Nutritional Consequences of Food Allergies

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Disclosures

Financial:
- Nutricia North America
- Royalties: UpToDate
Objectives

▶ Identify potential causes of nutritional risks in children and adults with food allergies

▶ Review the nutritional outcomes that have been measured in the literature

▶ Evaluate the impact of nutrition counseling on nutrient intake and growth in children
<table>
<thead>
<tr>
<th>Allergens</th>
<th>Main Nutrients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow’s Milk</td>
<td>• <strong>Protein, fat</strong>&lt;br&gt;• Calcium, Magnesium, Phosphorus, Iodine&lt;br&gt;• A, B6, B12, <strong>D, Riboflavin</strong>, Pantothenic Acid</td>
</tr>
<tr>
<td>Wheat</td>
<td>• <strong>Carbohydrate</strong>&lt;br&gt;• Magnesium, Phosphorus, Potassium, Zinc&lt;br&gt;• Frequently in enriched cereal products: <strong>Iron, Thiamine, Niacin, Riboflavin, Folate</strong></td>
</tr>
<tr>
<td>Soy</td>
<td>• <strong>Protein, fat</strong>&lt;br&gt;• Calcium, Phosphorus, Magnesium, Iron, Zinc&lt;br&gt;• Thiamine, <strong>Riboflavin</strong>, Vitamin B6, Folate</td>
</tr>
<tr>
<td>Egg</td>
<td>• <strong>Protein, fat</strong>&lt;br&gt;• <strong>Iron</strong>, Selenium, Choline&lt;br&gt;• Biotin, Vitamins B12, Pantothenic Acid, Folate, <strong>Riboflavin</strong></td>
</tr>
<tr>
<td>Fish/Shellfish</td>
<td>• <strong>Protein, fat, Omega-3 fatty acids</strong>&lt;br&gt;• Iodine, Choline&lt;br&gt;• Vitamins A and D</td>
</tr>
<tr>
<td>Peanut/Tree nuts</td>
<td>• <strong>Protein, fat</strong>&lt;br&gt;• Vitamin E, niacin, magnesium, chromium</td>
</tr>
</tbody>
</table>
Q. What are the dietary recommendations for children with food allergies?

<table>
<thead>
<tr>
<th>Alternative sources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cow’s Milk</strong></td>
</tr>
<tr>
<td>• Infants / Young toddlers (&lt; 2 years)- breast milk or substitute formula</td>
</tr>
<tr>
<td>• Older toddlers (&gt;2 years)- Calcium supplement</td>
</tr>
<tr>
<td>• Fortified alternative beverages were not specifically grade-evaluated such as soy, rice, hemp, almond, oat, coconut but can be used on an individual basis- if tolerated</td>
</tr>
</tbody>
</table>

World Allergy Organization Diagnosis and Rationale for Action against Cow’s Milk Allergy- DRACMA  JACI 2010 Dec;126(6):1119-28
Fussy eating and feeding difficulty in infants and toddlers consuming a cow’s milk exclusion diet

Maslin K, Dean T, Arshad SH, Venter C.

- Children with CMA (n=126) had significantly higher scores of feeding difficulties and fussy eating than a control group consuming an unrestricted diet. \( p<0.05 \)

- A higher consumption of milk substitute consumed per day was positively correlated to both feeding difficulties and fussy eating \( p=><0.05 \)

Q: Is it the avoidance of the allergen itself that increases nutritional risk or do other factors also play a role?

Elevated IP was found in 38% of asymptomatic children with FA on elimination diets and was associated with shorter stature.

Jarvinen et al. Pediatric Allergy and Immunology. 2013: 24 (6) ; 589-595
What is the impact of the clinical manifestation?

- **IgE mediated allergy**
  - The nutritional value of the food eliminated and the number of foods eliminated may affect the risk.

