

RESEARCH ABSTRACT

CHILDHOOD OBESITY AND KNEE JOINT STRESS

Gushue, D., Houck, J., and Lerner, A. "Effects of childhood obesity on three-dimensional knee joint biomechanics during walking." *Journal of Pediatric Orthopaedics*, 2005; 25(6):763-768.

INTRODUCTION

In the past 25 years, the prevalence of overweight children in the United States has quadrupled: An estimated 30 percent of children and adolescents are either overweight or at risk for being overweight. Previous studies have revealed strong associations between obesity and increased risk for knee osteoarthritis (OA) in adults. This presumably is because of increased uneven loading of the joint during weight-bearing activities. This imbalance of knee joint loading also may be present in obese children and adolescents, increasing their risk of OA later in life.

The purpose of this investigation was to quantify the three-dimensional knee joint stresses that occur during walking in children and adolescents of varying body masses.

METHODS

Ten overweight children (seven boys, three girls) and 13 children of normal weight (six boys, seven girls) participated in this study. Obesity was defined as being at or above the 95th percentile of body mass index, or BMI, for age. Normal weight was defined as at or above the 15th percentile but less than the 85th percentile of BMI for age. Any individuals who reported orthopedic or neurological problems that might influence gait were excluded from this study.

Subjects walked on a level walkway containing two identical



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force plates to measure vertical, horizontal and anterior-posterior ground reaction forces. Joint markers were placed on the foot, leg, thigh, pelvis and trunk of each subject. A motion analysis system was used to determine lower extremity joint mechanics.

RESULTS

Compared with the normal-weight group, the overweight group had reduced knee flexion during early stance and exhibited a significantly greater peak knee compressive force. No differences were found in the knee flexion torques between overweight and normal weight subjects. However, overweight children walked with 40 percent greater knee varus torque (lateral knee thrust). A high knee varus torque results in an increased compressive force in the medial aspect of the knee.

DISCUSSION

The results of this study illustrate that children in the overweight group walked with

similar knee flexion torques compared with the normal-weight group. However, they exhibited increased varus torques at the knee compared with the normal-weight group. While body mass was different between the two groups, height and age were similar. Therefore, the gait differences identified between the two groups likely related to body mass.

Other studies have reported that high varus torques at the knee increase an adult's risk for the development and progression of knee osteoarthritis. This suggests that obese children with associated high varus torques may be at risk for the development and earlier onset of knee OA. By addressing these risk factors early in life, we may be able to reduce the incidence of debilitating knee injuries in later adulthood. ■

– Article by Ryan Shelton



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GROWING PROBLEM: CHILDHOOD OBESITY

Perhaps it will take a government solution to reign in skyrocketing healthcare costs, but there's plenty of fat – literally – for the American population to cut.

Medical spending for obesity reached \$147 billion in 2008, an 87 percent increase in the past decade, according to a recent study published in *Health Affairs: The Policy Journal of the Health Sphere*. In other words, nearly 10 percent of health spending is for obesity.

While two-thirds of Americans are overweight or obese, the most alarming trend is among children. "The cumulative effect," according to a 2008 article in *The Washington Post*, "could be the country's first generation destined to have a shorter life span than its predecessor."

The Centers for Disease Control and Prevention reported that the number of obese children between the ages of 6 and 11 has doubled, while the number of obese adolescents has tripled over the past 20 years.

Obese children are more likely to remain obese into adulthood. In fact, a recent study found that 80 percent of children who were overweight at ages 10 to 15 were obese adults at age 25.

What's more, childhood obesity presents grave health consequences:

- Obese children often present with high cholesterol levels, elevated blood pressure and abnormal glucose levels.



- One study found that 70 percent of obese children between the ages of 5 and 17 had at least one of the recognized risk factors for cardiovascular disease; 39 percent had two or more risk factors.

- Type 2 diabetes, a serious disease that affects the neurologic and cardiovascular systems, has historically been a disease of obese adults. However, there has been an alarming increase in the diagnosis of Type 2 diabetes in obese children. This is significant, as the complications of diabetes are known to increase in severity with the duration of the disease.

- Asthma, a condition in which narrowed airways cause difficult breathing, has been associated with childhood obesity.
- Sleep apnea is another pulmonary

complication that occurs in 7 percent of this population. It is characterized by labored breathing, with brief cessations of breathing during sleep, which can lead to dramatic drops in blood oxygen.

There are also significant psychosocial consequences to childhood obesity. Obese children often are ridiculed by their peers, which studies have shown can lead to low self-esteem. This, in turn, can have detrimental effects on academic performance and social functioning.

CONTRIBUTING FACTORS

Multiple factors contribute to childhood obesity.

Genetic: Obesity tends to run in families. Overweight women are more likely to give birth to bigger babies, who are

more likely to become obese, according to *The Washington Post*. However, genetics are only a piece of the puzzle. As the CDC notes, the genetic characteristics of the human population have not changed in the past three decades while obesity has tripled among school-age children.

