Obesity and Asthma
Twin US epidemics- are they linked?

CATHERINE KIER, MD
Professor of Clinical Pediatrics
Division Chief, Pediatric Pulmonary, and Cystic Fibrosis Center
Director, Pediatric Sleep Disorders Center
SUNY Stony Brook
Disclosure Statement

• Original Speaker: Christine W. Wagner, RN, MSN, CPNP, FNP-BC, AE-C
  • Advisory board for Thermo-Fisher Scientific

• Catherine Kier, MD
  • No disclosures
Objectives

• Recognize numerous interactions/link of asthma and obesity

• Discuss the studies supporting or at least exploring these interactions in both adults and children

• Identify potential management strategies to address the complications of asthma and obesity
What is Obesity?

• Obesity is defined as “very fat or overweight; corpulent”
• Corpulent = “large or bulky of body; portly; stout; fat”
• Fat = “having too much flabby tissue; corpulent; obese”
Definition of Childhood Obesity

• A child who has a BMI at or above the 85th percentile and lower than the 95th percentile is considered overweight.

• A child who has a BMI at or above the 95th percentile for children of the same age and sex is considered obese.
Asthma and obesity statistics

• Centers for Disease Control:
  “Obesity is associated significantly with the development of asthma, worsening asthma symptoms, and poor asthma control.”

• Adults with asthma: how many are obese
  9.7 million (25 million have asthma overall)

• Children with asthma: how many are obese
  nearly 2 million obese asthmatic US children
  (6 million have asthma overall)

https://www.cdc.gov/asthma/asthma_stats/asthma_obesity.htm
Not a single bidirectional homogeneous association

Asthma ↔ Obesity

- many children with asthma avoid exercise
- increase sedentary time
- receive treatment with oral corticosteroid medications

– all three factors promote weight gain
Asthma and Obesity interactions

- Common genetic predisposition
- Environmental
- Altered lung mechanics
- Associated comorbid conditions
- Systemic inflammatory process
Asthma and Obesity interactions

- Common genetic predisposition
- Altered lung mechanics
- Systemic inflammatory process
- Associated comorbid conditions
- Environmental
Developmental/genetic influences

• Data from 1001 monozygotic and 383 dizygotic same-sex twin pairs
  - a strong association between their asthma and BMI
  - with a significant heritability for asthma (53%) and obesity (77%) → additive genetic influences on each disorder
Asthma and Obesity interactions

- Common genetic predisposition
- Environmental
- Associated comorbid conditions
- Systemic inflammatory process
- Altered lung mechanics
Influence on lung mechanics/function

- Reduced FRC and tidal volume
- Breathing at lower lung volumes
- Reduced changes in airway caliber during efforts
- Increased small airway closure
- Loss of bronchoprotective effect of deep inspiration
Asthma and Obesity interactions

- Common genetic predisposition
- Altered lung mechanics
- Systemic inflammatory process
- Associated comorbid conditions
- Environmental
Energy Balance

Ghrelin - increases appetite

Leptin - decreases appetite
Obesity-associated systemic inflammation

- Pro-inflammatory cytokines (e.g. TNFα, IL6)
- Chemokines (e.g. eotaxin)
- Acute phase reactants
- Increased oxidative stress
- Increased leptin and reduced adiponectin levels
Asthma and Obesity interactions

Common genetic predisposition

Environmental

Associated comorbid conditions

Altered lung mechanics

Systemic inflammatory process
Asthma-related comorbid conditions

- Rhinitis: Allergic, Nonallergic, Polypoid
- Chronic sinusitis
- GERD
- Obesity
- OSA
- Hormonal disturbances
- Hyperventilation: Glottic dysfunction
- Psychopathologies
- Smoking: Nicotine dependence
- COPD
- Respiratory infections
- Other conditions: Atopic dermatitis, ABPA, Bronchiectasis
Fig. 1. Hypothetical interaction of obstructive sleep apnea syndrome and obesity in activating pathways leading to metabolic disease. TNF-α, tumor necrosis factor alpha; IL-6, interleukin-6; CRP, C-reactive protein.