- **Eosinophilic esophagitis**
  - Esophageal dysfunction

- **Food protein induce enterocolitis syndrome**
  - Limited diets and altered complementary feeding schedule

- **Atopic Dermatitis**
  - Increase energy/protein needs

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Question

How do food allergies and elimination diets affect growth and nutritional status?
<table>
<thead>
<tr>
<th>Author</th>
<th>Year/Country</th>
<th>Number FA</th>
<th>Controls</th>
<th>Type of study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berry et al</td>
<td>2015/FI</td>
<td>46 (18 &amp; 26)</td>
<td>0</td>
<td>Prospective</td>
</tr>
<tr>
<td>Canani et al</td>
<td>2014/IT</td>
<td>91</td>
<td>66</td>
<td>Prospective non-randomized</td>
</tr>
<tr>
<td>Christie et al</td>
<td>2002/US</td>
<td>98</td>
<td>99</td>
<td>Cross-sectional</td>
</tr>
<tr>
<td>Tiainen et al</td>
<td>1995/FI</td>
<td>18</td>
<td>20</td>
<td>Cross-sectional</td>
</tr>
<tr>
<td>Isolauri et al</td>
<td>1998/FI</td>
<td>100</td>
<td>60</td>
<td>Prospective</td>
</tr>
<tr>
<td>Flammarion et al</td>
<td>2011/FR</td>
<td>96</td>
<td>95</td>
<td>Cross-sectional</td>
</tr>
<tr>
<td>Mehta et al</td>
<td>2014/US</td>
<td>439</td>
<td>9499</td>
<td>Retrospective chart review</td>
</tr>
<tr>
<td>Vieira et al</td>
<td>2010/BR</td>
<td>159</td>
<td>0</td>
<td>Observational, Cross-sectional</td>
</tr>
<tr>
<td>Meyer et al</td>
<td>2013/UK</td>
<td>97</td>
<td>0</td>
<td>Prospective</td>
</tr>
<tr>
<td>Hobbs et al</td>
<td>2015/US</td>
<td>245 RPFA</td>
<td>4584 CF=106/CD=102</td>
<td>Retrospective</td>
</tr>
<tr>
<td>Mukaida et al</td>
<td>2010/JP</td>
<td>491</td>
<td>10,982</td>
<td>Survey</td>
</tr>
<tr>
<td>Saruwatari et al</td>
<td>2015/JP</td>
<td>25</td>
<td>637</td>
<td>Retrospective</td>
</tr>
<tr>
<td>Cho et al.</td>
<td>2011/K</td>
<td>165-AD</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
The Effect of Past Food Avoidance Due to Allergic Symptoms on the Growth of Children at School Age

Kumiko Mukaida, Takashi Kusunoki, Takeshi Morimoto, Takahiro Yasumi, Ryuta Nishikomori, Toshio Heike, Tatsuya Fujii and Tatsutoshi Nakahata

Allergology International. 2010;59:369-374
Compared Food Avoiders in Infancy (FAI; \( N=491 \)) with Non-Food Avoiders (Controls: \( N=11,473 \))

<table>
<thead>
<tr>
<th>No. of patients</th>
<th>Length of avoidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>322</td>
<td>Outgrown by age 3</td>
</tr>
<tr>
<td>169</td>
<td>Continuous at age 3</td>
</tr>
<tr>
<td>112</td>
<td>Outgrown by age 3-6</td>
</tr>
<tr>
<td>57</td>
<td>Continuous at age 6</td>
</tr>
</tbody>
</table>

Results

- FAI (total) had significantly lower mean weight for age (WA) than non-FAI (no difference in HA) \((p=0.01)\)

- If outgrown by 3 years of age, there was no significant difference in WA compared to non-avoidance

- Those with continuous avoidance at age 3, if avoiding 2 or more foods or cow’s milk had significantly lower height for age (HA) than those with avoidance of one food or non-avoidance of cow’s milk. \((p =0.02, 0.04, \text{respectively})\)

Less likely to be overweight or obese than non-FAI and had less consumption of fast food.

Growth Comparison in Children with and without Food Allergies in 2 Different Demographic Populations

*The Journal of Pediatrics, Volume 166, Issue 1, January 2015, Page 212*

Harshna Mehta, MD
Manish Ramesh, MD, PhD
Elizabeth Feuille, MD
Marion Groetch, MS, RD
Julie Wang, MD
A retrospective chart review was performed for children with and without food allergies followed at 2 New York City general pediatric practices during 2010-2011.

