Nutritional Considerations of Common Childhood Conditions

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His dietitian experience includes tenure at some of the leading hospitals in the nation. Professional athletes, including those of Olympic standing, seek his expertise in nutritional consultation. His specialty includes the broad knowledge of using supplements in clinical practice for the prevention and treatment of chronic diseases such as diabetes, heart disease, arthritis, fibromyalgia and gastrointestinal disorders.
Micronutrient Malnutrition

- Deficiencies in micronutrients such as iron, iodine, vitamin A, folate and zinc affect nearly one-third of the world's population, and the consequences can be devastating.  
  [Global Report 2009]

- Iron deficiency is one of the top 10 causes of global disease and affects more than 2 billion children of their intellectual development, lowers their IQ, and contributes to about 25 percent of maternal deaths in developing countries.  
  [The State of the World's Children, 2009]

- Iodine deficiency is the leading cause of preventable mental retardation and causes brain damage in nearly 18 million newborns each year.  
  [Global Report 2009]
Micronutrient Malnutrition

- Vitamin A deficiency produces blindness in about 500,000 children and claims the lives of almost 670,000 children aged 5 years and younger. The Lancet, 2008

- Folate deficiency causes severe birth defects in approximately 150,000 newborns each year. Global Report 2009

- Approximately 1/3 of the world’s population lives in areas of high-risk for zinc deficiency, which contributes to as many as 800,000 child deaths per year. Food and Nutrition Bulletin. 2007
Respiratory Infections

- In children in developing countries, acute lower respiratory tract infections are among the most common causes of death, claiming ≈2 million lives every year.
- Risk factors are young age, low birth weight, pollutants, poverty, malnutrition, zinc deficiency, and lack of breastfeeding.
- Therapeutic or prophylactic administration of zinc to young children reduces the risk of acute lower respiratory tract infections and the episode duration.
Anemia and upper respiratory tract infections are common problems among primary school children of low socioeconomic status, and a complex relation exists between iron status and infection. Iron deficiency and anemia are associated with impaired immunocompetence and increased morbidity and infections can affect iron metabolism.
Zinc Deficiency

- Nutritional deficiency of zinc may affect nearly 2 billion subjects in the developing world.
- Consumption of cereal proteins high in phytate decreases the availability of zinc for absorption.
- Growth retardation, hypogonadism in males, rough skin, impaired immunity, neuro-sensory disorder and cognitive impairment are some of the clinical manifestations of zinc deficiency.
- Zinc is involved in many biochemical functions.
  - Over 300 enzymes require zinc for their activation and nearly 200 transcription factors require zinc for gene expression.
  - Oral zinc formulations may shorten the duration of symptoms of the common cold. CMAJ 2012
Vitamin C and Zinc

- Vitamin C and zinc play important roles in nutrition, immune defense and maintenance of health.

- Intake of both is often inadequate, even in affluent populations. J Int Med Res. 2012
Probiotics and URI

- Probiotics seem to be able to offer protection about common cold and respiratory infections in healthy and hospitalized children.

  J Clin Gastroenterol. 2012

- Clinical trials have shown that probiotics can be used as preventive and therapeutic agents in upper respiratory tract infections (URTIs) and otitis.

  J Appl Microbiol. 2012
Probiotics and Antibiotic Therapy

- Clostridium difficile colitis is the most common gastrointestinal infection, exceeding all other gastrointestinal infections combined.
- There has been a dramatic increase in Clostridium difficile infection (CDI) worldwide during the past decade.
- Antibiotic therapy is a trigger precipitating antibiotic-associated diarrhea (AAD), which may lead to CDI.
- Probiotics have been effective in reducing AAD and preventing CDI. Gastroenterol Clin North Am. 2012
Asthma
Asthma

- Over 9.5 million U.S. children under 18 years of age (13%) have been diagnosed with asthma; approximately 6.7 million children (9%) still suffer with asthma.
Etiology

