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Growth and Nutritional Concerns in Children with Food Allergy

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Abstract

Purpose of review—To describe the potential effect that avoidance diets for food allergy may have on nutrition and growth in children.

Recent Findings—We report here findings from previous studies suggesting impairment of growth and nutritional deficiencies due to elimination diets for food allergy. Feeding difficulties have also been reported, particularly in children with eosinophilic esophagitis that may further impact nutrient intake.

Summary—Food allergies are becoming more prevalent and better recognized. Treatment options typically include strict dietary elimination of major food allergens such as milk, eggs, wheat, soy, peanut, tree nuts, fish and shellfish. Monitoring growth and guiding food allergic patients in choosing appropriate alternatives to supply necessary nutrients becomes crucial to avoid deficiencies and retardation in growth.

Keywords

Food Allergy; Growth; Nutrition; Vitamin Deficiencies

Introduction

A recent expert panel report “Guidelines for the Diagnosis and Management of Food Allergy in the United States,” defined food allergy as “an adverse health effect arising from a specific immune response that occurs reproducibly on exposure to a given food.”⁽¹⁾ This definition includes immunoglobulin E (IgE) mediated reactions to foods, non-IgE mediated responses such as food protein induced enteropathy and mixed IgE and non-IgE mediated reactions such as eosinophilic esophagitis (EoE). Currently, the mainstay of therapy involves food avoidance and dietary interventions.

Most children develop food allergies within the first 2 years of life, which is a crucial period of growth and development.⁽²⁾ Several of the most common food allergens are foods that comprise a major portion of a developing child’s diet providing essential nutrients. Poor growth and inadequate nutrient intake by food allergic children have been suggested in

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Conflicts of Interest

There are no conflicts of interest.

previous studies, particularly for children avoiding milk.(3-5) This review will focus on the nutritional impact and growth concerns of children with food allergies.

The prevalence of food allergies in the United States has increased, and is now estimated to affect 6-8% of children.(6) Establishing a diagnosis is crucial as self-perceived food allergy rates are high and parental perceived food allergy has led to severe exclusion diets with nutritional consequences, including failure to thrive.(7, 8) In a retrospective case review, 11 children at a tertiary care center were diagnosed with failure to thrive due to parental perception of allergic reactions to multiple foods. Yet, only two of these children reacted during double blind placebo controlled food challenges. One reacted to milk (one of 14 suspected foods) and the other reacted to egg and milk (two of 15 suspected foods).(7) Similarly, Noimark et al. reported 3 separate cases of children with poor nutrition and secondary morbidity due to restrictive diets. One was a 10 month old with hypocalcemic seizures, clinical rickets and iron deficiency resulting from a restricted diet of breast milk and a limited number of fruits and vegetables as a consequence of cow's milk allergy (CMA) and maternal fears to progress the infant diet. A second case involved a 5 month old with multiple food allergies who presented with weight loss, diarrhea and protein-losing enteropathy due to allergen exposure through the breast milk. The third case was that of a 5 year old with poor weight gain who was avoiding multiple foods based on the results of alternative testing (e.g. IgG and electrodermal testing); he was able to tolerate all the avoided foods once he was appropriately tested.(9) These findings illustrate the importance of a comprehensive evaluation to correctly establish a diagnosis and identify the triggering food(s). Guidance should be provided not only on avoidance of the trigger food(s), but also to ensure that safe foods are provided for age-appropriate nutrition. Elimination diets, if not appropriately monitored, can cause deficiencies in macronutrients and micronutrients and lead to poor growth.

The most common food allergens in the pediatric population are milk, egg, soy, and wheat. Many foods contain similar nutrients as those found in eggs and soy, and although avoidance of these rarely compromises the nutritional quality of the diet, many processed foods contain these ingredients further limiting food choices. Milk and wheat are major constituents of a developing child's diet and alternative sources with similar nutrients should be incorporated. Families need guidance to ensure that appropriate nutrient dense substitutes are made.

Macronutrients

Protein, carbohydrates and fats are macronutrients, which provide energy in one's diet. Table 1 provides dietary sources of essential nutrients. Poor substitution can result in increased risk of specific macronutrient deficiencies and insufficient energy intake.(2, 10) Foods such as milk, egg, and soy are important sources of protein and fat, thus avoidance diets must be carefully planned to ensure that protein and fat requirements are met. Dietary fats provide a concentrated source of energy, and diets that are too low in fat are at risk of being hypocaloric, leading to poor growth. Protein deficient diets can also cause poor growth and protein deficient related morbidity. Kwashiorkor has been reported in children on allergen elimination diets.(11, 12) Among 12 children with kwashiorkor from 7 tertiary

care centers throughout the United States, half were due to deliberate food avoidance for suspected allergies without adequate substitution.(11, 12) Wheat provides complex carbohydrates, an important source of energy and the primary source of energy for the brain. Complex carbohydrates should provide between 45-65% of daily energy intake in children. Although fruits and vegetables provide carbohydrates as well, alternative grains must be provided to fill the gap and meet the great need for this macronutrient. Additionally, grains provide a unique set of micronutrients (thiamin, niacin, riboflavin, iron, folic acid) that are not found in most fruits and vegetables. Elimination diets for food allergic children should have an appropriate balance of macronutrients. Table 2 provides acceptable macronutrient distribution range for children.