9938 children seen- 439 (4.4%) were avoiding one or more foods

Children with CMA were shorter (P=.047) and weighed less (P=.0006) when compared with matched controls.
Children with food allergies and commercial insurance were significantly shorter (mean height $z$-score = 0.06) than children without food allergies (mean height $z$-score = 0.42) $P = .01$. 
But there was no difference in height in the patients with and without food allergy and state insurance
Children with food allergies and commercial insurance weighed significantly less (mean weight z-score $-0.1$) than children without food allergies (mean weight z-score $= 0.07$)  $P = .006$
In contrast, children with food allergies and state insurance were not smaller in height or weight compared with children without food allergies.
Q. Do certain food allergies put children at greater risk of decreased growth?

Cow’s milk

Yes
- Mukaida - Japan (2010)
- Mehta - US (2014) in children >2 years
- Vieira - Brazil (2010)

No
- Meyer UK (2013) - All patients under supervision of specialist RD
- Flammarion FR (2011) - 88% nutrition counseling
Do *multiple food allergies* put children at greater risk of decreased growth?

Yes

- Meyer UK (2013)
- Flammarion FR (2011)
- Mukaida - Japan (2010)
- Cho K (2011)
- Vieira - Brazil (2010)

No

  - Only 2.23% of population had MFA
Q. How prevalent is malnutrition in children and adults with food allergies?
Malnutrition

- Nutrient deficiencies

- WHO Growth standards definition of malnutrition

Normal growth 0 to +/- 2 Z-scores (WA, HA, WH)
Under-weight <= -2 Z-scores (WA)

Malnourished
- Wasted < --2 Z-scores (WH)
- Stunted < --2 Z-scores (HA)
- Overweight > +2 Z-scores (WA or WH)

Weight for Age (WA), Height for Age (HA), Weight for Height (WH)
Decreased bone mineral density (BMD) in young adult IgE-mediated cow’s milk–allergic patients.

- Calcium intake was significantly and severely reduced ($p<.0001$)

- Significant risk of reduced BMD and early osteoporosis (T score $<2.5$ SD; 27% vs. 0%; $p=.0071$)

Liat Nachshon, MD, Michael R. Goldberg, MD, PhD, Naama Schwartz, MA, et al. JACI 2014; 134; (5): 1108-1113.
Q. How prevalent is malnutrition in children with food allergies?

Increased Prevalence

- Meyer UK (2013)
- Flammarion FR (2011)
- Canani Italy (2014)
- Cho K Japan (2011)
- Vieira - Brazil (2010)
- Costa- Brazil (2014)

Overweight was also found but lower prevalence
Diet and Nutritional Status of Children with Food Allergies

Sophie Flammarion,
Clarisse Santos,
Dominique Guimber,
Lyne Jouannic,
Caroline Thumerelle,
Frederic Gottrand
Antoine Deschildre

- Cross sectional study
- 96 children with FA & 95 paired controls (mean age 4.7 years)
- Growth
- 3 day food records
  - Energy, protein, CHO, fat, Ca, P, Fe, Mg, vitamins A, D, C and E (compared to French RDI)

Pediatric Allergy and Immunology 22 (2011) 161-165.
Nutritional status of children with food allergies compared with controls

<table>
<thead>
<tr>
<th></th>
<th>Children with food allergies (n = 96) Mean</th>
<th>Controls (n = 95) Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z score weight for age</td>
<td>0.1 (1.6)</td>
<td>0.6* (1.2)</td>
</tr>
<tr>
<td>Z score height for age</td>
<td>0.2 (1.5)</td>
<td>0.8* (1.4)</td>
</tr>
<tr>
<td>Z score weight for height</td>
<td>−0.2 (1.4)</td>
<td>−0.1 (1.3)</td>
</tr>
</tbody>
</table>

No difference based on type of food allergy or allergic symptom

No difference in nutrient intake between the FA and control

Flammarion et al 2011

SD, standard deviation.
*p < 0.05 compared to controls.
Nutritional status according to the number of food allergies

