



# Juvenile Obesity: Biological and Environmental Causes and Policy

## Proposals to Alleviate this Growing Public Health Concern

Sooyoung Lim, Alice Woolverton Professor O' Hara, Richard Aronson, MD

Dept. of Biochemistry, Amherst College, Amherst, MA 01002

### ⌘ Abstract

Childhood obesity is one of the most important public health issues in the US today. In the past 30 years, obesity rates among children have tripled in this nation<sup>1</sup>. Childhood obesity is especially of grave importance since it could lead to other severe diseases in adulthood such as heart disease, type 2 diabetes, stroke, several types of cancer, and osteoarthritis. The aim of this presentation is to elucidate and promote awareness of some of the key factors causing the dramatic increase in juvenile obesity and to suggest policy changes to better address this issue. Some of the causes discussed of obesity in this presentation include: a high-fat diet, an energy dense diet, maternal undernutrition, reduced spontaneous physical activity, disruption of sleep-wake cycle, and perceived stress. Although less evident, psychological disorders in adolescents in relation to developing obesity is also discussed. Specific policies to comprehensively address these causes will be critical to reducing rate of obesity among children.

### ⌘ Introduction

- Not only has the rate of adult obesity risen in the past decades, but recently, the incidence of childhood and adolescent obesity has increased.
- Younger people are beginning to develop diseases associated with obesity such as type 2 diabetes and high cholesterol.
- 17% (or 12.5 million) of young people ages 2-19 are obese, three times as many as were obese in 1980.<sup>2</sup>
- Obesity most commonly affects low-income minority children, and 1 of every 7 low-income preschool-aged child is obese.<sup>2</sup>
- Public health policies should be more heavily implemented, and education about obesity should be more publically accessible.

### ⌘ Diet and Juvenile Obesity

#### High-fat diet:

- A major contributor to juvenile obesity due to a large shift in food culture that promotes fast food and commercial food that is high in fat content.
- Increases small intestinal cell proliferation and secretion of pancreatic lipase.<sup>3</sup>
- Increases the rate of gastric emptying, a phenomenon that could lead to increased food consumption.<sup>4</sup>
- Decreases sensitivity to hormones that inhibits food intake.<sup>4</sup>
- Decreases the satiation efficiency of a meal.<sup>5</sup>
- Maintaining a nutritionally balanced diet is just as important in regulating body weight.

*Public health measures must be taken to promote lower fat and less energy dense foods in fast food restaurants, vending machines and cafeteria. Also, children should be encouraged to drink water. Advertising low-calorie flavored waters and juice might be helpful.*



Image from: <http://www.mommymdguides.com/>



Image from: <http://www.parenthoodandkids.com/pregnancy/food/>

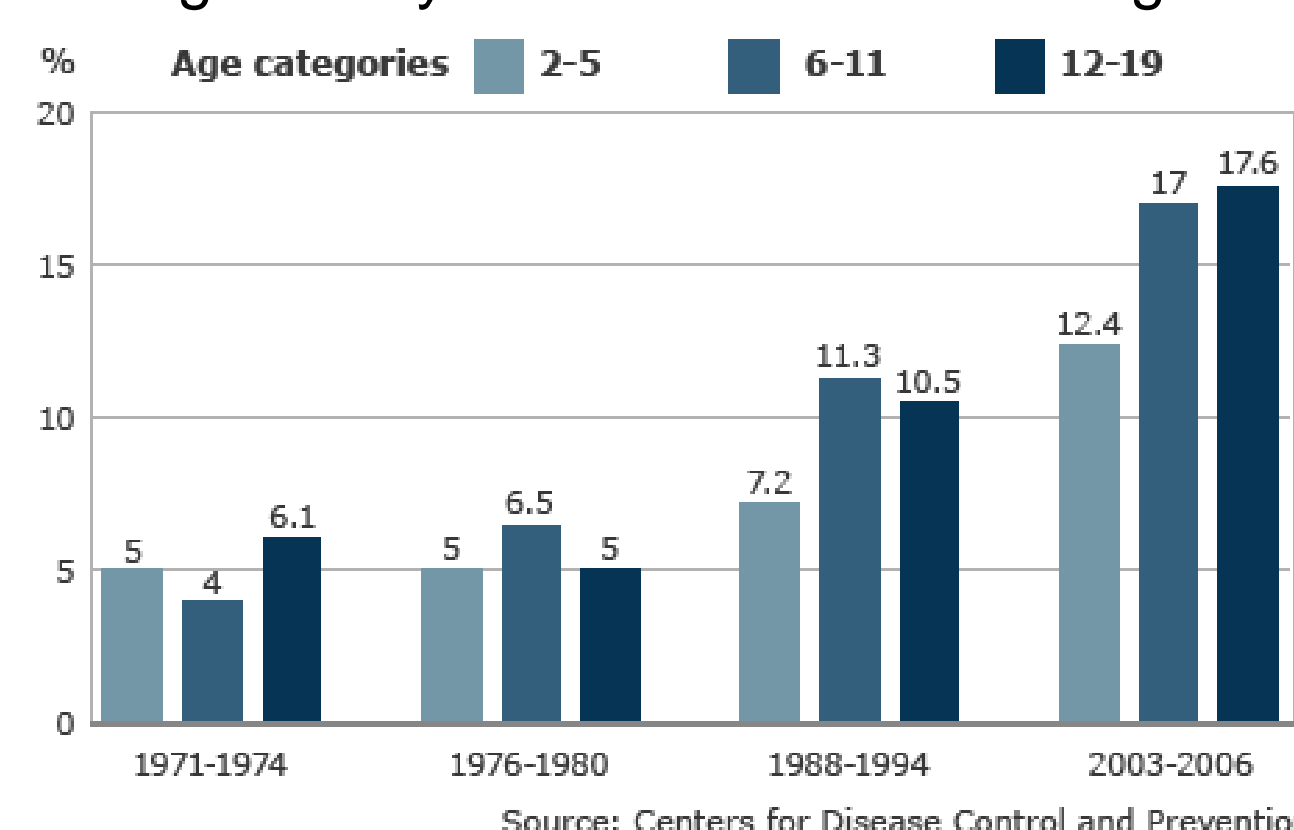
### ⌘ Maternal Undernutrition- Increased Obesity and Metabolic Syndrome in the Next Generation