Although not a complete measure of the adequacy of overall nutrition, growth is a profound indicator of the adequate provision of energy and protein intake in children. Weight, a sensitive measure of energy intake, is affected by dietary inadequacies earlier and to a greater extent than stature. However, due to protein inadequacy or chronic energy deficits, stature can be subsequently delayed. In an age matched, cross sectional study of 98 food allergic children and 99 children without food allergies, children with two or more food allergies were shorter, based on height-for-age percentiles than those with one food allergy ($p<0.05$). (5) Furthermore, children with food allergies were more often less than the 25th percentile height-for-age than control subjects. Inadequate intake of calcium was common among those with CMA, but was also twice as common among those with multiple food allergies. Importantly, among children with CMA, 91% who drank a safe infant/toddler formula or fortified soy beverage met their daily requirement for many nutrients, illustrating the importance of appropriate substitution for children with CMA. Similarly, Paganus et al. (13) and Tiainen et al.(14) followed children with CMA and found a lower height-for-age percentile among children with CMA compared with healthy controls. Due to this growing concern regarding the nutritional status of children with CMA, the World Allergy Organization published guidelines on the “Diagnosis and Rationale for Action against Cow’s Milk Allergy (DRACMA)” in 2010 and included recommendations for feeding infants and young toddlers with CMA.(15) Infants with CMA are advised to maintain a milk substitute in the diet until 2 years of age; either breast milk or a prescribed substitute formula. Additionally, the NIAID Food Allergy Guidelines recommends nutrition counseling and close growth monitoring for all children with food allergies.(1) Growth parameters should be plotted on appropriate charts and followed. As of 2010, the American Academy of Pediatrics (AAP) recommends the World Health Organization growth charts for children up to 24 months of age. The Centers for Disease Control and National Center for Health Statistics growth charts are recommended for children 2 years of age and over.

Micronutrients

Micronutrients include vitamins, minerals and trace elements. Each food contributes specific micronutrients, and when a food or food group is eliminated without adequate substitution or supplementation, micronutrient deficiencies can occur. Vitamin and mineral deficiencies have been associated with food elimination diets.(4, 5, 9, 10, 16-18) Cases of children developing vitamin D deficiency rickets as a result of unsupervised dietary manipulation in the context of CMA have been reported.(17, 18) Fox et al. reported a 14-month old boy with

CMA with vitamin D deficiency rickets as a result of unsupervised dietary manipulation. (18) He was breast fed every 2-3 hours as his mother felt that it was more nutritionally complete than soy milk and had severely limited expansion of solids in his diet besides fruits and vegetables. At initial presentation, he was at the third percentile-for-age for height and weight and had clinical signs of rickets. Additionally, his motor development was delayed. (18) While breast milk is a nutritionally appropriate food at this age, it is so in the context of a varied diet. Breast milk is a poor source of vitamin D. In 2006, Wu et al. reported a similar case of a 2-year-old boy with rickets due to CMA. (17) He drank 500-700 ml of fruit beverages with no supplementation of calcium or vitamin D. Though he initially attained all his milestones at 18 months of age, he regressed and lost the ability to walk. However, two weeks after therapy with vitamin D, calcitriol and elemental calcium, he was able to stand. (17)

Jensen et al. investigated bone mineral status in nine children with verified CMA who had been avoiding milk for more than 4 years and compared them to a large population of healthy controls (n=343). Whole body bone mineral content and bone mineral density was significantly reduced for age and bone age was retarded in the children with CMA. Height-for-age was also lower in the population with CMA. (19) Compared to their expected growth based on parental size and sibling's growth, the children with CMA were also smaller. Calcium consumption calculated from food intake was about 25% of the recommended dietary allowance. A dietary survey of young children (31-37 months of age) with adverse reactions to milk found significant differences in nutrient intake of children on milk-free diets compared to children consuming milk. (10) Children on milk-free diets had significantly lower intake of energy, fat, protein, calcium, riboflavin and niacin.

Other contributors to poor nutrition and growth

Many of these early growth studies on the pediatric food allergic population focused on the effects of milk elimination without adequate replacement of nutrients. However, Flammarion et al. (*20) conducted a cross-sectional study including 96 food allergic patients who had been counseled by a dietitian and 95 paired control children, and found that energy, protein and calcium intake of children with food allergies met nutritional recommendation goals and were similar to the dietary intakes of the control children. Although children with food allergies had growth that was considered normal, their weight-for-age and height-for-age z scores were significantly lower than the control subjects ($p < 0.01$ and $p < 0.03$, respectively). In this study, inadequate nutrient intake cannot explain the difference in growth pattern. Although these children did not have persistent digestive symptoms while on the elimination diet, loss of nutrients caused by continuous allergic inflammation or abnormal intestinal permeability was suggested. Persistent intestinal inflammation could be caused by continuous antigen challenge from non-compliance with diet, undiagnosed allergy or antigen remnants in the substitute formula. Another hypothesis is that children with co-morbid allergic disorders may have higher caloric and protein requirements. In this study, 63% of children with food allergies had atopic dermatitis, however no difference in growth was found in children with and without atopic dermatitis. In addition, no difference was observed between the growth of the 69% of children with asthma and those without asthma, though duration of steroid treatment for asthma was not evaluated. (*20)

