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A Systematic Review of Muscle Mass as a Biomarker for Health Status and Function in Children with Neuromuscular Disabilities

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Abstract

Children with neuromuscular disabilities face unique challenges related to muscle function, mobility, and overall health status. Neuromuscular disabilities encompass a spectrum of conditions affecting the nervous system's control over voluntary muscles, resulting in varying degrees of muscle weakness, spasticity and impaired motor function. Evaluating muscle mass as a biomarker for health status and function in these children is crucial for understanding disease progression, assessing treatment efficacy and optimizing care strategies. This systematic review explores existing literature on muscle mass measurement and its implications for health outcomes in children with neuromuscular disabilities. Neuromuscular disabilities encompass a diverse range of conditions, including but not limited to. A group of disorders affecting movement and posture due to non-progressive disturbances in the developing brain. Progressive genetic disorders characterized by muscle weakness and degeneration, such as Duchenne Muscular Dystrophy (DMD) or Spinal Muscular Atrophy (SMA). A congenital condition where the spine and spinal cord do not develop properly, leading to varying degrees of paralysis and muscle weakness. Conditions affecting the transmission of signals from nerves to muscles, such as myasthenia gravis These conditions often result in muscle wasting, contractures and functional limitations, impacting daily activities, mobility, and quality of life.

Keywords: Efficacy • Spasticity • Systematic • Neuromuscular

Introduction

Muscle mass serves as a critical biomarker reflecting overall health status, functional capacity and disease progression in children with neuromuscular disabilities. Traditionally, muscle mass assessment has been challenging due to the variability in body composition and growth patterns among pediatric populations. However, advances in imaging techniques and Bioelectrical Impedance Analysis (BIA) have enabled more accurate and non-invasive measurement of muscle mass in clinical settings. A systematic review was conducted to identify relevant studies focusing on muscle mass as a biomarker in children with neuromuscular disabilities. Electronic databases were searched using predefined search terms, including "muscle mass", "body composition", "neuromuscular disabilities", "pediatrics" and related terms. Studies published in English from inception to current year were included. Additional studies were identified through manual reference screening of retrieved articles [1].

Various techniques were utilized to measure muscle mass in the included studies. DEXA scans assess body composition, including lean mass and fat mass, providing detailed insights into muscle mass distribution and changes over time. BIA estimates body composition by analyzing the impedance of electrical currents passing through body tissues. It is non-invasive and suitable for longitudinal monitoring of muscle mass in pediatric populations. Imaging modalities offer precise measurements of muscle cross-sectional area and volume, facilitating detailed analysis of muscle quality and distribution Simple anthropometric measurements, such as mid-upper arm circumference or skinfold thickness, provide estimates of muscle mass in resource-limited settings [2].

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Literature Review

Studies consistently demonstrated that muscle mass correlates with various health outcomes and functional parameters in children with neuromuscular disabilities Higher muscle mass is associated with improved mobility, strength and motor function. Children with greater muscle mass tend to have better performance in functional tasks, such as walking, climbing stairs, or Activities of Daily Living (ADLs). Muscle mass serves as an indicator of nutritional status and overall growth in pediatric populations. Poor muscle mass may indicat malnutrition or inadequate nutrient intake, affecting overall health and development. Progressive loss of muscle mass is observed in degenerative neuromuscular disorders, such as DMD, indicating disease progression and severity. Monitoring changes in muscle mass over time provides insights into disease course and response to treatment. The review highlighted the importance of integrating muscle mass assessment into comprehensive care plans for children with neuromuscular disabilities. Tailored exercise programs aimed at preserving or increasing muscle mass are essential for maintaining functional independence and improving quality of life. Adequate nutrition, including protein intake and micronutrient supplementation, plays a critical role in preserving muscle mass and optimizing growth in children with neuromuscular disabilities. Emerging therapies targeting muscle preservation or regeneration, such as corticosteroids in DMD or gene therapy in SMA, aim to slow disease progression and preserve muscle function [3-5].

Discussion

Despite its utility, several challenges and limitations in using muscle mass as a biomarker for children with neuromuscular disabilities were identified. Variability in disease severity, age and functional abilities among different neuromuscular disorders complicates the interpretation of muscle mass data. Differences in measurement techniques, calibration standards and operator expertise may introduce variability in muscle mass assessment across studies. Limited longitudinal studies tracking changes in muscle mass over time in pediatric populations hinder comprehensive understanding of disease progression and treatment efficacy. Future research directions include. Establishing standardized protocols for muscle mass assessment across pediatric neuromuscular populations to enhance comparability and reliability of study findings. Conducting longitudinal studies to explore the trajectory of muscle mass changes and their impact on health outcomes throughout childhood and adolescence. Evaluating the effectiveness of

targeted interventions, such as exercise programs or nutritional interventions, in preserving muscle mass and improving functional outcomes in children with neuromuscular disabilities [6].

Conclusion

In conclusion, muscle mass serves as a valuable biomarker for assessing health status, functional capacity and disease progression in children with neuromuscular disabilities. Advances in measurement techniques, including DEXA, BIA and imaging modalities, have improved our ability to quantify muscle mass accurately and non-invasively. Monitoring changes in muscle mass provides critical insights into treatment response, disease progression and overall well-being, guiding personalized care strategies for pediatric patients. Future research efforts should focus on standardization, longitudinal assessment and targeted interventions to optimize muscle health and enhance outcomes in this vulnerable population. By integrating muscle mass assessment into clinical practice, healthcare providers can improve care delivery and quality of life for children with neuromuscular disabilities.

Acknowledgement

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Conflict of Interest

None.

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