass and therefore may not accurately represent body composition, particularly in cases of sarcopenic obesity. More precise methods of body composition analysis, such as dual-energy x-ray absorptiometry (DXA) or bioelectrical impedance analysis (BIA), can provide a clearer picture of fat distribution and prevalence [27].

Method of Sarcopenia Assessment

Sarcopenia is defined by both loss of muscle mass and decreased muscle function. Muscle mass can be evaluated using DXA or BIA, with sarcopenia often being defined as two standard deviations below the mean muscle mass of a healthy young reference group [1]. Assessing muscle strength, traditionally through grip strength or knee extensor strength, is another crucial element in diagnosing sarcopenia. However, the applicability of these tests may be limited in children with neurodisability due to their varied physical abilities.

Challenges in Diagnosis

The diagnosis of sarcopenic obesity in children with neurodisability poses additional challenges. The heterogeneity of this population, combined with the lack of established diagnostic criteria specifically for this group, complicates the diagnostic process. Furthermore, many assessment tools used in the general population may not be suitable due to physical limitations associated with neurodisability.

Therefore, there is a pressing need for research to establish appropriate diagnostic criteria and develop accurate, accessible assessment tools for diagnosing sarcopenic obesity in children with neurodisability.

Management of Sarcopenic Obesity

Managing sarcopenic obesity in children with neurodisability requires a comprehensive, personalized, and multidisciplinary approach that considers the unique characteristics of this population and address dietary habits, physical activity, medical treatments, and psychological support. The strategy thus should include intertwined nutritional intervention, physical activity, medical intervention, and psycho-social support.

Nutritional Intervention

A key component of managing sarcopenic obesity is nutritional intervention and aim to encourage a balanced diet, rich in lean protein to support muscle mass, and low in processed foods to prevent excess weight gain [19]. In some cases, dietitians may provide individualized meal plans, and occupational therapists can address feeding difficulties.

The balanced diet recommended not only includes adequate protein to support muscle health, sufficient vitamins and minerals to support overall growth and development, but also a controlled caloric intake to prevent excess fat accumulation [19].

Nutrition education for the child and their family is crucial. Working with a registered dietitian can provide tailored guidance to ensure that the dietary plan is nutritionally complete, feasible, and acceptable for the child. In certain cases where oral feeding is a challenge, alternative strategies such as use of a feeding tube may be necessary, and a dietitian can provide guidance on proper nutrition through these methods [28].

Physical Activity

Physical activity is essential for preserving muscle mass and function and combating obesity. Exercise plans should be adapted to the child's abilities and preferences, to encourage ongoing participation. This could include resistance training, aerobic exercise, or physiotherapy programs tailored to the child's abilities. Physiotherapy can also play a critical role, providing individualized programs to improve strength, flexibility, balance, and coordination, taking into consideration the child's physical limitations due to neurodisability [29].

Medical Intervention

Medical interventions can also be helpful in managing sarcopenic obesity. This could include adjusting medications that contribute to weight gain or muscle loss, and managing comorbid conditions that could exacerbate sarcopenic obesity, such as endocrine or metabolic disorders [30]. These may include adjustments to medications that may contribute to weight gain or muscle loss, such as certain antiepileptic drugs. Managing comorbidities is important as it can impact body composition and muscle function [30].

In some cases, pharmacological interventions, such as those that can stimulate muscle growth or suppress inflammation, might be beneficial, but more research is needed to understand the risks and benefits of these treatments in children with neurodisability.

Psychological Support

Addressing the psychosocial aspects of sarcopenic obesity is also essential. Psychological support plays a crucial role in managing sarcopenic obesity. The condition can impact a child's self-esteem, body image, and social interactions. Psychologists or social workers can provide counselling to help children cope with these issues and can assist families in navigating the complex social and emotional challenges associated with managing this condition [5].

The counselling can help children cope with body image concerns, or social support to encourage engagement in physical activities [31].

Conclusion

Sarcopenic obesity in children with neurodisability is a complex health issue with serious health implications, yet it remains an underexplored field. Obesity and sarcopenia have distinct but interrelated causes and consequences that require comprehensive and multidisciplinary intervention strategies for effective management. Although the current tools for diagnosing and managing sarcopenic obesity provide a foundation, they fall short of addressing the specific challenges and needs of children with neurodisability.

The challenges in diagnosing and managing sarcopenic obesity in this population underscore the urgent need for further research. Specifically, studies that aim to develop more refined diagnostic criteria and appropriate assessment tools are crucial. Additionally, intervention studies are needed to create targeted nutritional, physical activity, medical, and psychological strategies that can address the unique characteristics of children with neurodisability. By advancing our understanding and management of sarcopenic obesity, we can help improve the health and quality of life for children with neurodisability.

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