- Genetic
- Allergic
- Environmental
- Infectious
- Emotional
- Nutritional
Goals of Asthma Therapy

- Maintain normal activity levels
- Maintain normal pulmonary function
- Prevent chronic symptoms
- Prevent recurrent exacerbations
- Provide optimal pharmacotherapy with minimal or no adverse events.
- Monitor for nutrient deficiencies
- Monitor for drug-nutrient interactions
Asthma and Allergies

- Strongest risk factor in the etiology of asthma is atopy (allergies, atopic dermatitis, allergic rhinitis).
- Atopic individuals have a significantly greater probability of developing asthma, and persons with a family history of atopic disease are at greatest risk.
- Estimates of the number of people with asthma who also have allergic rhinitis are as high as 80 percent.
- In one study, 79 percent of individuals with asthma also had chronic rhinosinusitis.
Asthma can be caused or exacerbated by food allergy.

Some estimates are that 5-8 percent of people with asthma have a food allergy that can be confirmed via a double-blind, placebo-controlled food challenge.

Patient estimates of food allergy in asthma are much higher, ranging from 20-60 percent.
Gastrointestinal Symptoms

- Occur more frequently in children with asthma and atopic dermatitis.
- Abnormal gastrointestinal permeability is found in a greater percentage of asthmatics compared to non-asthmatic controls.
Gastroesophageal Reflux and Asthma

- Increased incidence of GERD has been noted in asthma patients.
- Sontag estimates:
  - ~75 percent of asthmatic patients experience GERD symptoms
  - ~80 percent have abnormal acid reflux
  - ~60 percent have a hiatal hernia
  - ~40 percent have esophageal damage (erosions or ulcerations).
Nutritional Considerations and Asthma
Vitamin C

- Oxygen radicals are involved in the pathophysiology of bronchial asthma.
- Inflammatory cells generate and release reactive oxygen species.
  - Inflammatory cells from asthma patients produce more reactive oxygen species than non-asthmatics.
- Significantly decreased levels of vitamin C and vitamin E were found in lung lining fluid of asthmatics in a study, even though plasma levels were normal.
- Fourteen children with asthma were found to have significantly decreased serum levels of vitamin E, beta-carotene, and ascorbic acid during an asymptomatic period, with elevated levels of lipid peroxidation products during an asthma attack.
Vitamin C (continued)

- Epidemiological studies of vitamin C intake and asthma symptoms and respiratory function note a beneficial overall effect of vitamin C.
- As vitamin C intake rises, FEV1 and FVC (forced vital capacity) increase.
- Schachter and Schlesinger studied the effect of ascorbic acid on exercise-induced asthma, and concluded that ascorbic acid has a mild bronchodilatory effect in exercise-induced bronchospasm, seen as a protective effect on FEV1 and FVC compared to placebo.
Niacin (Niacinamide)

- Appears to inhibit mast cell degranulation and histamine release.
- Niacin intake and serum levels are inversely correlated with the incidence of wheezing.
Vitamin B6

- Pyridoxal 5'-phosphate (PLP), is the active form of vitamin B6 in the body.
- This vitamin is found in lower concentrations in asthma patients.
- Treatment of asthma with pyridoxine (50 mg twice daily) resulted in improvements in a reduction of asthma exacerbations and wheezing episodes in adults.
- In 76 children with asthma, B6 supplementation (100 mg pyridoxine HCl twice daily) resulted in fewer bronchoconstrictive attacks; less wheezing, cough, and chest tightness; and less use of bronchodilators and steroid medications.
- Asthma patients treated with the bronchodilator theophylline have lower blood levels of PLP, possibly due to PLP depletion secondary to its use in theophylline metabolism.
Vitamin B12

- It has been reported that children with asthma may be B12 deficient.
- Jonathan Wright, MD, and Alan Gaby, MD, relate that asthmatic children respond well to B12 supplementation, particularly if they are sulfite-sensitive.
- Daily doses of 1000-3000 mcg may be required.
Magnesium

