Growth SUMMIT

ANHI
ABBOTT NUTRITION
HEALTH INSTITUTE

2018 GROWTH SUMMIT

ADVANCING NUTRITION SCIENCE FOR OPTIMAL CHILDHOOD GROWTH

Abbott

HIGHLIGHTS OF THE 2018 GROWTH SUMMIT IN PARIS, FRANCE

- What controls childhood and adult stature—nature or nurture? P 3.
- Optimal growth depends on adequate supplies of energy, as well as Type I and Type II nutrients. What are the different and common effects of these nutrients? P 4.
- Infants need a healthy gut for optimal growth and development. The trillions of microbes that come to populate the infant gut in turn yield remarkable benefits. How do gut microbes promote health in infants? P 5.
- From the viewpoints of a pediatrician and a dietitian, what's new for practicing clinicians who use nutrition to optimize growth in infants and children? P 6-7.

Dr Francisco J. Rosales, Medical Director, Scientific and Medical Affairs, Abbott Nutrition (USA) welcomed clinicians from 30 countries to the 2nd annual Growth Summit.

ADVANCING NUTRITION SCIENCE **FOR OPTIMAL CHILDHOOD GROWTH**

"Thank you for joining us to help cultivate the next generation of Growth Ambassadors," enthused Dr Francisco Rosales (USA) as he welcomed more than 200 attendees to the 2nd global Growth Summit (28 February 2018). The Growth Summit was scheduled to link with the 5th International Conference on Nutrition & Growth (ICNG), which took place 1-3 March 2018, in Paris, la Ville Lumière (the City of Light).

For this educational event, Abbott Nutrition assembled world-renowned experts to review the synergy between childhood nutrition and growth. Insights were gathered from a range of research findings—molecular studies to clinical trials to epidemiological and public health reports. Here, attendees learned about pediatric nutrition and growth from a wide range of perspectives, including laboratory and clinical researchers, pediatricians, and dietitians.

The Growth Summit and its related Growth Ambassador program aim to advance pediatric nutrition science and practice, in turn helping each child reach his or her optimal growth potential.

WHAT CONTROLS HEIGHT—**NATURE OR NURTURE?**

When it comes to height determination, the simple answer to the question of "*nature or nurture*?" is both. Here, *nature* represents a phenotype predetermined by parental genetics, while *nurture* represents environmental factors or experiences such as nutrition in infancy and childhood, inflammatory illnesses, and even a child's gut microbial population. Dr Julian Lui (USA) said, "Of these, nutrition has the greatest influence."

Dr Julian Lui (USA) recognized that nutrition has a great influence on childhood height growth.

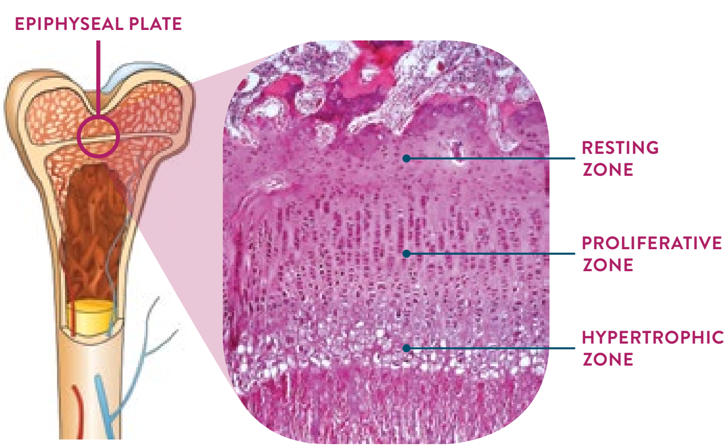
Dr Lui explained, "Elongation of long bones is what drives linear growth in children." The ultimate height achieved in adulthood is a summary of dynamic processes carried out at the epiphyseal or growth plate of long bones.

All genetic or environmental factors affecting childhood bone growth ultimately exert their effect on growth plate chondrocytes, the cells that proliferate and differentiate to become mature bone. Intrinsic factors regulate bone growth (positive regulatory factors such as growth hormone, sex steroids, and other hormones or growth factors). Extrinsic or environmental factors can modulate growth, eg, by way of growth inhibitors such as those related to inflammation (cortisol, FGF21, and interleukin 1). Intrinsic and extrinsic signals are integrated at several intracellular hubs where they influence expression of specific genes and transcription factors that in turn control cells in the bone growth plate.

