

# **Association Between Maternal Smoking and Higher Childhood Body Mass Index (BMI)**

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# Agenda

- Overview
- Methodology
- Results
- Policy Implications

# Overview - Definitions

Body Mass Index (BMI):

Weight in kilograms / (Height in meters)<sup>2</sup>

Childhood Weight Status

Overweight

BMI measures greater than or equal to the **90th percentile** obtained from CDC gender specific age by BMI growth charts.

Obese

BMI measures greater than or equal to the **95th percentile** obtained from CDC gender specific age by BMI growth charts.

## Overview - Importance

- ❑ “Obesity is one of the most serious problems facing the youth of the United States, and evidence suggests that the problem is worsening rapidly.”

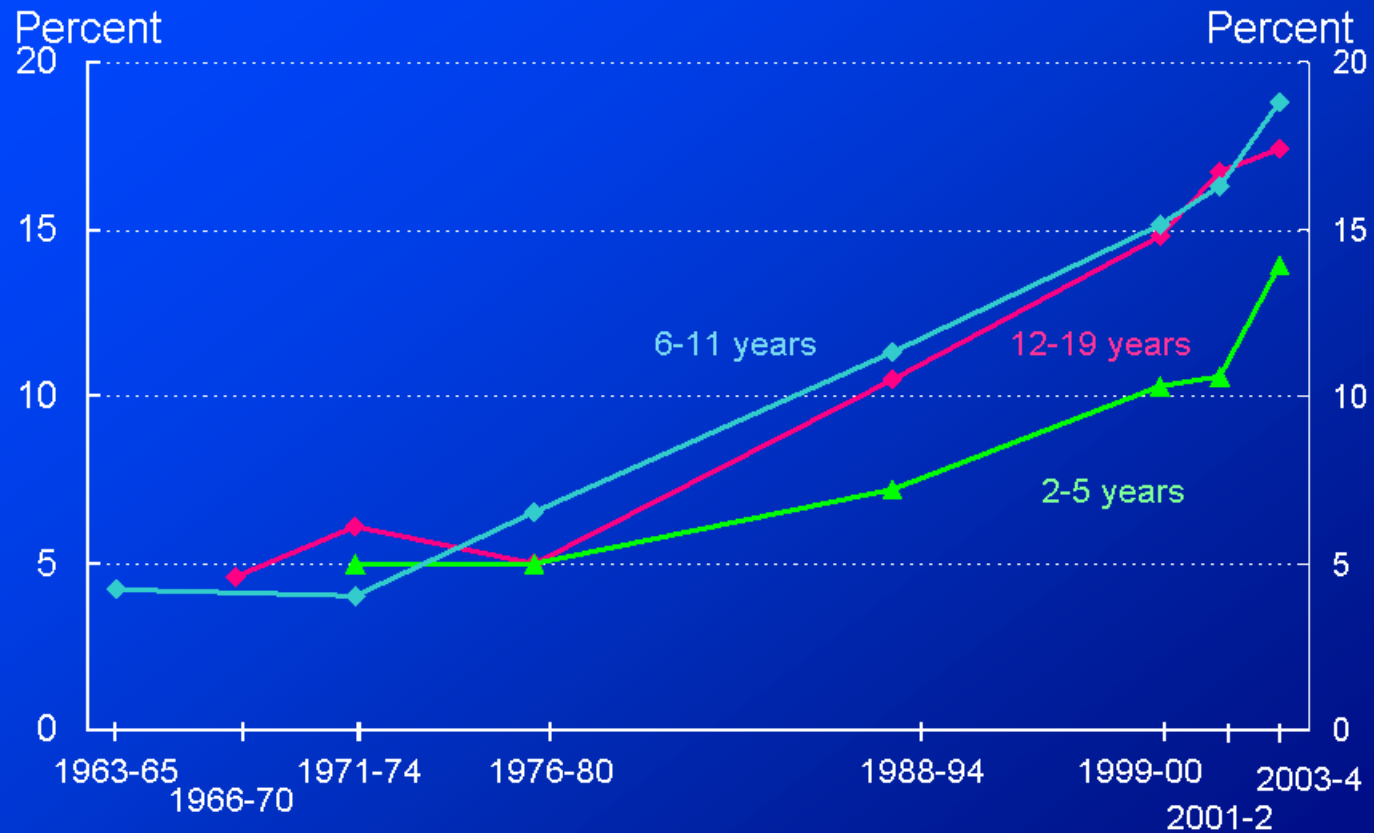
300,000 preventable deaths a year attributed to diet and activity patterns.

