

CHILDHOOD OBESITY CASE STATEMENT

Childhood obesity has contributed to an increased incidence of significant musculoskeletal disorders at a younger age over the past two decades. These disorders, such as slipped capital femoral epiphysis (displacement through the growth plate of the hip) and Blount disease (a growth disorder causing severe bowing, deformity, and instability of the knee), not only cause pain and impact childhood growth and development but have also been clearly shown to lead to significant pain and disability in adults. However, there is limited research related to the impact of these and other childhood obesity-related musculoskeletal disorders. The impact of obesity on the musculoskeletal system clearly needs to be included in education, advocacy, and research programs because of its long-term detrimental effects, as well as the short-term interference that obesity-associated musculoskeletal disorders have with healthy, physical activities, thus contributing to the vicious cycle of worsening obesity.

The musculoskeletal impact of obesity is a critical component in the battle to restore a healthy lifestyle to our citizens not only in the US, but throughout the world. The U.S. Bone and Joint Decade (USBJD) and its network member organizations, which are groups concerned with musculoskeletal health, have the unique opportunity to raise awareness of musculoskeletal issues and those conditions that affect musculoskeletal health, and to make certain that these are addressed by local and federal governmental agencies. They are also able to advocate for research support and the development of treatment programs that will decrease the burden of musculoskeletal disease associated with childhood obesity.

There is an extensive body of literature as well as internet web sites dealing with the worldwide increased incidence of overweight and obese children. The deleterious metabolic

effects and concerns about the long-term increase of risk of heart disease and diabetes is well recognized. The long-term impact of obesity on the musculoskeletal growth, development and function, and potential development of poor bone health and degenerative joint disease as these children become adults has not been defined.

The Pediatric Strategic planning group of the U.S. Bone and Joint Decade (USBJD) has determined that encouraging healthy lifestyles and addressing the “epidemic” of childhood obesity and the consequent deleterious effects on the musculoskeletal system is the highest pediatric priority of the U.S. Bone and Joint Decade. At the Bone and Joint Decade Global Network Conference held in Washington, D.C. in October 2009, fighting obesity was also deemed a high priority for much of the international community.

The purpose of this case statement is to raise awareness of the impact of childhood obesity on the musculoskeletal system of children, the need to identify deficiencies in the knowledge of this impact, and to explore strategies to improve the musculoskeletal health of children through working with partner members of the USBJD.

High-visibility campaigns to combat the ‘epidemic’ of childhood obesity, like the initiative recently unveiled by First Lady Michelle Obama, have energized the efforts of multiple organizations and brought this issue to the forefront of public attention. However, the effects of this ‘epidemic’ on musculoskeletal health is essentially absent from these efforts. ^(1, 2, 3, 4, 5)

The childhood obesity issue is acknowledged by the Latino community ⁽⁶⁾ and was the subject of the HITN-TV weekly roundtable discussion program, Destination Casa Blanca, hosted by Ray Suarez. Discussion participants included a social worker, who emphasized the need for a family centered change towards healthier lifestyle, a diabetes educator who also discussed health consequences, and a public health physician who discussed how the power of advertising affects

food choices. The Hispanic Information and Telecommunications Network, Inc. (HITN- TV) provides Spanish language educational television programming in the United States to advance the educational, social, cultural, and economic circumstances of Hispanics ⁽⁶⁾

An emphasis on obesity, rather than overall healthy lifestyle, may also have an unintended deleterious effect on children. The emphasis on obesity may push more children into eating disorders, including anorexia and bulimia, where the negative impact on the musculoskeletal system and overall health of children is clearly recognized. ^(7, 8) The media backlash engendered by the First Lady's campaign serves to caution those dealing with childhood overweight and obesity to broach the issue with sensitivity and compassion. ^(7,8)

International Scope of the Problem

Obesity is now recognized as a worldwide problem. Wang in 2006 demonstrated that with the exception of Russia and Poland in the 1990s, the prevalence of overweight and obesity has increased in almost all the countries studied. This finding is most profound in economically developed countries and in urbanized populations⁽⁹⁾ Kosli also showed significant prevalence of obesity not only in the US but also in the European Union and throughout the world ⁽¹⁰⁾

No area of the world is immune to this problem, with traditionally slender Chinese children showing the same metabolic abnormalities to obesity as children in other parts of the world ⁽¹¹⁾ However, there are relatively few review articles on the overall scope of the musculoskeletal problems related to obesity in children ^(12, 13)