In infancy and the first years of life, bone growth is remarkably rapid. Because of this rapid growth, Dr Lui emphasized, "Anything affecting growth early in life has a huge impact."[1]

A nutritional deficit in infancy and childhood can lead to short-for-age stature. Beyond puberty, growth normally slows due to senescence, ie, aging, of the growth plate.[2] However, this usual pattern of growth plate aging from infancy and childhood up to early adulthood is not absolute, as delayed senescence can occur in a growth plate that has not fulfilled its genetic potential for growth.[3] For example, catch-up growth remains possible when the factor that impaired growth is reversed, eg, when an undernourished child is provided additional nutrition support. Puberty may be delayed to allow continuing growth, but ultimately a child's growth velocity decreases to zero after epiphyseal fusion, ie, growth plate closure in late puberty.

To put the growth story together, Dr Lui concluded, "Genetics determines growth potential, while environment influences how well that potential is fulfilled."



(Left) Long bone showing location of the epiphyseal plate. (Right) The epiphyseal or growth plate of a developing long bone consists of layered zones of hypertrophic, proliferative, and resting cells. Long-bone growth is regulated by signaling factors that affect cell growth and differentiation.

Professor Joe Millward (UK) has spent a lifetime studying how nutrition affects growth.

THE ROLE OF NUTRITION IN **GROWTH REGULATION**

Professor Joe Millward (UK) has spent a lifetime studying how nutrition affects growth. He has published more than 200 scientific papers along the way—including a state-of-the-art review of why and how childhood growth can be stunted.[4]

In Prof Millward's view, "Growth is a mirror of the conditions of society, especially the nutritional and hygienic status of a population." Better childhood growth and increased adult heights have accompanied increased prosperity around the world. Young Dutch men and Latvian women are now the tallest in the world, while the largest height gains in the last 100 years have been in South Korean women (+20 cm) and Iranian men (+16.5 cm). The main factor underlying increased height is greater leg-length gain in preschool children, ie, reduced growth stunting.

In terms of nutrition, optimal growth depends on adequate supplies of energy, as well as Type I and Type II nutrients. Type I nutrients affect specific metabolic pathways, while Type II nutrients have universal effects on cellular metabolism. Deficiency of a Type I nutrient in a child's diet will lead to specific symptoms, eg, anemia with iron deficiency. Dietary deficiency of a Type II nutrient, particularly protein and zinc, will lead to inhibited linear growth. Fetal growth can be limited by Types I and II nutrients, but intrauterine growth especially depends on adequate supplies of folic acid and cobalamin.

NUTRIENTS NEEDED FOR HEIGHT GROWTH				
TYPE I NUTRIENTS			TYPE II NUTRIENTS	
Iodine	Selenium	Tocopherol	Protein	Magnesium
Iron	Thiamin	Calciferol	Zinc	Phosphorus
Copper	Riboflavin	Folic acid	Potassium	Water
Calcium	Retinol	Cobalamin	Sodium	
Manganese	Ascorbic acid	Pyridoxine		

Growth stunting is prevalent in developing societies with communities where plant-based diets are often consumed. Such diets are generally limited to staples of starchy root crops, which are nutritionally poor and of low protein quality, with few vegetables or pulses, and with little or no animal-sourced food. On the other hand, plant-based diets can be nutritionally adequate for children raised in homes with economic security and sanitary environments. Near-normal linear growth of children is observed within vegan communities in developed countries where families adopt the principles of protein complementation and supplementation with limiting nutrients such as vitamins A, D, and B_{12}.

For childhood diets, Prof Millward remarked that cow's milk seems to have some "magic factors" that enable height growth, which are not present in meat or other animal-sourced foods. In fact, epidemiological studies from countries in Central and South America, New Zealand, Japan, Denmark, and the United States have all shown that milk consumption is positively associated with adult height.[5,6] Milk has high levels of the amino acids tryptophan and leucine, which are recognized to serve as anabolic signals; it is likely that other factors for milk-associated growth are not yet understood.

In conclusion, Prof Millward noted that we still have much to learn about precise connections between linear growth regulation and nutritional supplies of energy and Types I and II nutrients.