Low birth weight caused by maternal undernutrition is associated with the diseases of metabolic syndrome— obesity, elevated serum cholesterol, elevated hypertension, and diabetes – in childhood and adult life.

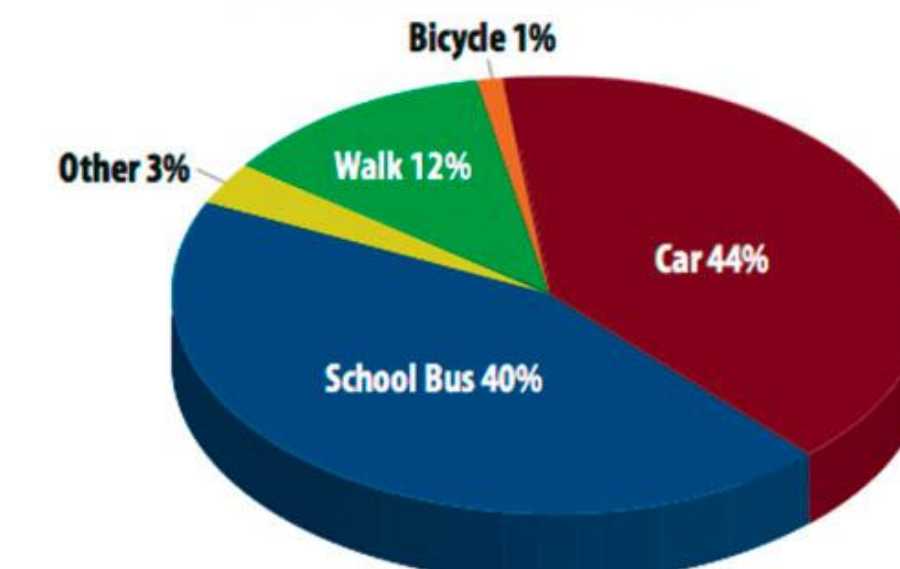
- This association supports the idea of fetal programming, which is an irreversible physical response to external indicators during important phases of growth and development.<sup>6</sup>
- Most popular hypothesis: thrifty phenotype hypothesis, which states that fetal exposure to undernutrition promotes “thrifty” consumption of scarce nutrients to promote survival. When the post-natal environment offers more energy than the pre-natal environment, the offspring metabolizes energy less efficiently and is more likely to gain excess weight.<sup>6</sup>

*Public health measures must be taken to ensure that pregnant women are educated about the importance of nutrition and those who cannot afford are given the priority to have access to healthy foods.*

#### Rising Obesity: US children and Teenagers



#### How Kids Get to School, 2009



Decrease in spontaneous physical activity: children don't walk to school

### ⌘ Physical Activity in Relation to Juvenile Obesity

Physical activity promotes fat oxidation and can help reduce obesity. However, in an increasingly convenient society, a decrease in the amount of spontaneous physical activity is also becoming a significant contributor of obesity.<sup>7,8</sup>

- Lack of street connectivity, low-density development, and lack of destinations within safe walking distance have been shown to encourage driving and discourage walking, therefore contributing to obesity.<sup>8</sup>
- An additional hour spent in a car per day is associated with a 6% increase in the likelihood of obesity.<sup>8</sup>
- An additional kilometer walked per day is associated with a 4.8% decrease in obesity.<sup>8</sup>



*The government should focus on increasing walkability or bike-ability by promoting mixed uses of land and designing good pedestrian and bike paths when designing neighborhoods. Government should also enhance the security of neighborhoods so that children will be encouraged to safely play outside. Such modifications of built environment have the potential to be an effective long-term solution for obesity.*

### ⌘ The Importance of Sleep in Preventing Juvenile Obesity

Considering the increasingly nocturnal lifestyle of children due to an increase of indoor activities such as video games, changes in sleep patterns may be one of the factors contributing to juvenile obesity.