Scope of the Problem: Pain

Obesity in adults has long been linked to musculoskeletal pain and post operative complications. A strong linkage of back pain to obesity in adults has not been proven⁽¹⁴⁾ Obesity has more recently also been reported to be associated with pain in children. The most common sites of discomfort in one study of obese children, (obesity defined as having a body mass index-BMI- in the 95th percentile for age- and sex- matched controls) were back pain in 39% of obese children, pain in the feet in 26%, and knee pain in 24%. The children with musculoskeletal pain in this study were older and taller, on average. Using BMI as the independent variable, Stovitz, et al found that children with hip, knee, or ankle pain had a significantly higher BMI than those children without pain in those joints⁽¹⁵⁾ . Overall, 45% of obese children reported back or lower extremity pain. This same institution had previously shown a negative impact of obesity on quality of life in children and adolescents⁽¹⁶⁾ Similarly, Timm, et al found that children with ankle injuries, matched for age and sex, who had BMI of >85th percentile had 44% greater chance of persistent pain at 6 months post injury, compared to 24% of children with a BMI of < 85th percentile.⁽¹⁷⁾ Others have also noted the increase in musculoskeletal pain in obese children and adolescents, which may perpetuate the cycle of ongoing obesity by decreasing their ability to participate in physical exercise^(18, 13) Childhood obesity may result in joint changes, leading to continued pain and an increased potential for osteoarthritis in adults. Lifestyle factors such as exercise, learned during childhood, may also impact the risk of an obese child growing into an obese adult. Obesity in adults has been correlated with work restricting pain of the knees and ankles⁽¹⁹⁾

Alignment/Gait Abnormalities

Concern over the long-term impact on joints of altered gait secondary to obesity has led to recommendation for further study⁽²⁰⁾. There is no significant information as to the long-term effect this alteration will have as these children become adults. It is of great concern that obese children and adolescents are already presenting with significant pain and malalignments at a very young age and that this may be a precursor to early degenerative arthritis as an adult⁽²¹⁾. Further research into this area is essential as it is well recognized that malalignment and secondary degenerative changes clearly have a significant impact on life style and function in adults, leading to lost productivity and diminished health.

Gait abnormality secondary to obesity has been noted for many years. Varus loading of the knee, which may be related to large thighs, places excessive stress on the medial side of the knee. This may contribute to the development of Blount's disease^(22, 23) as well as degenerative changes of the knee^(24, 25). This data has showed that the underlying static varus malalignment is not necessarily a prerequisite for the development of adolescent tibial vara, and that the dynamic gait deviation is secondary to the obesity, which was referred to as the 'fat thigh gait' and is significant in development of Blount's⁽²⁵⁾

Slipped Capital Femoral Epiphysis

The etiology of slipped capital femoral epiphysis is thought to be multifactorial. The association of this diagnosis with overweight conditions has been found in several countries, including the United States⁽²⁶⁾. Manoff in 2005 evaluated the correlation between BMI and the incidence of SCFE, utilizing the Center for Disease Control and Prevention BMI for age percentile growth charts. For those with slipped capital femoral epiphysis, 81.1% of the

individuals had a BMI above the 95th percentile for age and sex; for those without SCFE, the corresponding figure was only 41.3%. Manoff stated that when children whose BMI is between the 85th and 95th percentile are identified, lifestyle modifications may not only potentially decrease the incidence of SCFE but that of other illnesses related to obesity as well. ⁽²⁷⁾

The mechanism of this increased risk of SCFE among obese children and adolescents has not been clarified. One proposed mechanism is the increased remodeling of the femoral neck seen among obese children ⁽²⁸⁾. Decreased femoral anteversion, which is known to be a predisposing factor in children with slipped capital femoral epiphysis, has been reported at a higher incidence in children with obesity.

To clarify the epidemiology of idiopathic SCFE that occurred in children between 9 and 16 years of age, Lehman, et al 2006, compared data from the Kids Inpatient Database and US Census Bureau data for the years 1997 and 2000 ⁽²⁹⁾. They noted that the overall incidence of slipped capital femoral epiphysis during those years was 10.8 cases/100,000 children. The relative incidence was 3.94 times higher in African-American children and 2.53 times higher in Hispanic children than in Caucasian children. They also noted geographic differences in incidence, as well as a lower age of onset than had been previously reported, stating that this may suggest a downward trend in age of presentation ⁽²⁹⁾. However, despite this trend toward decreasing chronologic age at presentation, Loder noted in 2006 that bone age at presentation was essentially unchanged regardless of chronological age. This was a reflection of children maturing physically at a younger chronologic age. ⁽³⁰⁾ This more rapid rate of physical maturation maybe related to overweight conditions in some children.

Decreased femoral anteversion, which is known to be a predisposing factor in children with slipped capital femoral epiphysis, has been reported at a higher incidence in children with obesity. The obesity has been reported as causing an increased remodeling of the femoral neck⁽²⁸⁾

