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FOOD ALLERGY AND PEDIATRIC NUTRITION: UNDERSTANDING REPLACEMENT NEEDS FOR THE COMMUNITY ALLERGIST

Introduction

Food allergies are reported to affect between 7% and 10% of children in the developed world.[1,2] Most children develop food allergies within the first 2 years of life, which is a crucial period of growth and development.[3] Currently, no cure exists for food allergies; traditionally they are managed by avoiding the ingestion of the allergen to which a child is allergic. Additional emerging therapies include desensitization and/or inducing tolerance to the allergens.[4-6] Eight foods account for more than 90% of food allergies: milk, soy, wheat, eggs, peanuts, tree nuts, fish, and shellfish.[2] The elimination of any of the nutrient-dense foods from the diet without adequate substitution may result in poor nutrient intake and impaired growth in children.[7]

The role of macronutrients and micronutrients

A child requires a delicate balance of macronutrients (carbohydrate, protein, fat), as well as micronutrients (vitamins, minerals, trace elements) from their diet to promote growth and weight gain, and to support a healthy immune system.[8,9]

Macronutrients provide energy and the foundational elements required for growth in children. Inadequate substitution of any food group can result in insufficient energy intake and undernutrition.[11] The term "undernutrition" as defined by the World Health Organization (WHO) includes stunting (low height for age), wasting (low weight for height), underweight (low weight for age), and micronutrient deficiencies or insufficiencies (a lack of important vitamins and minerals).[12] Several studies have reported that children with multiple food allergies were shorter than children with one food allergy, and that weight for age percentiles decreased as the number of food allergies increased.[11]

Some of the most common allergens, such as milk, egg, soy and wheat are important sources of carbohydrates, protein and fat; therefore, avoidance diets must be carefully planned to ensure that nutritional requirements are met. Children require approximately 45%-65% of their daily energy from carbohydrates, 5%-30% from protein, and 25%-40% from fats, depending on their age and stage of growth and development. (**Table 1**)[8,9]

Micronutrients are needed by the body in very small amounts, but each micronutrient has a critical impact on the body's health, and a deficiency in any of them can cause severe and even life-threatening conditions. Micronutrients perform a range of functions, including enabling the body to produce enzymes, hormones and other substances required for normal growth and development.[12] Each food contributes its particular profile of micronutrients, and deficiencies resulting in negative health outcomes can occur when foods are eliminated without adequate supplementation. For example, Vitamin D deficiency may result in rickets; iron deficiency may result in anemia; and iodine deficiency may result in goiter. Most deficiencies are preventable through nutrition education and patient counselling, as well as the consumption of a healthy diet

Carbohydrate (45%-65% of energy in children)	Grains, fruits, starchy vegetables, juice, certain dairy products
Protein (5%-30% of energy in children)	Meats, poultry, fish, dairy products, tree nuts, peanuts, legumes, seeds, eggs, soy
Fat (25%-40% of energy in children)	Milk and dairy products (not skim), butter, margarine, vegetable and seed oils, nuts, avocado, fish, poultry, meat

Table 1: Dietary sources of macronutrients; courtesy of Rachel Freeman, MSc, RD

consisting of diverse foods, and food fortification and supplementation where needed.

The greater the number of foods to which a child is allergic, the more complicated it may be for the child to attain the nutrition they require for optimal growth and health, and the greater the effect of undernutrition on their growth.[11] A registered dietitian can play a significant role in aiding a family in assessing a child's current nutrient intake. They are also in a position to suggest replacement foods and/or supplements to provide all the nutrients the child needs to thrive in good health, within the context of their food allergies and preferences.[6,13]

It is especially important that food allergies are diagnosed accurately so that a child does not unnecessarily avoid foods or food groups essential to growth. Several clinical studies have demonstrated that the greater the number of foods to which a child is allergic and avoiding, the greater the impact of the resulting missing nutrients on their nutrition, growth and development, particularly if they are not replacing the missing nutrients in their diet.[14] Parental perceived food allergy (a parent is convinced that their child is allergic to foods to which they are not actually reacting) can lead to severe exclusion diets with nutritional consequences, including failure to thrive; additionally, it could potentially increase the risk of developing an IgE-mediated food allergy.[15,16]

Although elimination of dietary allergens may appear simple ("don't eat the foods to which you are allergic"), it is not without risk. Children with food allergies are at higher nutritional risk than adults, as they are more likely to need to avoid foods of greater nutritional importance for growth, such as milk and eggs. Furthermore, their nutritional needs for growth and development are substantial and unique.[6] Several of the most common food allergens (milk, eggs, wheat and soy) are foods that commonly comprise the greatest proportion of a growing child's nutritional needs.