<table>
<thead>
<tr>
<th></th>
<th>Controls (n = 95) %</th>
<th>Allergy to 1 or 2 foods (n = 55) %</th>
<th>Allergy to more than 3 foods (n = 41) %</th>
<th>All children with food allergies (n = 96) %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Z score WA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;-2</td>
<td>0</td>
<td>1.8</td>
<td>14.5*</td>
<td>9.3**</td>
</tr>
<tr>
<td>-2 to +2</td>
<td>82.4</td>
<td>89.1</td>
<td>73.4</td>
<td>80.3</td>
</tr>
<tr>
<td>&gt;+2</td>
<td>17.6</td>
<td>9.1</td>
<td>12.1</td>
<td>10.4</td>
</tr>
<tr>
<td><strong>Z score HA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;-2</td>
<td>2.7</td>
<td>3.6</td>
<td>12.1*</td>
<td>7.2**</td>
</tr>
<tr>
<td>-2 to +2</td>
<td>74.3</td>
<td>87.3</td>
<td>75.8</td>
<td>82.2</td>
</tr>
<tr>
<td>&gt;+2</td>
<td>23</td>
<td>9.1</td>
<td>12.1</td>
<td>10.6</td>
</tr>
<tr>
<td><strong>Z score WH</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;-2</td>
<td>8.1</td>
<td>1.9</td>
<td>9.8</td>
<td>5.3</td>
</tr>
<tr>
<td>-2 to +2</td>
<td>87.8</td>
<td>88.5</td>
<td>85.4</td>
<td>87.2</td>
</tr>
<tr>
<td>&gt;+2</td>
<td>4.1</td>
<td>9.6</td>
<td>4.8</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Flammarion et al 2011

*p < 0.05 compared to allergies to 1 or 2 foods.

**p < 0.05 compared to controls.
Q. What are the data to suggest dietary counseling can improved nutritional status in children with food allergies?
The Effects of Dietary Counseling on Children with Food Allergy: A Prospective, Multicenter Intervention Study


- Roberto Berni Canani, MD, PhD
- Ludovica Leone, LDN
- Enza D’Auria, MD
- Enrica Riva, MD
- Rita Nocerino
- Serena Ruotolo, MD
- Gianluca Terrin, MD, PhD
- Linda Cosenza, MD
- Margherita Di Costanzo, MD
- Annalisa Passariello, MD, PhD
- Anna Coruzzo, LDN
- Carlo Agostoni, MD, PhD
- Marcello Giovannini, MD, PhD
- Riccardo Troncone, MD
The Effects of Dietary Counseling on Children with Food Allergy: A Prospective, Multicenter Intervention Study

- 91 children with FA (49 M mean age 18.9 mo. 95% CI 16.5-21.3)
- Food intakes and protein, energy intakes assessed at baseline (T0) and at 6 months (T3)
- Children were seen after 2, 4 and 6 months RD
- At enrollment energy, protein intakes lower in FA; P<0.001
- And significantly lower calcium and zinc intakes
- After 6 months of dietary counseling, there was a significant increase in energy, carbohydrate, protein, iron, fiber, calcium, and zinc intake in children with FA vs baseline
At Baseline (TO) a weight/length ratio below 2 SD was observed in a significantly higher percentage of children with FA compared with healthy children (P<0.001).
Q. What recommendations are made in order to improve growth in children with food allergies?

- Individualized
- Adjusted daily amount of formula
- Increasing concentration when necessary
- Customize total amount of energy intake
- Discourage inappropriate elimination of other foods
- Address feeding strategies
- Consider micronutrients needs and supplementation
Proposed recommended nutrient densities for moderately malnourished children

<table>
<thead>
<tr>
<th>Protein g/kg/day</th>
<th>Energy kcal/kg/day</th>
<th>Protein/energy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 g/kg/day</td>
<td>1.02</td>
<td>89</td>
</tr>
<tr>
<td>2 g/kg/day</td>
<td>1.22</td>
<td>93</td>
</tr>
<tr>
<td>5 g/kg/day</td>
<td>1.82</td>
<td>105</td>
</tr>
<tr>
<td>10 g/kg/day</td>
<td>2.82</td>
<td>126</td>
</tr>
<tr>
<td>20 g/kg/day</td>
<td>4.82</td>
<td>167</td>
</tr>
</tbody>
</table>

Micronutrients

- Meyer et al. Pediatric Allergy and Immunology 2012; 23 (4) 307–314
Q. What are the research gaps? Q. What are your recommendations to healthcare workers and policy makers for addressing the nutritional consequences of food allergies and further preventing them?

*What are the specific requirements for patients with FA?  
*Does medical nutrition therapy have an impact?  
*How do we best way to educate dietitians?  
*How do we encourage doctors to use dietitians?  
*How do ensure access to dietitians?
Questions?