Social and Environmental Factors in Pediatric Obesity

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I will not discuss off label use or investigational use in my presentation.

I have no financial relationships to disclose.
Objectives

- Identify the social and environmental influences as a causative factor for obesity
- Discuss the epidemiological evidence for obesogens actions
- Discuss the effects of obesity in the pediatric population
Defining Childhood Obesity

- Obesity occurs when energy intake exceeds energy expenditure

- Body Mass Index (BMI) is a measure to determine childhood overweight and obesity

- Overweight is defined as a BMI at or above the 85th percentile and below the 95th percentile

- Obesity is defined as a BMI at or above the 95th percentile
<table>
<thead>
<tr>
<th>Weight Status Category</th>
<th>Percentile Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>Less than the 5&lt;sup&gt;th&lt;/sup&gt; percentile</td>
</tr>
<tr>
<td>Normal or Healthy Weight</td>
<td>5&lt;sup&gt;th&lt;/sup&gt; percentile to less than the 85&lt;sup&gt;th&lt;/sup&gt; percentile</td>
</tr>
<tr>
<td>Overweight</td>
<td>85&lt;sup&gt;th&lt;/sup&gt; to less than the 95&lt;sup&gt;th&lt;/sup&gt; percentile</td>
</tr>
<tr>
<td>Obese</td>
<td>95&lt;sup&gt;th&lt;/sup&gt; percentile or greater</td>
</tr>
</tbody>
</table>
BMI

- However, BMI measurements do not reflect adiposity accurately because a muscular individual might have the same BMI as an oversized individual.

- High lean body mass can elevate weight, leading to a higher BMI without corresponding high adiposity.
INTRODUCTION

- US national rates for child obesity has shown no significant changes
- Childhood obesity is still a significant problem, with 16.3% of 2-19-year-old
- Only one obesity prevention program has documented community-level changes
INTRODUCTION

- In 2003 Texas senate bill mandates 135 min of physical activity/week and School Health Advisory Councils.

- In 2004 The Texas Public School Nutrition program was instituted.

- In 2007 coordinated school health programs were implemented.
El Paso County Public Health 2013

• “Rethink your drink: Choose water.”

• “Decrease screen time to give your child a healthier life”

• “Getting fit and healthy as a family.”

• “Everyday small steps to keep kids healthy.”
• 32 percent of children in Texas 10-17 years old were reported as being overweight or obese in 2010.

• In Texas, Hispanic children have the highest rates of overweight and obesity.

• 47% of Texas Hispanic children were obese, compared to 26% of black-non Hispanic, and 23% of white non-Hispanic children.
• Among Texas’s children aged 2 to 5 years: 17% were overweight and 15% were obese.

• About 25% of the population in El Paso County are obese.

• The childhood obesity rate in El Paso, TX is at 33%, higher than the national average.
Source: DSHS Obesity Data Sheet (May 2010)
Factors Contributing to Childhood Obesity

- The main causes are similar to those in adults and include behavior and genetics.
- Behaviors can include dietary patterns, physical activity, inactivity, medication use and other exposures.
- Additional factors include the environment, education and skills, and food and marketing promotion.
Factors Contributing to Childhood Obesity

- Genes play a role in pediatric obesity but do not account for the recent increase in prevalence.

- Exogenous influences are more important (fast foods, prepackaged foods, and high fructose corn syrup).

- Less accessible and lower intake of fruits and vegetables.

- Lack of safe areas to play outside; sedentary lifestyles with more hours of television and video game use.
Community Environment

- American society promotes increased consumption of less healthy food and physical activity

Influences:
- Advertising of less healthy food
- Variation in licensure regulations among child care centers
- No safe or appealing place, to play or be active
- Limited access to healthy affordable food
- Greater availability of high energy-dense foods
- Increasing portion sizes
- Lack of breastfeeding support
### Risks Of Adult Obesity

<table>
<thead>
<tr>
<th>Age</th>
<th>Chance Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>As an infant</td>
<td>14%</td>
</tr>
<tr>
<td>As preschool age child</td>
<td>25%</td>
</tr>
<tr>
<td>At age 7 years</td>
<td>41%</td>
</tr>
<tr>
<td>At age 12 years</td>
<td>75%</td>
</tr>
<tr>
<td>In adolescence</td>
<td>90%</td>
</tr>
</tbody>
</table>
Protective Factors For Obesity