One of the most common pitfalls seen in pediatric allergy practice occurs when an infant is diagnosed with a cow's milk allergy. A nursing mother will be instructed to eliminate cow's milk protein and soy from her own diet in order to continue nursing, and an infant on a cow's milk formula will have to discontinue and find a dairy-free (and often soy-free) alternative. Often, there are no further instructions given as to what alternate or dairy-free products may be suitable replacements for the infant at the 4-6 month milestone when solid foods are typically introduced. Many times, a parent will attempt to introduce an alternative plant-based milk (e.g., rice milk, oat milk, coconut), which do not provide the correct balance of nutrients for a growing child and are not recommended as replacements for cow's milk in children. These children will often have diets that are low in fat, protein, calcium, and vitamin D. It is important to stress that Health Canada recommends that a milk-allergic child (that is also intolerant to soy) be placed on a hypoallergenic infant formula (e.g., Neocate, Nutramigen, Puramino) until the age of 2 years when they can safely be transitioned to either a fortified soy milk or alternate plant-based milk under the supervision of a registered dietitian.[9]

Growth is an overall indicator of the adequate provision of energy and protein intake in children.[3,10] Weight is a more sensitive indicator of energy intake and is affected earlier than height, however, stunting of height has also been observed when an energy deficiency persists. Numerous clinical studies have reported that growth can be affected by elimination diets, particularly when counselling has not taken place regarding how to replace the eliminated nutrients in a safe way with foods and supplements, without allergenic risk.[3,7,14,17-19] An international multicentre survey reported that low weight for age, low height for age, and low BMI for age are common in children with food allergies, and that stunting will affect nearly 1 in 10 children with any number of food allergies.[18] A clinical study examining the effects of a cow's milk elimination diet found that the elimination of cow's milk before the age of 2 can affect nutritional habits and eating behaviours of children between the ages of 2 and 6 years old, and can cause the insufficient intake of both macro- and micronutrients, resulting in poor growth. More severe nutrient deficiencies have also been observed with elimination diets. For example, cases of vitamin D deficiency rickets and low bone mineral density have been reported as a result of unsupervised cow's milk elimination diets.[3]

In addition to nutritional deficiencies and poor growth, food allergy is associated with parental stress. The food allergic child may experience reduced opportunities to participate in typical social eating situations where food is commonly shared.[13] Children with food allergies may experience problems such as food aversion, food refusal, food neophobia, and anxiety about eating in general, which can also lead to inadequate nutrient intake.[3,10] This has been shown to be of concern in both the IgE-mediated food-allergic population, as well as the non-IgE-mediated food-allergic population, particularly those with resulting esophagitis and other types of gastrointestinal pain and discomfort. These children may learn maladaptive behaviours such as food

refusal, low volume and variety of intake, grazing, and spitting out food out to avoid discomfort. These symptoms and resulting behaviours can condition a child to avoid eating and can result in nutritional deficiencies and failure to thrive.[20]

The primary objective in the management of food allergy is to avoid reactions to the offending foods while providing an adequate, healthy, enjoyable, and nutritionally balanced diet that will allow the child to grow and develop normally. It is, therefore, particularly beneficial for the family of a child with one or more food allergies to be able to access nutritional support for their child.[6,2123] Data suggest that dietetic consultation can improve eating habits and the nutritional status and growth of children living with food allergies. They additionally indicate that avoidance of a particular food does not necessarily lead to nutritional deficiencies, provided the diet is adequately supplemented, and appropriate substitute foods are consumed (**Table 2**).[12,22,23] A dietitian practicing in the field of food allergies needs to understand the immunological mechanisms, differing clinical presentations and tolerance levels of food allergies; and to have the ability to advise patients and their caregivers appropriately.[6,13]

A registered dietitian can assist the allergist and patient's family by providing a comprehensive assessment of a child's current dietary intake, monitoring of the child's growth and nutrient intake, and providing nutritional counselling to aid with food substitutions and supplements tailored to the individual child's preferences and requirements. The dietitian would also take into consideration the family's eating habits and culturally relevant food choices.

If an allergist or family physician does not have access to referral resources for a dietitian within their practice or institution, in Canada, a physician or patient can search for a private practice-based dietitian using the "Find a Dietitian" page on the Dietitians of Canada website[24] or can access some education and services from registered dietitians through their local Public Health Department.