Asthma phenotype

- T2-type asthma
  - Allergic asthma
  - Late-onset eosinophilic asthma
  - Aspirin-exacerbated respiratory disease
  - Exercise-induced asthma

- Non-T2-type asthma
  - Very late-onset asthma (women)
  - Obesity-associated asthma
  - Smooth-muscle-mediated paucigranulocytic asthma

- Childhood-onset asthma
- Adult-onset asthma

Nature Reviews | Disease Primers

Stony Brook Children’s
Asthma obese phenotype/endotype

**Asthma Syndrome**
- Characterized by variable and recurring symptoms, airflow obstruction, bronchial hyperresponsiveness, and inflammation

**Phenotypes**
- Observable characteristics including clinical presentation, triggers, and treatment response

**Endotypes**
- Condition subtype defined by a distinct functional or pathophysiological mechanism (links clinical characteristic with a molecular pathway)

- Early onset atopic asthma:
  - A classic T Helper 2 (Th2) mediated inflammatory disease
  - Cytokines made by fat tissue and leptin (elevated in obesity) could contribute to chronic inflammation in asthma

- Later onset, non-atopic asthma:
  - Neutrophilic
  - Breathing at low lung volumes may increase airway hyperresponsiveness and smooth muscle remodeling

Journal of Allergy Volume 2013, doi.org/10.1155/2013/602908
Asthma and Obesity

- Both asthma and obesity are on the rise
  - Weight gain can precede the development of asthma or poorly controlled asthma can lead to obesity
  - Increase of 1 point in BMI relates to 6% increase in prevalence of asthma
  - Weight loss can improve asthma control

Asthma and Obesity

• Altered respiratory physiology in obesity
  ◦ NiOx was increased in asthmatics, obese non-asthmatics and obese asthmatics

• Increased inflammation due to obesity
  ◦ P2 protein helps fat cells store fat molecules also inflames cells lining the surface of the airways *

• Adults with asthma has major reductions in asthma symptoms and need for asthma medications following weigh loss via lap band surgery

Risk Factors

• Mother’s pre-conception weight and weight gain during pregnancy
• Very high birth weight AND very low birth weight are associated with childhood obesity
• Maternal smoking during early pregnancy is associated with a 500% greater risk of obesity at age 5
Mediating Factors

- Breastfeeding reduces the risk of obesity
  - 4% decrease for every month of breast feeding
  - Plateaus at 9 months
- Strongest effects of obesity reducing benefits of breastfeeding are seen in adolescents
- Early introduction of solids (before 6 months) increases risk of obesity in childhood
Other Issues Related to Asthma

• Reduced physical activity due to poorly controlled asthma resulting in
• Increased screen time
• Effects of asthma medications on weight – effects of oral and inhaled corticosteroids
Screen Time

• Children 8—18 years of age spend an average of 7.5 hours a day using entertainment media, including TV, computers, video games, cell phones, and movies.

• 4.5 of those hours are contributed to TV viewing
The Problem

• About half of parents with an overweight or obese child do not think their kids are too heavy
• About 14% of parents see their normal weight children as underweight
• Parents of children ages 2-5 are more likely to underestimate their child's weight
• Parents are less accurate in judging the size of their sons
Obesity: Why Now?

- Genetics
- Lifestyle changes:
  - Increased calorie intake poor expenditure
  - Costs and quality of food
  - Portion size - Energy Dense Foods more plentiful
- Diet in school
  - 75% of beverages and 85% of snacks sold in US middle and high school are of poor nutritional value
Implications as a Nation

• In 2010, 12 states have obesity rates over 30%
  • 20 years ago, no state had an obesity rate above 15%
• Obesity is the #2 cause of preventable death in the US
• Obesity related health costs exceed $100 billion annually
• 35% of children are overweight (BMI > 85%); 11% with BMI > 95%........an increase of 30% in past 10 years
• Childhood obesity predicts adult obesity
Changes over 20 years

<table>
<thead>
<tr>
<th>Item</th>
<th>Calories</th>
<th>Old</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>333 calories</td>
<td></td>
<td></td>
<td>590</td>
</tr>
<tr>
<td>140 calories</td>
<td></td>
<td>3&quot;</td>
<td>6&quot;</td>
</tr>
<tr>
<td>210 calories</td>
<td></td>
<td>2.4 oz</td>
<td>6.9 oz</td>
</tr>
<tr>
<td>610 calories</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Sugar Intake 1970 vs 2007

http://www.thecooksden.com/calories/, retrieved February 20th, 2013  statistics are from Economic Research Services-USDA
Vitamin D and Obesity

• In 118 obese adults Vitamin D insufficiency was found in 90% of the population.

• Serum 25-(OH)D3 levels were significantly lower in the obesity group of children compared to the normal weight control group.
Vitamin D and Obesity

• Obesity-associated vitamin D insufficiency is likely due to the decreased bioavailability of vitamin D3 from cutaneous and dietary sources because of its deposition in body fat compartments.

Vitamin D and Asthma

• Vitamin D levels reduced in many asthmatics
• Vitamin D appears to have suppressing effect on inflammation
• Vitamin D also seems to reduce asthma exacerbation and increase the response to glucocorticoids
Where do you start?