The presence of allergic diseases such as atopic dermatitis (21-23) and asthma (24-27) have been shown effect growth, however, the contribution of food allergy in addition to a co-morbid allergic disease was suggested by Isolauri et al.(4). In this study, the relative length of 100 children with atopic dermatitis and challenge proven CMA was decreased when compared with healthy controls.(4) The decrease in relative length coincided with the onset of symptoms and the start of the elimination diet. Additionally, no catch up growth was seen by 24 months. The delay in growth was more pronounced in children with early onset of symptoms than in those with later onset. The authors suggest that sustained allergic inflammation caused by continued low grade antigen exposure, either through dietary noncompliance or from exposure through the substitute formulas, is a possible explanation for decreased growth.

In addition to dietary restrictions and modifications, poor feeding skills and/or maladaptive feeding behaviors in this population can affect growth. Children with food allergies may experience problems such as food aversion, food refusal, food neophobia, and anxiety about eating in general, which can lead to inadequate nutrient intake. (28, 29) Not only is this a problem for IgE-mediated allergies, symptoms of feeding dysfunction have also been reported for children with gastrointestinal symptoms due to eosinophilic esophagitis (EoE). Maladaptive behaviors can include limiting the diet to liquid or pureed foods or refusing to eat solids after previously eating them. Recently, Wu et al. conducted a gender and age matched case control study where parents of children with eosinophilic gastrointestinal disorders (EGID) completed validated measures of assessing behavioral feeding problems, parenting stress and adherence to the prescribed dietary regimen.(*30) Their findings showed that significantly more children with EGID have feeding behavioral problems than healthy controls. A similar study found that 16.5% of children with EGID and no comorbid diseases (i.e. neurologic or developmental disorders known to be associated with negative effects on feeding) had significant feeding dysfunction.(31) Of these children, approximately 94% had learned maladaptive behavior such as food refusal, low volume and variety of intake, grazing, and spitting food out. These symptoms were associated with feeding in conjunction with or followed by repetitive, unpredictable bouts of pain which may condition a child to avoid eating. Though the study was focused on feeding behavior and not growth, 21% of these children were diagnosed with failure to thrive, suggesting that feeding dysfunction may contribute to deficient oral intake contributing to malnutrition and growth disturbance. These findings illustrate the importance of assessing for all potential risk factors that may limit the nutritional contribution to the diet of food allergic children.

Conclusion

Currently, an elimination diet of the causative food allergen(s) is the mainstay of treatment for food allergies. Several studies have raised concerns for poor growth and nutritional deficiencies related to avoidance diets,(3-5) however, large population studies examining the effects of avoidance diets on the growth of children with food allergies are limited. In addition to the dietary restrictions, co-morbid disorders such as atopic dermatitis and feeding difficulties may also contribute adversely to nutrient intake in these children.

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Key Points

- An elimination diet is the mainstay of treatment for food allergic children.
- Studies have raised concerns about poor diet and nutritional deficiencies in children following avoidance diets.
- Co-morbid disorders such as atopic dermatitis and feeding dysfunction may also contribute and negatively affect nutrient intake in these children.
- Large population studies examining the effects of avoidance diets on growth and nutrition for food allergic children are limited.

Table 1**Dietary Sources of Essential Nutrients**

Dietary protein	Milk, egg, meat, fish, poultry, soy and soy based products, peanuts, other legumes, tree nuts, seeds
Dietary fat	Saturated and <i>trans</i> fatty acids: Whole milk and dairy products, butter, margarines, meat products Poly- and Mono-unsaturated fatty acids: Vegetable oils such as olive, canola, safflower, sunflower, soy, corn, peanut, cottonseed; avocado, fatty fish, nuts, seeds
Calcium	Milk (whole, fat-reduced, low fat and fat free), calcium fortified juice [*] , alternative enriched beverages ^{**} , fish with bones, calcium set tofu
Vitamin D	Salmon and other fatty fish, fish oils, fortified breakfast cereals, ^{**} Vitamin D enriched milk and vitamin D enriched alternative milk beverages.

* Calcium fortified juice should not be used as the main source of calcium.

** Not all alternative enriched beverages are safe and appropriate as a milk substitute for young children due to inadequate protein, fat or the potential presence of unsafe ingredients.

Table 2

Acceptable Macronutrient Distribution Range (AMDR)

Macronutrient	AMDR
Protein	5-20 % for children 1-3 years 10-30% for children 4-18 years
Fat	30-40% for children 1-3 years of age 25-35% for children 4-18 years of age
Carbohydrates	45-65% for children 1-18 years of age

Source: Dietary Reference Intakes for Energy, carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, Amino Acids (2002/2006). www.nap.edu

The Acceptable Macronutrient Distribution Range (AMDR) is the range of intake from an energy source associated with reduced risk for chronic diseases while providing essential nutrients.