Several authors have noted an increase in the incidence of SCFE. Benson, et al reported that the incidence of slipped capital femoral epiphysis in New Mexico had doubled from between the 1960s and the report in 2008. The authors also noted that the National Health and Nutrition Examination survey data from 2003-2004 indicated that the rates of obesity have tripled since 1971.⁽³¹⁾ This changing incidence of slipped capital femoral epiphysis was also noted in Scotland, where the incidence of slipped capital femoral epiphysis increased from 3.78/100,000 children in 1981 to 9.66/100,000 in 2000. This reflected a 2.5 times increase in incidence over two decades. The authors also noted what had been reported in other studies, that SCFE was seen at younger ages during the course of the study, with the average age at presentation decreasing from 13.4 to 12.6 years for boys, and from 12.2 to 11.6 years of age for girls. They also noted that there were more children with SCFE less than 8 years of age in the decade prior to 2000 compared to the previous decade. The opinion of the authors was that this change was related to the increase in childhood obesity over the preceding 20 years.⁽³²⁾ Bowen, in 2009, compared the associations among slipped capital femoral epiphysis, Blount's disease, and Type II juvenile diabetes. They noted that the tibia vara group had the highest body mass index, averaging 40.81, the diabetes group 35.76, and the slipped capital femoral epiphysis group 29.08. They demonstrated no overlap of disease at initial presentation among the slipped capital femoral epiphysis, tibia vara, or Type II diabetes groups.⁽³³⁾

The relationship of endocrine abnormalities with slipped capital femoral epiphyses, especially in younger children, has been noted in the past. There have been no recent reports however of an increase in the incidence of endocrine problems⁽³⁴⁾ In one report by Loder, et al it was noted that of those children with hypothyroidism, no slips occurred after they had started hormone replacement therapy. However, the slips in patients with growth hormone deficiency usually have the endocrinopathy diagnosed before the slip. All of the hypothyroid patients developed the first slip before or during hormonal supplementation, whereas 92% of the growth hormone deficient children developed a slip during or after supplementation. It was noted that because of the prevalence of 61% bilaterality in this group, prophylactic treatment of the opposite hip should be considered.⁽³⁵⁾

Fractures

There have been reports of an increasing incidence of distal radial fractures and forearm fractures in children over the past few decades. It is unclear whether this is related to changing patterns of physical activity, decreased bone acquisition due to poor calcium and vitamin D intake, or other factors.⁽³⁶⁾ Complications of treating fractures, at least of the femur, have been reported to be higher in children with obesity. However, these numbers are small and the association with higher complications in these children will need to be studied further^(37,38) It is also unclear whether obese children have a higher incidence of fractures overall because of issues of proprioception and balance, as well as lower extremity malalignment

There have been reports that overweight and obese children have low bone mass and area for their weight⁽³⁹⁾ More recent research that shows that children with obesity have a greater weight for height for age, advanced maturation for age, and a greater lean mass for height⁽⁴⁰⁾ In the same paper, Leonard et al demonstrated that obesity is associated with greater vertebral area

bone mineral density for height, greater bone mineral density volume, and a greater vertebral bone mineral concentration for bone area. In a population of obese children undergoing successful weight loss, Stettler et al demonstrated that the unadjusted bone mineral concentration (BMC) increased among the obese adolescents, despite this weight loss. They stated that after adjustment for height, the whole body BMC did not change significantly from baseline to 12 months.⁽⁴¹⁾ There is further study being undertaken on bone loss of obese adolescents during weight loss.⁽⁴²⁾ The relationship between childhood obesity and the accumulation of peak bone mass and risk of fractures, as well as the impact of weight loss on these variables, needs additional research.

SUMMARY AND CONCLUSIONS

The impact of obesity (typically defined as a body mass index over the 95th percentile matched for age and sex) in children, as it relates to metabolic diseases such as diabetes and heart disease, cannot be emphasized enough. Unfortunately, limited literature exists examining the associated musculoskeletal problems. However, clinicians are recognizing that obese children and adolescents are presenting with significant musculoskeletal abnormalities, especially pain and developmental issues of the lower extremities, and a higher rate of fractures. There are also significant musculoskeletal problems associated with the opposite end of the spectrum; these are the eating disorders. It is important that these children be included in efforts related to maintaining a healthy lifestyle, as the impact of eating disorders may be equally as devastating as obesity.

There is also relatively little documentation of the chronic joint problems and chronic pain syndromes with which these children present. The long-term implications of significant obesity and/or overweight on joint function and overall musculoskeletal health as these

individuals enter adulthood is unclear. However, the association of bone and joint diseases and malalignment with obesity is clearly described in adults. It is unfathomable that obese children with significant malalignment and significant increased joint reactive forces will not develop degenerative changes at a relatively early age.

The role of Vitamin D and mineral supplementation in a healthy diet is also not clear in children and requires further areas of emphasis and research. It is becoming increasingly recognized that many children are Vitamin D deficient, both from a dietary as well as a sun-exposure standpoint. This obviously has implications long-term not only for musculoskeletal health, but also for many other potential medical conditions.

There are many resources at this time to help clinicians as well as families deal with childhood obesity^(43, 44, 45, 46) There are also many resources easily available to encourage healthy lifestyles, public fitness, and musculoskeletal activity^(47, 48, 49, 50, 51, 52, 53,). There needs to be increasing awareness of the significant short- and long-term impact of childhood obesity and lifestyle issues on musculoskeletal health, as well as availability of existing resources to children, parents, schools, and social and sports organizations to intervene to reverse this trend.

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