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USDA/ARS
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at Baylor College of Medicine

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NUTRITION & YOUR CHILD

UNDERSTANDING CHILDREN'S GROWTH PATTERNS DURING THE SCHOOL YEAR AND SUMMERTIME

Several studies have been conducted that focus on children's height and weight changes throughout the school year and summer months. Some suggest that children's body mass index (BMI, a measure of one's weight for one's height) increases at a faster rate during the summer, while others demonstrate that seasonality plays a role in their height and weight gain throughout the year. A Baylor College of Medicine expert discusses her findings in a literature review, published in *Obesity Reviews.*

"My early research identified that summertime is a time when children increase their standardized BMI, (i.e., a measure of BMI that is also normalized to account for both a child's age and sex) at a fast rate compared to the school year. That has led us to conclude that the summertime might be an important time to intervene with children for the prevention of obesity," said Dr. Jennette Moreno, assistant professor of pediatrics at the USDA/ARS Children's Nutrition Research Center at Baylor.

According to previous reviews of obesity interventions, 60 to 82 percent of obesity prevention programs are school-based interventions, suggesting that we may be ignoring an important time to intervene and avert the development of obesity among elementary-aged children. While school based studies typically measure students once at the beginning of the fall semester and once at the end of the spring semester, some older studies conducted monthly measurements of children's height. These older studies suggest seasonality may affect the timing of the greatest increases in children's height and weight rather than the effects attributed to the school year or to the summer environment.

A previous study looked at evidence of height seasonality across 7-to-8-year-old children with complete blindness, children who were sighted, and children with partial sight. The study found that children who were blind and partially sighted demonstrated increases in their height that occurred across the year. In the sighted children, the timing of the maximum increases in height gain occurred between January and June, suggesting that the timing of their greatest height increases were entrained or synchronized by the light-dark cycle.

"We know that our circadian and seasonal rhythms are entrained by light exposure that is captured through the eyes and transmitted to the superchiasmatic nucleus in the brain," Moreno said. "This study is unique in that we can see differences between children who have the ability to be entrained versus those who don't."

Another study randomized children to either receive light therapy (exposure to additional light) in the winter or not at all. Researchers found that the children who received seven hours of light therapy in the winter gained greater amounts of height in the winter. The children who received no light therapy did not gain as much height during that winter time period, however they caught up during summer and, by the end, gained the same total amount, suggesting that light exposure helps to synchronize the timing of when height gain occurs. This is important because height is part of the BMI calculation and children are growing between measurements of BMI. Thus, growth differences may explain some of the seasonal differences in children's BMI.

A cross-sectional study looked at 70,000 children in Wisconsin between 5 and 16 years old and reviewed their

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SCIENTISTS CREATE 'EPIGENETIC COUCH POTATO' MOUSE

Why is it that some people love to exercise, and others hate it? A Baylor College of Medicine-led study in mice shows for the first time that "epigenetics" may play an important role. In simple terms, epigenetics is the way that genes are regulated (turned on or off) differently in different cell types. For example, when a certain type of chemical tag, called a methyl group, is added to DNA of a gene inside a cell, it can turn the gene off. The findings suggest a potential way to help 'program' people to enjoy physical activity.

In the journal *Nature Communications,* Baylor researchers and colleagues report the surprising creation of an 'epigenetic couch potato' mouse. They found that DNA methylation in cells in a part of the brain called the hypothalamus had a major effect on how much the mice exercised.

"We study developmental programming, which refers to how the environment during development can have a long term impact on risk of disease," said corresponding author, Dr. Robert A. Waterland, professor of pediatrics – nutrition at the USDA/ARS Children's Nutrition Research Center at Baylor College of Medicine.

Over the last several years, the researchers studied various mouse models to understand developmental programming of energy balance, that is, the balance of calories consumed vs. those burned off. Over time, positive energy balance leads to obesity. Remarkably, whether the early environmental influence was growth restriction in the womb, infant overfeeding, or maternal exercise during pregnancy, the long-term effect on energy balance was always due to long-term changes in physical activity, not food intake.

"Our earlier findings suggested that establishment of one's physical activity 'set point' can be affected by early environment, and that this may involve epigenetics," said Waterland, who also is a professor of molecular and human genetics and a member of the Dan L Duncan Comprehensive Cancer Center at Baylor.

How the brain regulates the body's energy balance

In the current study, Waterland and his colleagues designed an experiment to directly test whether DNA methylation in the brain affects energy balance. They focused on the hypothalamus, a brain region that plays a central role in energy balance.

By disabling the *Dnmt3a* gene, the researchers reduced DNA methylation specifically in neurons known to regulate food intake, called Agrp neurons. *Dnmt3a* is responsible for adding methyl groups to DNA, particularly in the brain during early life right after birth. The investigators then tested whether these animals gained or lost weight when compared to normal mice.