- Magnesium is a cofactor in over 300 biochemical processes in the body.
- Hypomagnesemia is common in asthmatics, and worsens in more severe cases.
- Intracellular magnesium was assessed in 22 asthma patients and compared with 38 controls with allergic rhinitis. Magnesium levels were significantly lower in individuals with asthma versus controls.
- A large British study of dietary magnesium intake and asthma symptoms in 2,633 people found individuals who had a greater dietary intake of magnesium had a significantly higher FEV1 and significantly decreased airway hyper-reactivity.
Zinc

- Asthma patients have been shown to have lower plasma zinc than healthy controls.
- Serum and hair zinc were significantly lower in individuals with asthma and atopic dermatitis.
- Zinc deficiency may switch the Th1 immune response toward a Th2-type response.
- Zinc deficiency may cause an imbalance between Th1 and Th2 functions;
  - increased production of IL-4, IL-6, and IL-10
  - decreased production of IL-2 and tumor necrosis factor alpha.
- Zinc deficiency has also shown to decrease NK-cell activity and decreased numbers of cytotoxic CD8+ T-cell precursor cells.
Selenium

- Glutathione is a vital component of the body’s antioxidant system.
- Glutathione peroxidase (GSH-Px) is the selenium-containing enzyme that uses glutathione as a cofactor to metabolize hydrogen peroxide, and can thus protect against oxidative damage.
- Individuals with asthma tend to have increased oxidative activity, lowered selenium status, and decreased activity of glutathione peroxidase.
N-acetyl Cysteine

- Mucolytic agent
- Precursor to Glutathione
Coenzyme Q10

- Shown to markedly decrease histamine release from lung tissue.
**Obesity in Children**

- Approximately 17% (or 12.5 million) of children and adolescents aged 2—19 years are obese.
- Since 1980, obesity prevalence among children and adolescents has almost **tripled**.
- There are significant racial and ethnic disparities in obesity prevalence among U.S. children and adolescents.
- In 2007—2008, Hispanic boys, aged 2 to 19-years, were significantly more likely to be obese than non-Hispanic white boys, and non-Hispanic black girls were significantly more likely to be obese than non-Hispanic white girls.

*Center of Disease Control*
Fructose Intake in United States

- Free fructose
- HFCS
- Overweight
- Obesity
Foods Containing HFCS In the United States

- HFCS is found in almost all foods containing caloric sweeteners.
  - Most soft drinks and fruit drinks, candied fruits and canned fruits, dairy desserts and flavored yogurts, most baked goods, many cereals, and jellies.
- Over 60% of the calories in apple juice, which is used as the base for many of the fruit drinks, come from fructose, and thus apple juice is another source of fructose in the diet.
- Approximately two-thirds (2/3) of all HFCS consumed in the United States are in beverages.
Sweetener Intake in USA

AJCN-2002
Soft Drinks and Bone Mineral Density

![Graph showing the relationship between soft drinks consumption and femoral neck BMD](image)

AJCN- 10/2006
NonAlcohol Fatty Liver Disease

- Nonalcoholic fatty liver disease (NAFLD) is the leading cause of chronic liver disease in children, and can present in toddlerhood. Clin Liver Dis. 2012

- The NAFLD was associated with poor bone health in obese children. Aliment Pharmacol Ther. 2012

- Non-alcoholic fatty liver disease (NAFLD) occurs with a high prevalence and severity in obese, insulin-resistant adolescents. Pediatr Diabetes 2009
NAFLD

- Children with NAFLD have a diet that is insufficient in vitamin E and this may contribute to the pathophysiology of NAFLD.