- The circadian clock can be divided into two: central and peripheral clocks. Obesity is most relevant to peripheral clock.
- Disrupted circadian rhythm may cause proliferation of fat-cells: Many pro-adipogenic transcription factors are under the control of circadian clock.<sup>9</sup>
- When asleep, the rate of lipolysis increases and when awake, lipolysis rate decreases and lipogenesis rate increases.<sup>9</sup>
- Eating at night could also contribute to obesity by altering peripheral clock and thus changing activity of many metabolically relevant enzymes.<sup>9</sup>

*The importance of sleep should be emphasized to teachers, healthcare providers, and parents. Parents should also limit children's food intake and restrict watching televisions and playing video games late at night.*

### ⌘ Perceived Stress and Obesity

Perceived stress can also contribute to obesity by increasing food intake, especially palatable, high-fat, high-sugar food items and promote fat-cell proliferation and differentiation.

- Stress increases amount of high-fat, high-sugar food consumed.
- Stress-hormone (cortisol) is shown to increase hormones that stimulates proliferation and differentiation of fat-cells.<sup>10</sup>
- Stress-hormone can also decrease insulin sensitivity and increase fatty acid uptake and lipogenesis.<sup>10</sup>
- Food could act like drugs: palatable food could act as a positive re-enforcer and increase its own uptake when stressed.<sup>10</sup>

*Policies that reduce the severity and prevalence of long-term and severe stress should be implemented on a broader scale in order to improve the mental and physical well-being of our society. School should provide a section of time each day to promote stress-reducing activities such as: yoga, meditation, regular exercise, positive visualization, and prayer.*

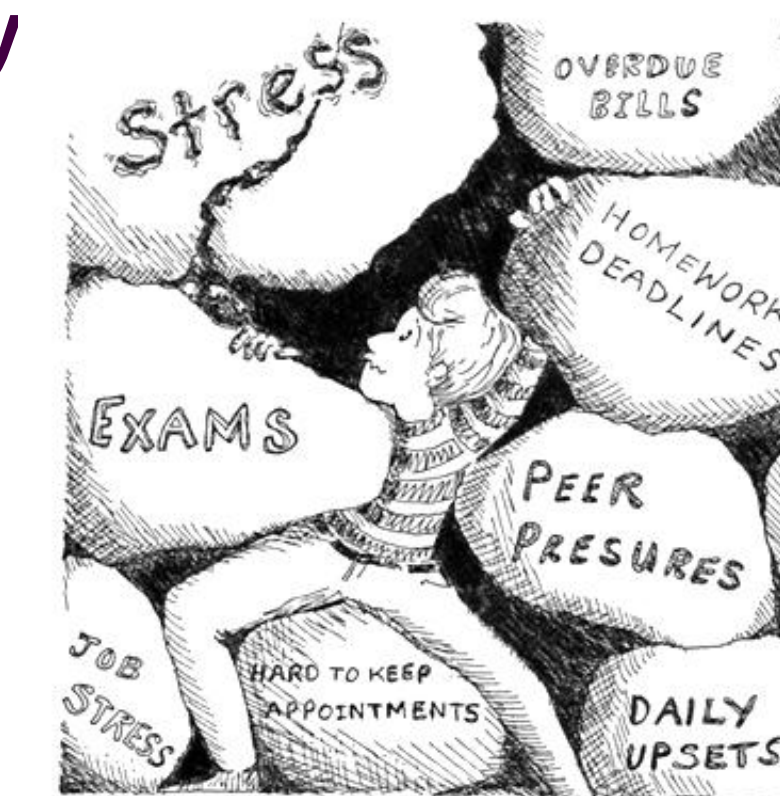


Image from: <http://ashalifeishope.blogspot.com/>



Image from: <http://www.essortment.com>



Image from: <http://blogcil.com/wp-content/uploads/2011/11/>

Activities like meditation or exercise can help reduce stress

### ⌘ The Association Between Childhood and Adolescent Psychological Disorders and Obesity

Depression, anxiety, and attention deficit disorder (ADD) in childhood young adulthood have been shown to be associated with obesity.

- A longitudinal study showed that depression in late adolescence was associated with later obesity, but only in females.<sup>11</sup>
  - There was also a dose-response relationship in which girls with a higher number of depression episodes were more likely to be obese in adulthood.<sup>11</sup>
  - Another study showed that obese women had a significantly higher rate of anxiety than non-obese women by almost 50%.<sup>12</sup>
- Public health measures should be taken to improve the mental health of young people and their parents. The stigma associated with psychological disorders should be lessened by government officials taking a more open approach to advertising mental health treatments.*

### ⌘ Conclusions

- There are many varied factors that have contributed and continue to contribute to the increase in juvenile obesity.
- Children are fatter than ever before, and if they age and do not lose weight, the cost of treating the diseases associated with their obesity will be extraordinarily high.
- Implementing the public health programs that are suggested in this paper will cost money. However, these policy changes have the potential to save lives and save an enormous amount of money in the long run.
- However, addressing all of these factors comprehensively will lead to effective solution to juvenile obesity.