Nutrition, Obesity and Its Effects on Asthma/Allergies/Infections

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Disclosures

- Advisory board Optinose
Objectives

1. Identify Obesity and nutrition as comorbidities in Asthma and recurrent infections.

2. Describe the effects of obesity in asthma

3. Develop an understanding for basic nutritional influences on the Immune system.
Obesity is body mass index (BMI) at or above the 95th percentile from the sex-specific BMI-for-age 2000 CDC Growth Charts. Data are from the National Health Examination Surveys and National Health and Nutrition Examination Surveys.

Combined overweight and obese rates, children ages 10 to 17

- 0 - 9.9%
- 10 - 14.9%
- 15 - 19.9%
- 20 - 24.9%
- 25 - 29.9%
- 30 - 34.9%
- 35%+

NorthShore University HealthSystem
The majority of today’s children will have obesity at age 35

Predicted prevalence of obesity among 2-year-olds at future ages

Projections show that 59% of today’s 2-year-olds will have obesity when they are 35.
Medical Complications of Obesity

- Metabolic
- Structural
- Inflammatory
- Degenerative
- Neoplastic
- Psychological

236 comorbidities affecting EVERY organ system and medical specialty

Yuen M ... Kaplan LM, Obesity Week 2016
An increased prevalence of asthma occurs in children with obesity; the adjusted odds ratio of having asthma is 1.29 (95% CI 1.16-1.42) in obese compared with lean children. The prevalence of asthma in obese and lean women is 14.6 and 7.9 percent, respectively, whereas the prevalence in obese and lean men is 7.1 and 6.1 percent.

In some individuals, obesity precedes asthma, and obesity is a risk factor for the later development of asthma. In other individuals, asthma precedes obesity, suggesting that asthma may be a risk factor for the development of obesity. Asthma at the age of three to four years is reported to increase the risk of obesity nearly two-fold by age eight.
Asthma and Obesity – Contributing factors

• Genetic factors – Twin studies showing a shared genetic risk for both asthma and obesity

• Environmental exposures – air pollution and parental smoking are independent risk factors for the development of both obesity and asthma

• Dietary factors – Poor dietary quality (e.g., diets high in sugar or saturated fatty acids, or low in antioxidants or fiber) is associated with increased respiratory symptoms.
  – A meal high in saturated fatty acids can acutely increase airway inflammation and decrease lung function.
  – Low levels of micronutrients such as vitamin D may also contribute to the risk of asthma
Asthma and Obesity – Contributing factors

- Lung growth – Children with obesity have increased lung volume relative to airway caliber ("dysanapsis"), reflected by a lower than normal ratio of forced expiratory volume in one second to forced vital capacity (FEV$_1$/FVC) despite normal values for FEV$_1$ and FVC
  - Airflow limitation in obesity
  - Increased asthma exacerbation
  - Increased use of systemic steroids

- Mechanical factors – Mass loading of the chest wall and abdomen with adipose tissue decreases the functional residual capacity (the lung volume at the end of normal tidal exhalation)
Obesity and immune effects

- Adipose tissue mediators
  - Increased proinflammatory mediators, (IL)-6 *, TNF - α, and leptin
    - * High levels of IL-6 is associated with poor asthma control
  - Decreased release of anti-inflammatory adipokines, such as adiponectin

- Increased oxidative stress
  - Obese patients with late-onset (≥12 years) asthma have increased levels of oxidative stress, associated with impaired lung function.
• Immune cell function
  – Adaptive and innate immune cell function are altered in obesity.
  – Suppression of T-helper lymphocyte function involved in allergic responses
  – Innate lymphoid cells (ILCs), which respond to intrinsic damage signals rather than antigens, may contribute to asthma airway inflammation in obesity.
  – Eosinophil function is also altered by obesity.
    • submucosal eosinophils are increased in obese patients with asthma relative to overweight and lean subjects,
    • eosinophils in induced sputum and peripheral blood are not increased with obesity
Subtypes in Asthma and Obesity

• **Asthma complicated by obesity.**
  – This phenotype likely includes all asthma phenotypes found in lean patients.
  – Early-onset disease (typically <12 years old), elevated markers of allergic inflammation (atopy, allergic symptoms, high serum immunoglobulin E), significant physiologic changes (airway obstruction and hyper-responsiveness), and severe disease.
  – These patients gain weight faster than those with later-onset disease