- Breastfeeding
- Families who have active lifestyles
- Minimal television usage
- Having non obese parents
Medical Complications

- Hypertension (2.9 times higher in obese children)
- Type 2 diabetes (2.9 times higher in obese)
- Hypercholesterolemia (2.1 times higher)
- Obstructive sleep apnea
- Left ventricular hypertrophy
- Mechanical stress on joints
- Coronary artery disease
- Insulin resistance, acanthosis nigricans
- Social stigma, depression, and low self-esteem
Potential Results of Reducing BMI

- If BMI is reduced by 10%
  1. Blood pressure decreases by 10 mm Hg
  2. Triglycerides decrease below 100 mg/dl or by 200 mg/dl (if genetic defect present)
  3. High-density lipoprotein (HDL) cholesterol increases by 3 to 5 mg/dl
  4. Low-density lipoprotein cholesterol (LDL) sometimes lowers (diet/weight loss combined can lower by 25% to 30% if elevated)
New Hypothesis

• In 2002, a new hypothesis argued that the increase in the prevalence of obesity/overweight in the US was caused by exposure to environmental toxins.

• Low-dose chemical exposures were associated with weight gain (in experimental animals)

• Chemicals present in the air, food, and water altered metabolic processes in the body and led to weight gain
Obesogen Hypothesis

- Endocrine-disrupting chemical (EDC)
- Obesogens
- Organotins
Environmental Obesogens

**ENVIRONMENTAL POLLUTANTS**
- Fine particulate Matter (PM$_{2.5}$)
- Benzo[a]pyrene
- Lead
- ? Ozone, NO$_2$, SO$_2$

**INDUSTRIAL CHEMICALS**
- Organotins
- Bisphenol A
- Perfluorooctanoic acid
- Phthalates
- Polybrominated Diphenyl Ethers
- Polybrominated Biphenyl Ethers

**OTHER OBESOGENS**
- Dietary Source: Fructose, Monosodium glutamate, Genistein
- Pharmaceutical: Estradiol, Diethylstilbestrol
- Smoking

**ORGANO-PHOSPHATE PESTICIDES**
- Chlorpyrifos
- Diazinon
- Parathion
Air Pollution/Smoking/Obesity

- There is an association between maternal smoking and the risk of obesity in children

- The odds ratios increased with age, suggesting strengthening of the relationship over time

- The prevalence among adolescents was greater among those whose mothers smoked during pregnancy
Vicious cycle of obesity epidemic
How Air Pollution Causes Obesity

- The molecular mechanisms remain poorly understood.
- Exposure to air pollutants occurs even before people are born.
- Exposure to pollutants during fetal growth has been shown to produce metabolic reprogramming in the fetus that leads to obesity.
Air Pollutants and Obesity

- Pesticides, Herbicides and Fungicides
- TF, DDT, TBT, TFZ
- PHYTHALATE INDOMETHACIN PHENAMIN DES
- Medical & Pharmaceutical devices
- PCB DIGOXIN TCDD
- Industrial waste and products
- Clothing and furniture
- Plastic toys and bottles
- Phytochemicals & food colorings
- EMODIN FLAVANONE BIXIN
- Personal Care products and Household Supplies
- PHTHALATES ALKYLPHENOLS NONYLPHENOL OCTYLPHENOL
- PBDES AND OTHER FLAME RETARDANTS
- BPA PHTHELATES DEHP MEHP
Tobacco smoke and lipids

- Associated with greater levels of serum cholesterol during adulthood
- Associated with a 2.5-fold greater risk of having increased triglycerides
- 2.3-fold risk of having low high-density lipoprotein levels
Polyaromatic Hydrocarbons and Estrogenic Activity

- Polyaromatic hydrocarbons are air pollutants

- Commonly generated from motor vehicular exhausts, especially from diesel vehicles

- PAH can easily cross the placental barrier after being inhaled by the pregnant mother.
• Prenatal and early life exposure to environmental estrogens has been shown to cause obesity later in life