"We expected that interfering with DNA methylation in AgRP neurons would result in major changes in the animals' weight," said Dr. Harry MacKay, a postdoctoral fellow in the Waterland lab and first author of the study. "Somewhat disappointingly,

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THE ROLE OF PARENTAL PERCEPTION OF CHILD'S WEIGHT

With obesity being a significant health issue nationally, researchers are continually seeking to understand factors that contribute to excess weight gain. In a recent study led by investigators at the USDA/ARS Children's Nutrition Research Center at Baylor College of Medicine, researchers wanted to learn whether parents' perceptions of their child's weight impacted their feeding practices.

"There are many studies looking at how parents perceived the weight of their child. These studies show that in some racial/ethnic groups, a larger child is seen as a healthier child. We were interested in whether parents' perceptions of their child's weight characteristics may predict how they feed their child," said Dr. Sheryl Hughes, associate professor of pediatrics at the CNRC and contributor to the study, published in the journal *Appetite*.

This was part of a larger study of Hispanic Head Start preschoolers and their mothers. The current study used cross-sectional data to examine associations between mothers' feeding behaviors and their perceptions of their preschoolers' weight status. Also, the child's actual weight status and mothers' concern about their child's weight was taken into consideration.

The study found that mothers' perceptions of their child's body weight were not related to most of the feeding behaviors measured (97% of mothers of overweight or obese children underestimated their child's weight). Instead, children's actual weight status was the strongest predictor of mothers' feeding behaviors.

"Contrary to what we expected, mothers of children with a higher weight status reported higher levels of healthy eating guidance and responsiveness during feeding and lower levels of pressuring the child to eat, using food as a reward, and using food to regulate the child's emotions," Hughes said.

These mothers were more likely to show an indulgent feeding style in which the mothers are very responsive to their child's wishes and set very few boundaries. They were less likely to show an authoritarian type feeding style, one in which mothers are strict disciplinarians and expect their child to obey every command. Mothers' perceptions only mattered when they used strategies during child feeding episodes to restrict certain foods for weight purposes. This information can be used when developing childhood obesity prevention programs for preschoolers.

Other contributors to this study included Jackelyn Hidalgo-Mendez and Thomas Power, Washington State University; Jennifer Orlet Fisher, Temple University Center for Obesity Research and Education; and Teresia O'Connor, CNRC.

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however, the *Dnmt3a*-deficient mice were only slightly fatter than those that were not deficient."

But when the researchers explored why the mice with less methylation were fatter than the normal mice, things got more interesting. The team expected to find differences in food intake between normal and *Dnmt3a*-deficient mice, but there were none. Instead, they found a major difference in spontaneous physical exercise.

The researchers placed running wheels in the animals' cages for eight weeks and measured how much they ran each night. Normal male mice ran about 6 km (3.7 miles) every night, but the *Dnmt3a*-deficient mice ran only half as much and, accordingly, lost less fat. Importantly, detailed treadmill studies showed that, although they ran only half as much as normal mice, the *Dnmt3a*-deficient mice were just as capable of running. They had the ability, but appeared to lack the desire.

"Our findings suggest that epigenetic mechanisms, such as DNA methylation, that are established in the brain during fetal or early postnatal life, play a role in determining individual propensity for exercise," Waterland said. "Nowadays, as decreases in physical activity contribute to the worldwide obesity epidemic, it is increasingly important to understand how all of this works." In the meantime, it makes sense to focus on developing healthy routines and finding opportunities for physical activity that you and your family can enjoy together.

Other authors contributing to this work include Harry MacKay, C. Anthony Scott, Jack D. Duryea, Maria S. Baker, Eleonora Laritsky, Marta L. Fiorotto, Rui Chen, Yumei Li and Cristian Coarfa (Baylor College of Medicine); Amanda E. Elson and Richard B. Simerly (Vanderbilt University) and Theodore Garland Jr. (University of California at Riverside).

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electronic medical records. Researchers looked at the seasonality of standardized BMI among pediatric patients, and found that contrary to the school-based studies, children decreased their standardized BMI during the summertime. The researchers then asked the question: if only two measurements had been made at the same time periods that school based studies do, what would the results have been? The researchers found that if they cut the year into two segments, separating the school year and summer, they would have found an increase of standardized BMI in summer months. This analysis suggested more frequent measurements are needed to better understand children's growth and weight gain.

"By not measuring frequently enough, we're missing important patterns in children's height and weight gain, which could lead us to some incorrect conclusions," she said.