- Hill, J.O., & Trowbridge, F.L., 1998

- ❑ In 2004, legislation required all schools receiving federal funding to have wellness programs in place.
- ❑ In 2005, the Institute of Medicine classified the childhood obesity issue as an epidemic.
- ❑ “Fighting childhood obesity is a top priority.”  
– Dr. James Holsinger, Jr.

# Overview - Prevalence

## Trends in Child and Adolescent Overweight



Note: Overweight is defined as BMI  $\geq$  gender- and weight-specific 95th percentile from the 2000 CDC Growth Charts.  
Source: National Health Examination Surveys II (ages 6-11) and III (ages 12-17), National Health and Nutrition Examination Surveys I, II, III and 1999-2004, NCHS, CDC.

# Overview - Why Maternal Smoking During Pregnancy May be Associated with Overweight and Obese Children

- ❑ Fetal origins of adult disease hypothesis  
(Barker, D.L.P., 1992)
- ❑ Thrifty phenotype hypothesis  
(Hale, C.N. & Barker, D.L.P., 1992)
- ❑ Developmental programming  
(Armitage, J.A. et al., 2004)
- ❑ Pre-natal programming  
(Huang, J.S. et al., 2006)

# Methodology

- Data
  - National Longitudinal Survey of Youths (NLSY)
  - 6,194 children repeatedly surveyed between 5 – 12 years of age
  
- Statistical Analysis
  - SAS Proc Mixed
  - Random Intercept – Slope Growth Model



# Methodology

- Variables
  - Natural log of Child BMI is the dependent variable.
  - Mother's smoking status during pregnancy is the primary predictor.
    - **Non-Smoker** (did not smoke 12 months prior to pregnancy)
    - **Quit** (smoked 12 months prior to pregnancy but not during)
    - **Smoker** (smoked during pregnancy)
  - The model is adjusted for child demographics as well as mother demographics, SES, and lifestyle/behavior variables during pregnancy and when the child is age 5 (baseline).