• In utero exposure to PAH was associated with a 79% greater risk of obesity at the age of 5 years

• In utero exposure to PAH was associated with a 226% at the age of 7 years
<table>
<thead>
<tr>
<th></th>
<th>Obesity at Age 5 Years</th>
<th>Obesity at Age 7 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RR&lt;sup&gt;a&lt;/sup&gt;</td>
<td>95% CI</td>
</tr>
<tr>
<td>Birth weight (per 100 g)</td>
<td>1.04</td>
<td>1.00, 1.08</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dominican</td>
<td>1</td>
<td>Reference</td>
</tr>
<tr>
<td>African-American</td>
<td>0.68</td>
<td>0.45, 1.01</td>
</tr>
<tr>
<td>Maternal receipt of public assistance during pregnancy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>Reference</td>
</tr>
<tr>
<td>Yes</td>
<td>0.94</td>
<td>0.65, 1.36</td>
</tr>
<tr>
<td>Child’s sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1</td>
<td>Reference</td>
</tr>
<tr>
<td>Male</td>
<td>1.01</td>
<td>0.70, 1.44</td>
</tr>
<tr>
<td>Maternal prepregnancy obesity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>Reference</td>
</tr>
<tr>
<td>Yes</td>
<td>1.39</td>
<td>0.93, 2.08</td>
</tr>
<tr>
<td>Child’s age at measurement, months</td>
<td>1.05</td>
<td>1.00, 1.10</td>
</tr>
<tr>
<td>Tertile of prenatal PAH exposure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First (&lt;1.73 ng/m³)</td>
<td>1</td>
<td>Reference</td>
</tr>
<tr>
<td>Second (1.73–3.07 ng/m³)</td>
<td>1.79</td>
<td>1.08, 2.98</td>
</tr>
<tr>
<td>Third (≥3.08 ng/m³)</td>
<td>1.79</td>
<td>1.09, 2.96</td>
</tr>
</tbody>
</table>
Inflammation and Adipose Tissue

- Air pollution induces obesity via a systemic inflammatory pathway that targets adipocytes.

- Exposure to pollutants has been shown to cause visceral adipose tissue inflammation and oxidative stress.

- EDCs are highly lipophilic and accumulate in mature adipocytes, resulting in high local concentration in the fat pad.
Effects on Endocrine and Autonomic Nervous System

- Environmental toxins induce obesity via alterations in weight-controlling hormones
- Via alterations in sensitivity to neurotransmitters
- Via alterations in the activity of the sympathetic nervous system
Obesity and Air Pollution

Obesity increases susceptibility of lungs to harmful effects of air pollution.

- Increased deposition of pollutants
- Physiological reduction in lung volumes
- Autonomic imbalance: increased vagal tone
- Obesity induced oxidative stress: ROS in circulation
- Obesity induced systemic inflammation: IL6, IL-5, TNF-α
Summary

- Air pollution is now recognized as a novel risk factor for the development of obesity.

- Several xenobiotic chemicals can disrupt the normal development and homeostatic controls over adipogenesis and energy balance.

- Exposure to obesogens has been identified to induce obesity.
Summary

- Obese individuals are also more vulnerable to the harmful effects of air pollutants.

- Despite the emerging evidence for the role of air pollutants in obesity, this topic is still in its infancy.

- More knowledge needs to be generated by means of dose-response studies on air pollutants and obesity to conclusively establish the link.
5 to Go!!! Message

- 5: Eat FIVE fruits and veggies a day
- 4: Give and get FOUR compliments a day
- 3: Consume THREE dairy a day
- 2: No more than TWO media hours a day
- 1: At least ONE hour of exercise a day
- 0: No sugar-sweetened drinks, ever

GO: Be well, inside and out!!
References

- Marcie B. Schneider, MD,* and Susan R. Brill, MD. Obesity in Children and Adolescents. Pediatrics in Review Vol.26 No.5 May 2005
- Solveig A. Cunningham, Ph.D., Michael R. Kramer, Ph.D. Incidence of Childhood Obesity in the United States. n engl j med 370;5, January 30, 2014
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