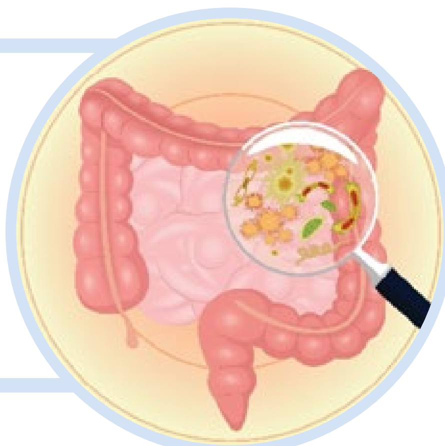
INFANT NUTRITION, HEALTH, **AND THE GUT MICROBIOTA**

Dr David Mills (USA) discussed how and why microbes colonize a neonate's gut.

Many people think of growth and development in terms of body cells and organs, but Dr David Mills (USA) addressed the development of the human microbial community. Early in a neonate's life, bacterial cells begin to colonize the digestive tract, where they play roles to support growth and health in infancy and beyond.[7,8] Many factors shape the gut microbial population—mode of delivery (vaginal or cesarean), diet, and antimicrobial exposure. As well, infants receive distinct, personalized bacterial exposures leading to differential colonization as a result of cultural practices and geographic location. In particular, mother-child contact, including breastfeeding of microbe-containing milk, provides organisms to seed the infant's developing gut population.

While each infant's microbial population is unique, there are some important generalities, which can be traced to the infant's diet. Notably, human milk is rich in complex bioactive carbohydrate molecules that are indigestible to the infant—human milk oligosaccharides (HMOs).[9,10] While HMOs are not a source of nourishment to the infant, they are considered bioactive because they help protect infants against infection and resultant diarrhea. Biochemically, HMOs are chains of saccharides linked together in different combinations to create structures containing as little as 3 to as many as 50 saccharides. All HMO structures have the disaccharide lactose (glucose + galactose) at their reducing end and are elongated by enzyme-mediated addition of various monosaccharides (galactose, N-acetylglucosamine, fucose, and/or N-acetylneuraminic acid) or disaccharides (N-acetyllactosamine and lacto-N-biose).[11] In a key role, HMOs serve as a "food" for the developing population of beneficial bacteria in the infant gut.

*Specifically, bacteria of the **Bifidobacterium** species are commonly enriched in the gut of breastfed infants, and these species are associated with normal gut function.*[12]



In a recent study, Dr Mills and colleagues sought to determine whether it was possible to beneficially alter an infant's gut microbial population by oral probiotic administration.[13] For the study, mothers intending to breastfeed were recruited and given lactation support. One group of mothers fed the probiotic *Bifidobacterium longis* subspecies *infantis* to their infants from day 7 to day 28 of life, and a second group did not give any probiotic. Results showed that breastfed infants' guts could be stably colonized at high levels by provision of *B infantis*, with changes to the overall microbiome composition persisting more than a month later. Such findings open up the future therapeutic possibility that the combination of human milk, or a formula with added HMOs, and an infant-appropriate *Bifidobacterium* probiotic can together promote gut health in infants.

Dr Virginia Stallings (USA) highlighted the WHO Child Growth Standards as a "landmark change."

NUTRITION INTERVENTIONS FOR HEALTHY GROWTH: **A PEDIATRICIAN'S PERSPECTIVE**

Dr Virginia Stallings (USA) is a pediatrician known for her expertise in pediatric nutrition and health policies. From her perspective, the introduction of Child Growth Standards by the World Health Organization (WHO) has been "a landmark change of our time." These global growth standards have become a guideline for assessing physical growth, growth velocity, and motor development in all children from birth to age 5 and beyond.

The WHO standards are based on findings from a community-based, multi-country project involving more than 8,000 children from Brazil, Ghana, India, Norway, Oman, and the United States. All children in the study were breastfed, had non-smoking mothers, and were from food-secure households.

The WHO Growth Standards reflect the concept that children born anywhere in the world and given a good start in life will have the same normal growth trajectory, ie, growth potential within the same ranges for height and weight. While growth differs between children, these differences are more influenced by nutrition, feeding practices, environment, and healthcare than by genetics or ethnicity.