• Is the child/family concerned about the child’s weight?
• Readiness to change critical
• Even if not ready to change, the issue needs to be addressed
• Should be discussed at every encounter
• Opens the door for the child
Psychosocial factors and opportunity for education

- Reduced activity in asthmatic children is not universal.
- Depend on the attitudes and teaching of parents about the role of exercise in asthma control.
- May be affected by childhood emotional health.
Who, what, where, when and how?

• Who purchases the food, prepares the food, eats with the child, etc
• What do they eat and HOW MUCH
• Where are meals eaten
• When are meals served
• How does eating affect them, what motivates them to eat
Be Specific

• How much juice, sugared drinks, sports drinks
• What type of milk is used
• What is the perception of health, healthy eating
• Where is the nearest grocery store, fast food restaurant
• Is the neighborhood safe
Recommendations

• Define portion size
• How to read labels
• Importance of fiber
• Family effort
• Reduce screen time - goal is one hour per day but we settle for 2
• Increase activity-goal is 1 hour per day
### Current Label

**Nutrition Facts**

**Serving Size:** 2/3 cup (55g)  
**Servings Per Container:** About 8

<table>
<thead>
<tr>
<th>Amount Per Serving</th>
<th>Calories:</th>
<th>230</th>
<th>% Daily Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calories</strong> 230</td>
<td>Calories from Fat 40</td>
<td>% Daily Value*</td>
<td></td>
</tr>
<tr>
<td><strong>Total Fat</strong> 8g</td>
<td>12%</td>
<td><strong>Saturated Fat</strong> 1g</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Trans Fat</strong> 0g</td>
<td><strong>Cholesterol</strong> 0mg</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td><strong>Sodium</strong> 160mg</td>
<td>7%</td>
<td><strong>Total Carbohydrate</strong> 37g</td>
<td><strong>Dietary Fiber</strong> 4g</td>
</tr>
<tr>
<td><strong>Protein</strong> 3g</td>
<td></td>
<td><strong>Sugars</strong> 1g</td>
<td></td>
</tr>
</tbody>
</table>

Vitamin A: 10%  
Vitamin C: 8%  
Calcium: 20%  
Iron: 45%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily value may be higher or lower depending on your calorie needs.

### Proposed New Label

**Nutrition Facts**

**Serving Size:** 2/3 cup (55g)  
**Amount per 2/3 cup Calories:** 230

<table>
<thead>
<tr>
<th>Amount per 2/3 cup Calories:</th>
<th>230</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Fat</strong> 8g</td>
<td>12%</td>
</tr>
<tr>
<td><strong>Saturated Fat</strong> 1g</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Trans Fat</strong> 0g</td>
<td><strong>Cholesterol</strong> 0mg</td>
</tr>
<tr>
<td><strong>Sodium</strong> 160mg</td>
<td>7%</td>
</tr>
<tr>
<td><strong>Total Carbohydrate</strong> 37g</td>
<td>12%</td>
</tr>
<tr>
<td><strong>Dietary Fiber</strong> 4g</td>
<td>14%</td>
</tr>
<tr>
<td><strong>Sugars</strong> 1g</td>
<td></td>
</tr>
<tr>
<td><strong>Added Sugars</strong> 0g</td>
<td></td>
</tr>
<tr>
<td><strong>Protein</strong> 3g</td>
<td></td>
</tr>
</tbody>
</table>

Vitamin D: 2mcg  
Calcium: 260mg  
Iron: 8mg  
Potassium: 235mg

*Percent Daily Values are based on a 2,000 calorie diet. Your daily value may be higher or lower depending on your calorie needs.

*Footnote on Daily Values (DV) and calories reference to be inserted here.
Barriers to Weight Loss

- Eating healthy is more expensive
- Unsafe environments for outside activities
- Reduced parental supervision
- No exercise partners
- Lack of motivation
- Irregular schedules
- No encouragement
Home Gym

• Resistance bands
• Zumba or other dancing
• Heavyweight yoga
• Exercise during commercials
RECOMMENDATIONS

• Motivate adults to be good role models
• Offer suggestions on how to buy healthier options
• Instill structure regarding meal times/food choices/TV
• Encourage positive/healthy eating for family unit
• Use TV/video games as a reward to exercise/physical activity
• Eliminate eating when bored
Summary

• Causal link between asthma and obesity not definite but there is a growing body of literature to support the link
• Strong association cannot be ignored
• Difficult to control asthma can be influenced by obesity
• Other co-morbid conditions to both diseases should be considered
• As Certified Asthma Educators we should promote good health