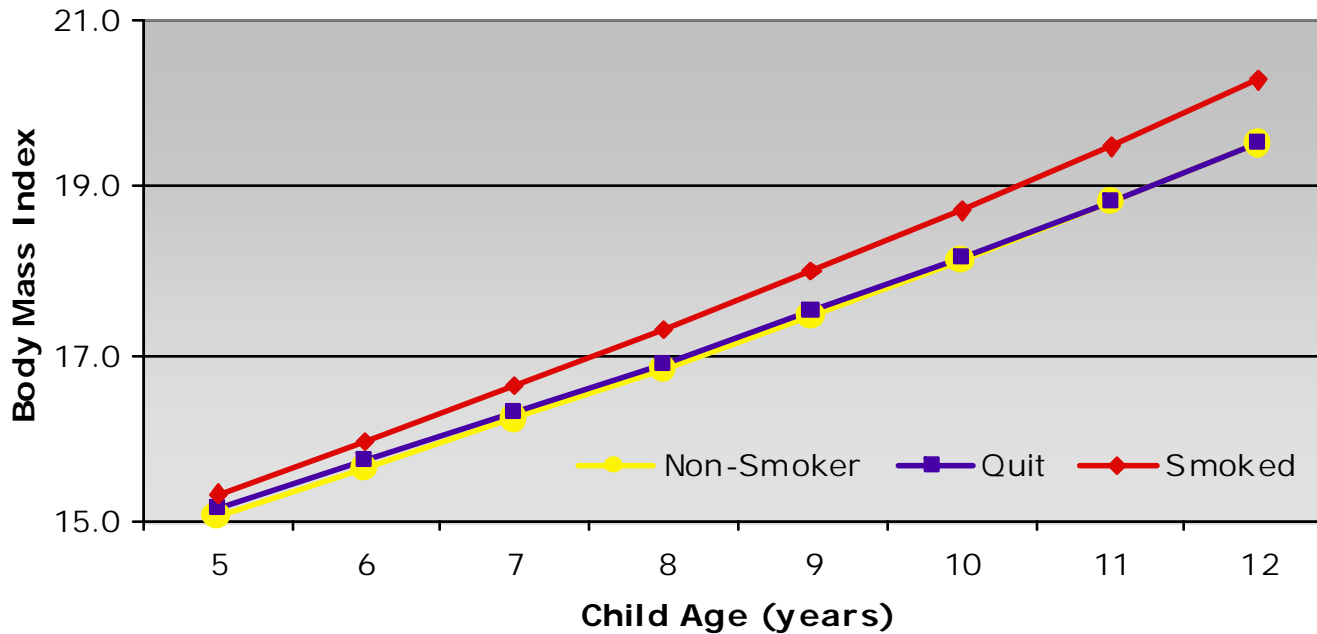
# Results

- Parsimonious model parameters, standard errors and significance level as a predictor of the natural log of child BMI

Variable	Value	Parameter	Standard Error	p-value
Age	Years	0.03479	0.000977	< 0.0001
Maternal Smoking Status	Smoker	0.002939	0.009318	0.7524
	Quit	0.008951	0.02151	0.6774
	Non-Smoker	<i>reference category</i>		
Age x Maternal Smoking Status Interaction	Smoker	0.002901	0.001127	<b>0.0101</b>
	Quit	-0.00070	0.002644	0.7922
	Non-Smoker	<i>reference category</i>		

<b>Variable</b>	<b>Value</b>	<b>Parameter</b>	<b>Standard Error</b>	<b>p-value</b>
Maternal Drinking Status	Drinker	-0.02282	0.009030	0.0115
	Quit	-0.00073	0.01334	0.9565
	Non-Drinker	<i>reference category</i>		
Age x Maternal Drinking Status Interaction	Drinker	0.004469	0.001098	< 0.0001
	Quit	0.001528	0.001636	0.3504
	Non-Drinker	<i>reference category</i>		
Race (White is reference category)	Non-White	0.01757	0.004388	< 0.0001
Poverty Status at Child Age 5 (Not in poverty is reference category)	In Poverty	-0.01026	0.004725	0.0299
Child Breast feeding status (Breastfed is reference category)	Not Breastfed	0.008520	0.004182	0.0417
Mother's BMI at Child Age 5	kg/m <sup>2</sup>	0.006463	0.000348	< 0.0001
Mother's Age at Child's Birth	Years	0.001867	0.000469	< 0.0001
Weight Change During Pregnancy	Pounds	0.000339	0.000136	0.0126

