The Musculoskeletal Aspects of Obesity in Neuromuscular Conditions

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KEYWORDS

• Obesity • Spina bifida • Cerebral palsy • Muscular dystrophy • Musculoskeletal

KEY POINTS

- Obesity is extremely common in cerebral palsy, spina bifida, and Duchenne muscular dystrophy.
- Obesity in cerebral palsy can render computerized gait analysis less accurate.
- Obesity increases perioperative risks in neuromuscular patients, including an increased risk of infection after spinal instrumentation and fusion.
- Early dietary intervention and encouragement of physical activity through local health and wellness programs is imperative in controlling obesity in individuals with developmental disabilities.

OBESITY IN NEUROMUSCULAR CONDITIONS

Introduction

Obesity and overweight are epidemic among children in the United States.[1] The National Health and Nutrition Examination Survey (NHANES III) indicated that 14.4% of children and adolescents aged 2 to 19 years were overweight or obese.[2,3] A recent literature review revealed that the rate of obesity and overweight in children with disabilities was almost twice that of their nondisabled peers.[4] Furthermore, obesity is increasing in the United States and that increase is mirrored in patients with neuromuscular conditions. An investigation into the prevalence of obesity in ambulatory individuals with cerebral palsy (CP) disclosed an increase in the rate of obesity from 7.7% in the time period from 1994 to 1997 to 16.5% from 2003 to 2004.[5] Children with spina bifida have a 28% to 50% rate of obesity.[6–11] In addition to the typical health risks, obesity in individuals with neuromuscular disease can pose additional challenges. Ambulation may be a laborious process for these individuals and the additional weight can affect this adversely.[12,13] Evaluation of these patients for possible orthopedic surgery can be made less accurate by obscuring of bony landmarks. Computerized gait analysis can be affected because of difficulties with marker ball placement[14,15] and the motion of marker balls because of abdominal pannus.[16] The performance of orthopedic procedures may be rendered more difficult and the complication rate may be higher because of obesity.[17,18] This article reviews the pertinent literature on the orthopedic aspects of obesity in individuals with neuromuscular conditions.

CEREBRAL PALSY

Introduction

CP is the leading cause of childhood disability,[19] and occurs in 2 to 2.5 per 1000 live births.[20] The rate of obesity is increasing in able-bodied children, and this is reflected in individuals with CP.[5,21] Hurvitz and colleagues[21] retrospectively

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evaluated 137 children aged 2 to 18 years in a pediatric rehabilitation clinic. Body mass index (BMI) and Gross Motor Function Classification Score (GMFCS) were calculated and statistical analyses were performed. It was noted that 29.1% of children were considered overweight (>95th percentile) or at risk for overweight (85th–95th percentile). Ambulatory patients (GMFCS levels I and II) were more likely to be overweight than nonambulatory children (GMFCS levels IV and V). Underweight was more prevalent in nonambulatory children. In individuals with CP, the nonambulatory children are more likely to have feeding and swallowing dysfunction, which would confer on them a greater risk of underweight. A tendency for the more severely involved, nonambulatory children to be underweight has also been noted by other investigators.[22]

Multiple mechanisms may lead to overweight or obesity in children with CP. These children are often born premature or small for gestational age, both of which have been shown to be risk factors for obesity.[23–25] Body composition may be different in children with spastic quadriplegic CP, with a decrease in cell mass and expansion of the extracellular compartment.[26] Energy expenditure may be lower in these children and medical and social issues may restrict or preclude their participation in activities that are available to their able-bodied peers.[26–28] Risk of overweight in children and adolescents with CP are likely related to sedentary behavior. van den berg-Emons and colleagues[29] evaluated daily activity in 10 children with spastic diplegia and 10 children without disabilities. The children with CP were less active than their able-bodied peers, and the type of physical activity engaged in was not of an intensity that would be likely to improve their physical fitness. In addition, young people with spastic CP have been shown to have lower levels of aerobic capacity,[30,31] which may be partially caused by disruption of the reciprocal synchronization between agonist and antagonist muscle groups.[32]

Measurement

Measurement of BMI in individuals with CP and other disabilities may be problematic. Joint contractures, involuntary movements, and spinal deformity may render height or length measurement inaccurate.[20] Clinic personnel need to be adequately trained in measuring height in these individuals. Also, charts developed by the Centers for Disease Control and Prevention (www.cdc.gov) on BMI were developed for able-bodied individuals. Nevertheless, to date, BMI is the most practical and easily reproducible method for expressing body composition.

The Effect of Obesity on Health and Function

Individuals with neuromuscular conditions and obesity have the same general health problems as obese individuals without neuromuscular problems. Obviously, this carries significant implications with regard to the risk of cardiovascular disease and diabetes in adulthood. Peterson and colleagues[33] found that, in adults with CP, abdominal obesity highly correlated with vitamin D deficiency.

In a study of neurologically normal children, fractures, musculoskeletal discomfort (particularly knee pain), impaired mobility, and lower extremity malalignment were more common in obese children.[34] It has been shown that neurologically normal children with obesity alter their gait to adapt to increased mass.[35,36] Obese children tend to collapse into hip adduction on the stance phase side, resulting in a Trendelenburg gait. This gait increases valgus stress at the knee, increasing the likelihood of future knee pain and arthritis.[37] The effect of obesity on function in ambulatory patients with CP is not completely understood. It is known that the sudden increase in weight during the adolescent growth spurt in diplegic CP is related to worsening crouch gait,[38] which may be caused by a declining strength/body mass ratio.[39] An increase in adipose tissue versus lean body mass would have an even more deleterious effect than the mere increase in size seen during the growth spurt.

Meyns and colleagues[12] experimentally evaluated the effect of increased weight on gait analysis parameters in children with CP and in typically developing children by adding 10% body weight using a belt around the waist. They noted that typically developing children increased their walking velocity, increased their step and stride length, and decreased their duration of double support, whereas the opposite pattern was found in CP. Typically developing children increased joint ranges of motion, angular velocities, moments, and powers, whereas CP children did not. In short, it seemed that CP children lacked the ability to compensate for experimentally added weight. With regard to nonambulatory patients, obesity can interfere with transfers and add to the burden of caretakers.

The Effect of Obesity on Patient Evaluation

Imperative to the orthopedic treatment of patients with CP is an accurate physical