Clinical Pearls and Tips

(for Community Allergists and Family Physicians diagnosing infants with food allergies)

1. At the time of allergy diagnosis, it is important to inform parents of an allergic child what to avoid, but equally as important to tell them replacements may be considered to avoid nutrient deficiencies resulting in poor growth and development. (**Table 2**)
2. Breastmilk (from a mother following an appropriate elimination diet) or a hypoallergenic formula (e.g., Neocate, Nutramigen, or Puramino) is recommended for a child with a milk allergy that cannot tolerate soy until the age of 2 years. If the child does not react to soy, then a soy infant formula can be given.
3. At the time of allergy diagnosis, parents should be counselled to avoid giving alternate (plant-based) beverages (e.g., rice, oat, coconut) until after the age of 2 years, and then may include them in a varied diet in consultation with a registered dietitian.
4. None of the plant-based milks currently available in Canada are nutritionally equivalent to cow's milk. They are each missing some nutrient(s) a child requires for proper growth and development.
5. Parents wishing to use plant-based milks for their child, should only do so after age 2, only if they are fortified (with Vitamins A and D_3), and only in consultation with a registered dietitian who can help the parents supplement any nutrients that may be missing as a result of their substitution.
6. A food-allergic child should have their weight and growth followed regularly by their pediatrician or family doctor and consult with a registered dietitian if any concerns arise with their intake or growth.

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Food Eliminated	Most critical nutrients involved in growth	Alternate dietary sources
Dairy	Macronutrients: Fats, protein Micronutrients: Calcium, vitamin D, vitamin A, phosphorus, riboflavin, vitamin B12	Breast milk, hypoallergenic infant formulas(< age 2) or enriched soy milk (> age 2), other fortified alternative beverages (under supervision).* Healthy fats from vegetable oils, margarine, avocado, meats, fatty fish, peanuts, tree nuts, seeds. Protein from meat, fish, poultry, eggs, soy products, peanuts, legumes, tree nuts, seeds. May also require vitamin/mineral supplements such as calcium and vitamin D.
Eggs	Macronutrients: Fats, protein Micronutrients: Riboflavin, pantothenic acid, vitamin B12, biotin, selenium, iron	Healthy fats from vegetable oils, margarine, butter, dairy products (not skim), avocado, meats, fatty fish, peanuts, tree nuts, seeds. Protein from meat, fish, poultry, cheese, yogurt, soy products, legumes, peanuts, tree nuts, seeds. Vitamin/mineral supplements may be required, particularly iron and B vitamins in plant-based diets. Egg replacement products can be used in baking but do not provide equivalent nutritional value.
Wheat	Macronutrients: Carbohydrates, fibre Micronutrients: Thiamine, riboflavin, niacin, iron, folate (if fortified)	Fruits, vegetables, legumes, alternative whole grains and products made with alternative grains or flours (rice, oat, corn, buckwheat, potato, tapioca, amaranth, millet, quinoa. Vitamin/mineral supplements may be required, particularly of iron and B vitamins in plant-based diets.
Soy	Macronutrients: protein (A significant source of protein in plant-based diets) Micronutrients: Thiamine, riboflavin, pyridoxine, folate, calcium, phosphorus, magnesium, iron, zinc	Protein from meat, fish, poultry, cheese, yogurt, eggs, legumes, peanuts, tree nuts, seeds.
Nuts and Peanuts	Macronutrients: Protein, fat Micronutrients: Vitamin E, niacin, magnesium, manganese, chromium	Other nuts and legumes that do not cause symptoms can continue to be included. Protein from meat, fish, poultry, cheese, yogurt, eggs, legumes. Healthy fats from vegetable oils and avocados, fatty fish, seeds.
Fish/seafood	Macronutrients: Protein, fat Micronutrients: Omega-3 fats, zinc, iron, iodine	Other fish and seafood not causing symptoms can be included. Protein from meat, soy products, poultry, cheese, yogurt, eggs, legumes, peanuts, tree nuts, seeds. Healthy fats from vegetable oils, margarine, butter, dairy products (not skim), avocado, meats, fatty fish, peanuts, tree nuts, seeds. Flax/linseeds (or supplements) can provide some Omega-3. Seaweed, milk, eggs, and iodized salt can be sources of iodine.

Table 2: *Nutrients of concern due to food eliminations (and alternate sources); courtesy of Rachel Freeman, MSc, RD*
** Fortified soy beverages (or other plant-based alternative beverages) are not suitable as a primary milk source for children under 2 years of age. For the older infant or young child who is not being introduced to cow's milk, soy-based or hypoallergenic infant formula is recommended until 2 years of age.*[9]

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