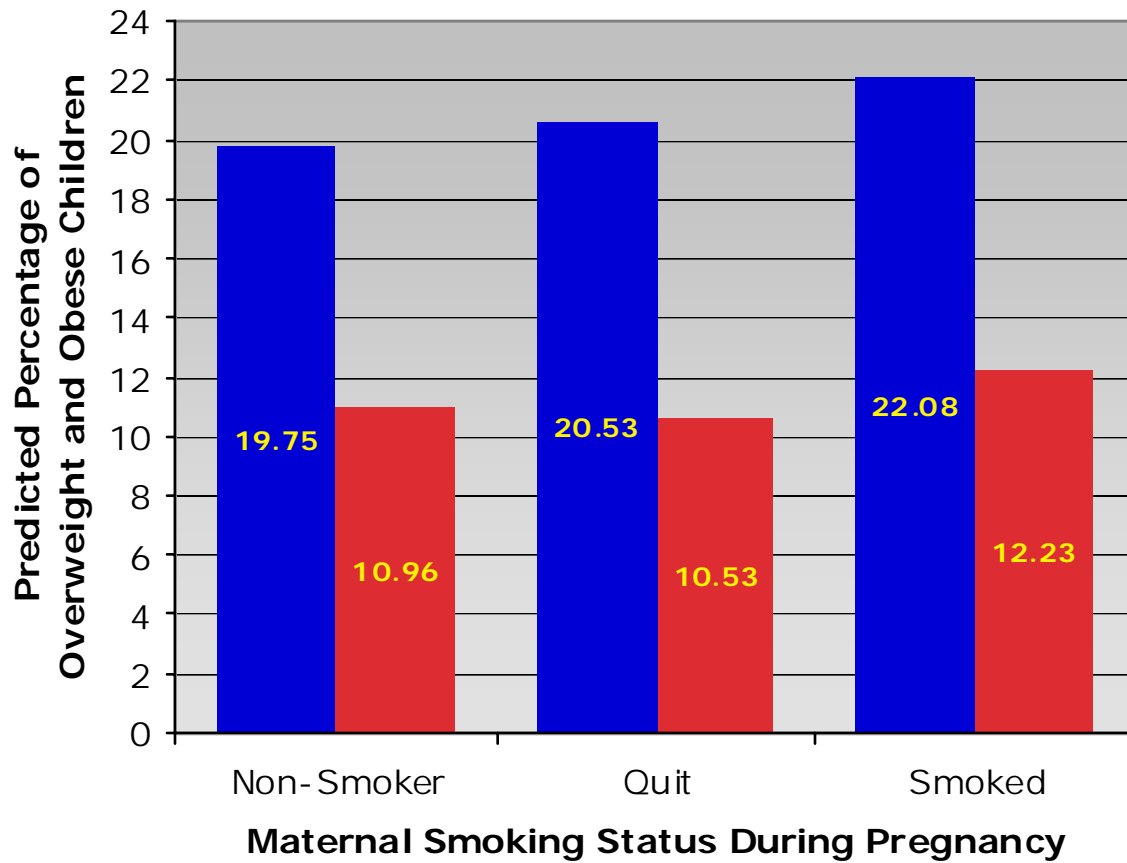
## Adjusted Mixed Model Least Squares Mean Estimates for Child BMI Between the Ages of 5 - 12 Years by Maternal Smoking Status During Pregnancy



Statistically significant difference ( $\alpha=0.05$ ) in fitted Child BMI values *across all ages* between children of **Non-Smokers** and **Smokers** during pregnancy.

Statistically significant difference ( $\alpha=0.05$ ) in fitted Child BMI values *from 8 - 12 year of age* between Children of mothers who **quit smoking** and those who **continued smoking** during pregnancy.

## Age and Sex Adjusted Predicted Percentage of Overweight and Obese Children by Maternal Smoking Status During Pregnancy



Note: Based on children participating in NLSY surveys through at least 9 years of age.

# Policy Implications from Results

- ❑ In addition to the innumerable reasons not to smoke, especially during pregnancy, the increased risk of offspring becoming overweight or obese is a new message to be included in all pre-natal counseling.
- ❑ Pre-natal counseling also needs to include information on the social, emotional, health, and economical costs of childhood obesity.
- ❑ The health care system of the future will be increasingly stressed if an exponential increase of obesity related disease treatment is required during a time when the aging population is expected to make increased demands on the same system.

# Limitations

- Lack of lifestyle/behavior/dietary variables at the child and mother levels may indicate that maternal smoking during pregnancy is simply a moderating or mediating variable for the risk of childhood obesity.



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*Questions ?*

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