WHO Child Growth Standards	
MEASURE	**WEBSITE**
Length/height for age	http://www.who.int/childgrowth/standards/height_for_age/en/
Weight for age	http://www.who.int/childgrowth/standards/weight_for_age/en/
Weight for length/height	http://www.who.int/childgrowth/standards/weight_for_length_height/en/
Body Mass Index (BMI) for age	http://www.who.int/childgrowth/standards/bmi_for_age/en/
Head circumference for age	http://www.who.int/childgrowth/standards/hc_for_age/en/
Arm circumference for age	http://www.who.int/childgrowth/standards/ac_for_age/en/
Motor development milestones	http://www.who.int/childgrowth/standards/motor_milestones/en/
Weight velocity	http://www.who.int/childgrowth/standards/w_velocity/en/
Length velocity	http://www.who.int/childgrowth/standards/l_velocity/en/
Head circumference velocity	http://www.who.int/childgrowth/standards/hc_velocity/en/

A child with faltering growth will have reduced weight gain velocity, reduced linear growth velocity, or both. Study results have shown that children whose growth faltered in infancy are lighter and shorter at school age and can have poor intellectual outcomes. In developing countries, the main cause of childhood growth faltering is undernutrition. In developed countries, disease-related malnutrition is a likely cause of poor growth, although food insecurity may also contribute. The first step toward preventing poor growth is to identify children who are at risk. Correction of the problem underlying poor growth, along with nutrition support, propels growth acceleration. In most cases, children with faltering growth can be brought back to their original growth trajectories.

Pediatric professionals agree that nutritional status should be monitored, yet there is still no universally accepted screening tool for children. To date, a variety of tools have been used to identify malnutrition in hospital settings.[14] For children with poor growth, the good news is that the human capacity for catch-up growth is outstanding.

NUTRITION INTERVENTIONS FOR HEALTHY GROWTH: **A DIETITIAN'S VIEW**

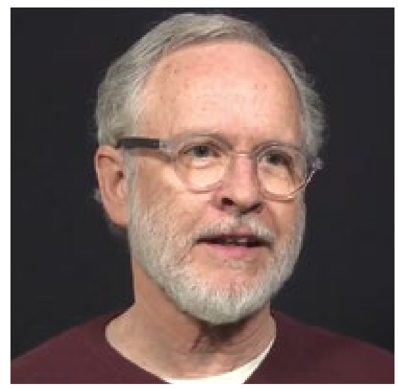
Dr Luise Marino (UK) has worked as a pediatric dietitian both in England and in South Africa. From her perspective, the dietitian usually gets involved when a child's growth is impaired or when a child is at nutritional risk because of an acute or chronic illness. Needed interventions depend upon the severity of nutritional risk and on the child's life stage (infant, toddler, young child, adolescent).

Based on her experiences, Dr Marino recommended routine and systematic approaches to nutrition screening, assessment, and intervention.[15] She advised the use of a nutrition risk-screening tool, the identification of risk factors for malnutrition such as food access and vulnerability, and the development of nutrition care pathways for all children who require nutrition support. Nutrition support should be monitored throughout the course of care, especially in children who are hospitalized, and an appropriate post-discharge nutrition care plan should always be made.

Dr Luise Marino (UK) underscored the need for routine and systematic approaches to nutrition screening, assessment, and intervention.

KEY TAKEAWAYS FROM THE **GROWTH SUMMIT**

For the past year, Dr Robert Murray (USA) has traveled the world building the Growth Ambassador Program based on research and clinical insights learned in the first Growth Summit. In summing up learnings from this year's Growth Summit, Dr Murray challenged pediatric practitioners to identify children at risk and to intervene early and aggressively to prevent malnutrition—not just treat malnutrition after it becomes obvious. Calories, macro- and micronutrients, and diet quality are essential to support growth and development. He advised pediatric practitioners across the world to look for opportunities to build consensus about public health nutrition in their regions. Such efforts will make a big difference for infants and children.



Dr Robert Murray (USA) traveled the world this past year to build the Growth Ambassador Program. He seeks to promote healthy growth among all children by advancing pediatric nutrition care.

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IMPORTANT NOTICE: Breastfeeding is best for babies and is recommended for as long as possible during infancy.

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