- In children with NAFLD, reported sugar-sweetened beverage consumption is low; however, uric acid, which may reflect total fructose consumption, was significantly associated with NASH (nonalcoholic steatohepatitis).
Nutritional Relationships in Neurology
Headaches in Children

- Experts report that 30% to 50% of school-aged children and 50% to 80% of teens get headaches.

- Migraine Type
  - 3% of preschoolers
  - 11% of elementary school students
  - 23% High school students
Nutrient Deficiencies and Headaches

- Magnesium
- Vitamin B12
- Pantothenate
- CoQ10
- Riboflavin
- Zinc
- Vitamin D
Mental Health Disorders

- One in 10 children and adolescents in the United States have a mental illness severe enough to significantly impair functioning, with worldwide prevalence rates for child and adolescent mental disorders of ≈20%.

US Department of Health and Human Services, 2001
Lancet 2006
Common Childhood Mental Disorders

- Examples:
  - Attention-deficit hyperactivity disorder (ADHD)
  - Depression
  - Anxiety.

- The World Health Organization suggests that childhood neuropsychiatric disorders will increase worldwide by >50% by 2020, with these disorders becoming 1 of 5 of the most common causes of morbidity, mortality, and disability in children.

The World Health Report 2001
Zinc and Mental Disorders

- Studies in humans have shown relations between low zinc concentrations and symptoms of depression and ADHD and there is evidence of potential effectiveness of zinc supplementation for these disorders.
Zinc’s Roles with Mental Disorders

- Zinc is important for the production and modulation of melatonin, which regulates dopamine function, and for the conversion of dietary pyridoxine to its active form, pyridoxal phosphate, which is necessary for the conversion of tryptophan to serotonin.

  Int J Neurosci 1990
  J Child Adolesc Psychopharmacol 2005
  Biol Psychiatry 2004

- Dopamine and serotonin neurotransmitter systems appear to be involved in ADHD.

  J Am Acad Child Adolesc Psychiatry 2001

- Supplementation with zinc may resolve the reduction in melatonin and serotonin synthesis and improve ADHD symptoms, such as impulsivity.

  J Atten Disord 1999
Docosahexaenoic acid (DHA, 22:6n−3)

- Principal omega-3 (n−3) fatty acid in mammalian brain gray matter, representing ≈15–20% of the total fatty acid composition in the frontal cortex of adult humans and nonhuman primates.
- Mammals cannot synthesize DHA de novo, cortical DHA composition is positively correlated with dietary omega-3 fatty acid intake.

Pediatr Res 2005
Brain Res Bull 2001
Preclinical Evidence

- DHA and/or its bioactive metabolites have neurotrophic properties during perinatal brain development and are neuroprotective against a variety of insults associated with elevations in oxidative stress and lipid peroxidation.

  Prostaglandins Leukot Essent Fatty Acids 2009 & Stroke 2009

- Identified DHA as an important determinant of cortical astrocyte maturation and vascular coupling and cortical glucose uptake and metabolism.


- Functional integrity and resilience of cortical neurons is mediated in part by cortical DHA composition.
## Identified Prevalence of Autism Spectrum Disorders

### ADDM Network 2000-2008

Combining Data from All Sites

<table>
<thead>
<tr>
<th>Surveillance Year</th>
<th>Birth Year</th>
<th>Number of ADDM Sites Reporting</th>
<th>Prevalence per 1,000 Children (Range)</th>
<th>This is about 1 in X children...</th>
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<tr>
<td>2000</td>
<td>1992</td>
<td>6</td>
<td>6.7 (4.5-9.9)</td>
<td>1 in 150</td>
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<tr>
<td>2002</td>
<td>1994</td>
<td>14</td>
<td>6.6 (3.3-10.6)</td>
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<tr>
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<td>1996</td>
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<td>1998</td>
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<td>9.0 (4.2-12.1)</td>
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<tr>
<td>2008</td>
<td>2000</td>
<td>14</td>
<td>11.3 (4.8-21.2)</td>
<td>1 in 88</td>
</tr>
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