Moreno went on to propose reasons for why we might see seasonal influences on children's height and weight. For seasonality in children's height, she based her reasoning on a 2015 paper published in *Nature Communications* that found that there is seasonality in the expression of one's genes that regulate growth related pathways, explaining why children grow more at certain times of the year.

Changes in weight may have to do with the seasonal differences in melatonin duration. Melatonin is the sleep-promoting hormone of darkness, and it is secreted at night when it is dark outside. When the nights are longer, melatonin duration is longer. Melatonin duration lasts longer in the wintertime, whereas the nights are shorter in the summer. Adults have a shorter sleep duration during the summertime. According to Moreno, the current importance of melatonin in sleep cycle regulation is controversial because modern lighting allows us to extend the "daytime" by self-selecting exposure to light and dark. In other words, we now have the power, literally, to extend the daytime. In winter months particularly, adults do not demonstrate significant differences in their melatonin duration between the winter and summer. Unfortunately, there is not enough evidence to confirm that this applies to children as well.

However melatonin is known to inhibit insulin secretion. Insulin is needed in order to let glucose into the cells for energy metabolism, especially brain activity. Insulin secretion by the pancreas responds to dietary ingestion of glucose. At night, when we are not eating, insulin secretion is low and this is responsible for accelerated release of fats by our fat cells to supply energy to sustain the overnight fast. Thus, if the duration of melatonin release is shortened, the period of time your body is engaged in lipolysis is likewise shortened and this may have a small impact on weight.

"Before investing a lot of resources in interventions targeting summertime, we really need to understand if this is really due to an increase in more obesogenic behaviors during summer, like eating more, or if it is something that seems to be regulated by naturally occurring biological phenomenon, like seasonal light/dark cycles," Moreno said. "It is also possible that a combination of behavioral and seasonal influences contribute to excess summer weight gain. For example, it is possible that children are primed to gain weight during summer, but the co-occurrence of unhealthy behaviors such as going to bed late, snacking late at night, and sedentary behavior may create the perfect storm for excess weight gain in children."

More studies are needed to understand the influences of seasonality of children's height and weight gain, and how these impact the development of obesity in children during the summer. This line of research may suggest that instead of just focusing either on the school year or on the summer individually, perhaps interventions should be developed to target specific "physiological" time periods, as there may be different behaviors that impact children's increases in BMI during the school year as well as the summer." To address this need, Moreno is leading a study to examine the feasibility of a summertime intervention designed to promote healthy sleep and robust circadian rhythms in children for the prevention of accelerated summer weight gain.

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JOIN A CNRC NUTRITION STUDY!

Houston-area residents are invited to participate in the following nutrition research projects designed to help CNRC scientists learn more about the nutritional needs of children. Free parking is provided. For most studies financial compensation is provided. For questions on becoming a CNRC research volunteer, call Noemi Islam at 713.798.7002 or email nislam@bcm.edu.

Type 2 Diabetic Volunteers Needed H-34291

Eligible participants must be Black or Hispanic men and women, between the ages of 20 and 60 years, diagnosed with type 2 diabetes within the last 10 years, overweight and with no other chronic medical conditions. The study will investigate whether type 2 diabetic patients make an important compound called arginine in different amounts. Free parking and financial compensation is provided. For more information, contact Adriana Cardenas at 713.798.7003 or adriana.cardenas@bcm.edu.

Teen Talk Study H-46202

Baylor College of Medicine is recruiting 14-17 year olds living in rural communities and their parents to help us understand what affects their food and physical activity choices and body weight. For more information, please contact Chishinga Callender at 713.798.0506 or Noemi Islam at 713-798-7002.

Teen Heart Health H-30665

12-21 year old adolescents and young adults (normal weight and overweight) with and without type 2 diabetes are needed for a research study investigating risk for heart disease in youth. Study involves body composition, scan and blood tests. If interested, please call us at 713.798.6791.

Bone Health Study H-45986

Adolescents and young adults, ages 12-21 years, normal weight and overweight with and without type 2 diabetes are needed for a research study to investigate the effect of obesity and childhood onset diabetes on bone health and risk of heart disease in youth. Study involves body composition, scan and blood tests. If interested, please call us at 713.798.6791.

A Pediatric Gastroparesis Registry H-41641

Researchers at Baylor College of Medicine and Texas Children's Hospital are conducting a research study to learn how slow stomach emptying (called gastroparesis) affects children and how they might treat it. Children ages 5-17 who have been diagnosed with gastroparesis or have a combination of pain, nausea, vomiting, early satiety, or postprandial fullness may be eligible. The study requires visits to the CNRC and you will be compensated for your time. For more information, contact the study coordinator, Heather Charron, at 713.798.0381 or charron@bcm.edu