• **Asthma secondary to obesity**
  – Many obese patients with asthma have later-onset disease (≥12 years old), less allergic inflammation, and are more likely to be female
  – typically characterized by less airflow obstruction and hyper-responsiveness and is less severe than patients with the earlier-onset disease.
  – some patients appear to have neutrophilic airway inflammation

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Obesity and asthma: an association modified by age of asthma onset.
Comorbidities of Patients with Asthma and Obesity

- **Sleep apnea**
  - OSA is associated with worse asthma control, increased health care utilization, and neutrophilic airway inflammation

- **Reflux** – may mimic asthma

- **Metabolic Syndrome** – (abdominal obesity, insulin resistance, hypertriglyceridemia, and hypertension)
  - affecting approximately 60 percent of those who are obese, and may contribute to asthma pathogenesis.
  - Serum interleukin (IL)-6, a marker of the metabolic syndrome, is increased in patients with poor asthma control

- **Depression**
  - increased in obese patients with asthma
  - associated with poor asthma control

*Serafino-Agrusa L et al. World J Clin Cases 2015*
PROCESSED FOODS EXPLAINED

**UNPROCESSED**

Food as it would be found in nature. These foods are generally highest in nutrients and fiber.

**PROCESSED**

Food that is canned, frozen, trimmed, or preserved. These foods still contain essential nutrients. Be careful of added sugar, fat, and salt.

**ULTRA-PROCESSED**

Food which contain few nutrients and fiber. These foods are usually sourced from corn, soy, or wheat with added fat and. Many packaged foods fall into this category.
Asthma and nutrition

• Studies showing effects of high fat meal:
  – Increased induced sputum neutrophil percentages
  – Increased TLR4 mRNA
  – Impaired response to B2-agonist
• Fiber intake inversely associated with airway eosinophils and positively associated with FEV1
• Dietary intake of antioxidants – vitamin C, Vitamin E and carotenoids are positively associated with lung function and negatively associated with asthma related outcomes
• Fruit intake inversely associated with wheeze and chronic lung disease and positively associated with FEV1
• Vegetable intake inversely associated with wheeze and asthma risk
  – Reducing fruit and vegetable intake to 3 servings a day in 1 study increased sputum neutrophils, Expression of NFkB and clinical outcomes worsened, including lung function and asthma control in 10 days

Asthma and nutrition

- The consumption of ultra-processed products was positively associated with the presence of asthma and wheezing in adolescents.
- the consumption of fast foods, particularly hamburgers, correlates to asthma in a dose-response pattern, which needs to be further validated in longitudinal and interventional studies
- A higher intake of fruits and vegetables was associated with a lower prevalence of allergic symptoms in Latin American children. Conversely, intake of fast food was positively associated with a higher prevalence of wheeze in adolescents.

Wang et al. Respirology. 2018 Oct
Lung. 2017 Dec
Nutrition and Wheeze, eczema

- Increased fruit intake
  - Decreased eczema
  - Decreased wheeze
- Increased fast food/ultra processed foods intake
  - Increased Eczema
  - Increased Wheeze

ISAAC III

*Nutrients* 2015
FIG 1. Potential explanations for a link between maternal lipidomic profiles and food allergy risk in offspring.

Koplin, K and Peters, R JACI Sept 2019
Diet and Food allergy

Hong et al. JACI Sept 2019
Diet and Food allergy

GRAPHICAL ABSTRACT

High fat diet-induced changes in the gut commensal community structure promote food allergy susceptibility

<table>
<thead>
<tr>
<th>High fat diet (HFD) feeding</th>
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<tbody>
<tr>
<td>Metabolic disease (Obesity)</td>
</tr>
<tr>
<td>Intestinal bacterial diversity</td>
</tr>
<tr>
<td>Food allergy susceptibility</td>
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</tbody>
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(12 weeks)

<table>
<thead>
<tr>
<th>HFD-associated microbiome transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>normal diet</td>
</tr>
<tr>
<td>HFD-microbiome colonizer</td>
</tr>
<tr>
<td>Germ-free recipient</td>
</tr>
<tr>
<td>HFD-microbiome reconstituted</td>
</tr>
<tr>
<td>No transfer of obesity</td>
</tr>
<tr>
<td>Intestinal bacterial diversity</td>
</tr>
<tr>
<td>Food allergy susceptibility</td>
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</table>

Hussain et al. JACI July 2019
Without Healthy eating, healthy weight and regular exercise studies have shown asthma is more difficult to control, there is a greater risk for exacerbations (i.e. increased symptoms), poor response to treatment (i.e. medications do not work as well and you need more of them) and increased risk for infections.