Behavioral: Large portion sizes, frequent snacking, and beverages with added sugar all contribute to high caloric intake. At the same time, children are less active: daily participation in school physical education among adolescents has dropped 14 percent over the last 13 years. Funding for sports has declined, resulting in fewer after-school physical activity options.

Environmental: With advances in technology and online social networking, children have substituted inside, sedentary activities for outside, physical activities. Gone are the days when children walked to school and rode their bikes for transportation. With suburbanization, children ride buses to school and are driven to friends' homes, the mall, movie theaters. With both parents working and tending to all of their responsibilities, there is little time left for physical recreation with the family.

Clearly, the prevention and early management of childhood obesity is critical. The Centers for Disease Control and Prevention has teamed with 23 state health departments to create the Nutrition, Physical

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Activity and Obesity Program. The overall objective of the program is to prevent and control obesity and other chronic diseases by promoting physical activity and better dietary habits. Meanwhile, 20 states have passed requirements for body mass index and other weight-related screenings in schools.

HOW PARENTS CAN HELP

But parents hold the key to the prevention of childhood obesity. (They're increasingly being held accountable for their children's weight problems, too. In one of many recent high-profile legal cases, a mother was charged with the criminal neglect of her 14-year-old son who reached a weight of 555 pounds.)

Among the ways that parents can help to reduce the risk of their child becoming obese:

- Schedule yearly well-child visits. A pediatrician will measure height and weight, and thus assess the risk of a child becoming overweight.
- Advocate for healthy food and drink choices at school.
- At home, serve healthful meals and snacks.
- Never used food as a reward or punishment.
- Most important, parents must serve as good role models for their children, engaging in healthy eating habits and physical activity themselves.
- Encourage family activities that are physical in nature, such as hikes, bike rides and backyard games. Parents should limit the

time children spend watching television or with the computer.

At the community level, parents should work with local leaders to provide sidewalks, safe bike paths, and neighborhood parks to encourage children to become more active.

If a child is overweight, parents should be positive and praise signs of progress. They should talk with their child about his or her feelings, and focus on positive goals. They should seek medical advice and discuss the possibility of a physical therapy conditioning program with their physician. The influence of an involved and loving parent can make all the difference in the world.

REFERENCES:

Ogden, C.L., Carroll, M.D., Flegal, K.M. "High body mass index for age among U.S. children and adolescents, 2003-2006," *Journal of American Medical Association*, 2008;299:2401-2405.

Whitaker, R.C., Wright, J.A., Pepe, M.S., Seidel, K.D., Dietz, W.H. "Predicting obesity in young adulthood from childhood and parental obesity," *New England Journal of Medicine*, 1997; 37(13):869-873.

Eaton, D.K., Kann, L., Kinchen, S., Ross, J., Hawkins, J., Harris, W.A., et al. "Youth risk behavior surveillance - United States, 2005," *MMWR Surveillance Summary*, 2006; SS-5 (55).

Freedman, D.S., Mei, Z., Srinivasan, S.R., Berenson, G.S., Dietz, W.H. "Cardiovascular risk factors and excess adiposity among overweight children and adolescents: the Bogalusa Heart Study," *Journal of Pediatrics*, January 2007;150(1):12-17.e2.

Luder, E., Melnik, T.A., Dimaio, M. "Association of being overweight with greater asthma symptoms in inner-city black and Hispanic children," *Journal of Pediatrics*, 1998;132:699-703.

Mallory, G.B., Fiser, D.H., Jackson, R. "Sleep-associated breathing disorders in morbidly obese children and adolescents," *Journal of Pediatrics*, 1989;115:892-897.

Dietz, W. "Health consequences of obesity in youth: childhood predictors of adult disease," *Pediatrics*, 1998;101:518-525.

Swartz, M.B., and Puhl, R. "Childhood obesity: a societal problem to solve," *Obesity Reviews*, 2003; 4(1):57-71. ▀

— Article by Joaquin Barrios



Q&A

CHILDHOOD OBESITY

IN CHILDREN, WHAT IS THE DIFFERENCE BETWEEN BEING OVERWEIGHT AND BEING OBESE?

According to the Centers for Disease Control and Prevention, an overweight child is defined as having a body mass index (BMI) at or above the 85th percentile, but lower than the 95th percentile of age-matched data. Obese children have BMIs equal to or greater than the 95th percentile of their age and gender. Currently, more than 30 percent of children and adolescents are considered overweight or obese.

WHAT IS BMI?

It is the most commonly used method to identify obesity in children and adults, providing an indirect measure of body fat. It takes into account weight and height and is the ratio of weight/height squared. BMI is not as accurate as underwater weighing, which is considered the gold standard measure of body fat. However, BMI is a much more convenient measure and has been shown to correlate well with body fat percentage.

WHAT IS THE IMPACT OF CHILDHOOD OBESITY?

Obesity increases risks for developing early cardiovascular disease, type 2 diabetes, hypertension, high cholesterol, asthma and sleep apnea. A low fitness level and excess body weight also may predispose these individuals to increased musculoskeletal injuries of the lower extremity. Recent studies have shown that overweight and obese adolescents suffer lower extremity injuries more often than their normal-weight peers. It has been suggested that dynamic balance is reduced in obese adolescents. Obese adolescents may be at greater risk for sustaining ankle sprains and traumatic knee injuries such as anterior cruciate ligament ruptures. The prevalence of skeletal

fractures has been found to be significantly greater in overweight children and adolescents.

WHAT RISK FACTORS ARE ASSOCIATED WITH OBESITY?

There is a strong relationship between genetic and environmental factors. Genetic influences may include high birth weight, maternal diabetes and obesity in family members. Before 3 years of age, parental obesity is a stronger predictor of obesity than the child's weight status. Recent studies indicate that children are less active than in the past, reflecting the increase in sedentary leisure activities including television, videos and computer games. Fewer than 28 percent of adolescents meet recommended levels of activity. A recent study found that 80 percent of obese 15-year-olds go on to become obese adults.

WHAT CAN BE DONE ABOUT CHILDHOOD AND ADOLESCENT OBESITY?

The American Heart Association recommends that all children ages 2 and older participate in at least 60 minutes of enjoyable, moderate-to-vigorous physical activity every day. Decreasing portion sizes and limiting foods with added sugar also may assist with avoiding obesity.

HOW CAN PHYSICAL THERAPY HELP?

A physical therapist may be involved in the evaluation and treatment of lower extremity musculoskeletal injuries associated with increased body weight and loading of joints. The early treatment of an injury can help remove a potential barrier to accomplishing recommended daily exercise levels. Treatment may include therapeutic exercise, stretching and aerobic exercises to address biomechanical deficits. ▀

— Article by William Young

CASE STUDY

PHYSICAL THERAPY'S ROLE IN MITIGATING CHILDHOOD OBESITY RISK FACTORS

The medical consequences of childhood obesity can be serious, including type 2 diabetes, hypertension, high cholesterol, orthopedic complications and psychosocial difficulties. The referral of children to physical therapy for obesity, deconditioning (a condition of compromised health and fitness that makes daily activities difficult), and related orthopedic conditions is becoming more common.

PATIENT HISTORY

The following is a case review of an 11-year-old boy who, when he began physical therapy, was 4-foot-11 and weighed 195 pounds. He reported a long history of bilateral knee pain, which eventually brought him to his family physician. Upon examination, his physician concluded that his overall physical status was a serious concern. Besides suffering from anterior knee pain, the patient was a hypertensive, borderline diabetic and grossly out of shape. However, he was highly motivated to play baseball without knee pain and to get in shape.

He had bilateral anterior knee pain, with excessive hip internal rotation, genu valgum and foot/ankle pronation, which was evident in stance and accentuated with gait. He exhibited significant trunk and lower extremity weakness. Stair negotiation was difficult without the use of a handrail. Sit-to-stand transfers required push-off of the upper extremities. He was only able to walk for 5.5 minutes before requiring rest.



ASSESSMENT

During his first physical therapy visit, the patient was educated about the effect that his weight had on his knee pain. He was told of the positive effects exercise could have on this pain as well as his other, more serious health conditions. The patient's mother regretted having allowed her son to become so inactive because of ongoing complaints of knee pain. She assured the therapist that she was committed to helping her son achieve

his goal: to play youth baseball without knee pain.

TREATMENT

The patient was seen three times per week for six weeks. He was weighed at the beginning of each session. After a brief warm-up and stretch period, patellar taping was applied. This significantly reduced his knee symptoms, allowing him to tolerate exercises targeted specifically at strengthening his trunk and lower extremities. An over-the-

counter orthotic was prescribed early in his rehabilitation to help improve his lower extremity mechanics. Cardiovascular exercises using a bike, a treadmill and an elliptical machine were emphasized and gradually progressed. Ice was applied to his knees after each session to control post-exercise inflammation.

OUTCOME

Initially, the patient was exhausted after just 15 minutes of exercise. By the end of his therapy, he no longer required taping and was performing 1.5 hours of activity. At the conclusion of his treatments, he weighed 184 pounds (a loss of 11), was pain-free and was participating in youth baseball. What's more, his blood sugar values had improved significantly, further underscoring the many positive effects of exercise.

In a follow-up phone conversation five months after discharge, the patient's mother reported that her son was much happier and remained motivated to exercise to prevent a return of his knee pain.

SUMMARY

This case study underscores the negative effect that obesity can have on children. It also highlights the role that physical therapy can play in mitigating the risk factors associated with childhood obesity. The patient's motivation and strong family support were critical to the success of this case. ▀

— Article by Jim Couch

RESOURCES

www.cdc.gov/obesity/childhood
www.americanheart.org/children