- Decreased SABA response
- Decreased steroid response
Asthma and Lifestyle

• If you have high blood sugar levels or Diabetes:
  • increased asthma symptoms
  • increased infections (immune cells do not work as well in the presence of high blood sugar levels)
• Increased HbgA1C is associated with increased risk for asthma exacerbations:
  – Pre Diabetic range - 27% increased risk
  – Diabetic range – 33% increased risk

Wu et al. JACI In Practice. March 2019
Decreased
- Neutrophil chemotaxis and adherence to vascular endothelium
- Phagocytosis
- Intracellular bactericidal activity
- Opsonization,
- Cell-mediated immunity
Mediterranean diet in patients with recurrent infections

- Population: Children ages 1-5, 63 girls, 65 boys
- Methods: Mediterranean diet education
- Results:
  - Number of URI episodes, degree of intensity and emergency and hospital admissions all decreased
  - In 1 year compared to average of 4.64 URIs in previous year
    - 53.9% no URIs
    - 25% 1 URIs
    - 16.4% 2 URIs
  - Antibiotic use decreased by 87.4%

Everyday comparison

- Take a good history
- Use the history to guide choice of therapy
Environmental Drivers to Obesity

- Labor-saving devices (decreased physical activity) (effects on muscle more than calories)
- Chronic stress and distress (incl. sleep, circadian) (direct impact on relevant brain areas)
- Altered food supply (signaling more than calories)
- Medications (up to 10% of obesity)

These influences act by raising the fat mass set point
Weight Gain Promoting Medication

- Diet
- Activity
- Sleep
- Circadian Rhythm
- Stress

Discontinue or substitute for weight gain-promoting medication

- CNS Agents
- Anti-diabetes
- Steroids
- Beta-blockers
- Anti-histamine
- Sleep Aids
DO ...

- Promote a healthy diet
  - High in fruits and vegetables
  - High in fiber
  - High in omega fatty acids
  - Limited in saturated fats
  - Low in processed carbohydrates
  - Low in trans fats
- Promote regular physical activity
- Promote stress reduction
- Promote sleep health
- Promote normal circadian rhythms
- Encourage treatment of obesity
Think of food as medicine. Eating healthy will improve your health and decrease your chances for chronic illness.

There are many different dietary lifestyles - Paleo, Keto, Plant based, Mediterranean, intermittent fasting. They all share 1 general principle: Remove processed, preserved and fast food (i.e. things that are quick and in a box or bag) and avoid foods with added sugars including consuming too many natural sugars including simple/process flours and eat LOTS of vegetables.

“You are what you eat, so don’t be fast, cheap, easy or fake.” - The morning Chalk up.
• DON’T …

• **Expect** that these changes will lead to **long-term weight loss**
  - They **may** in selected patients – if so that is a **bonus**

• **Create expectations** of weight loss when promoting lifestyle-based reduction of metabolic risk
  - Doing so is often used as a means of encouraging patient compliance
  - It is frequently counterproductive – patients who don’t realize weight loss benefits may become frustrated and abandon the otherwise beneficial lifestyle recommendations
Go Slow and Try Different Approaches

- Test therapies sequentially
- Pursue combination therapies – including combinations of specific lifestyle changes with more classical medical approaches
- Be supportive
  - Be persistent
  - Be there for the patient

_Aim for the “cure,” but always provide the care._
You have a 6 year old boy come in for follow up to your office following 3 wheezing episodes. His symptoms today are resolved. To prevent future exacerbations, In addition to assessing for environmental tobacco smoke what may you consider evaluating?

A. BMI
B. Amount of fast food in the diet
C. Environmental allergy assessment
D. All of the above
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You are seeing a 16 year old girl with asthma and allergic rhinitis in your office. She comes to see you stating that her diet and activity level has been unchanged but that she is gaining weight. Which common over the counter medications used in allergy and asthma patients can promote weight gain?

A. Primatene mist.
B. Saline rinses
C. Antihistamines
D. fluticasone
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A. Avoiding all contact with other children during cold and flu season
B. An extensive laboratory evaluation evaluating for immune deficiency.
C. Allergy evaluation
D. A detailed dietary history and recommendations to change to a Mediterranean Style diet.
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Thank you!

“LET FOOD BE THY MEDICINE AND MEDICINE BE THY FOOD”

-HIPPOCRATES