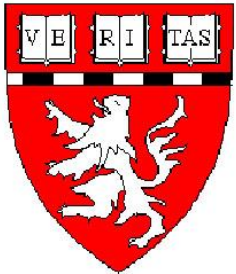


Modifiable Risk Factors of Overweight and Obesity from Birth to age 5: Sleep, Activity, and Sedentary Behavior

Elsie M. Taveras, M.D., M.P.H

Division Chief, General Academic Pediatrics; Director of Pediatric Population Health Management, MassGeneral Hospital *for Children*; Harvard Medical School

*Institute of Medicine's Obesity in the Early Childhood Years
October 6, 2015*



MassGeneral Hospital
*for Children*SM

Goals of this Presentation

- Describe the state of the science and research gaps relating the following modifiable risk factors to overweight and obesity in infancy and early childhood:
 - Sleep
 - Physical Activity
 - Sedentary Behavior
- Describe socioeconomic, racial, and ethnic disparities in the development of obesity

Short Sleep Duration: Associations with Childhood Obesity



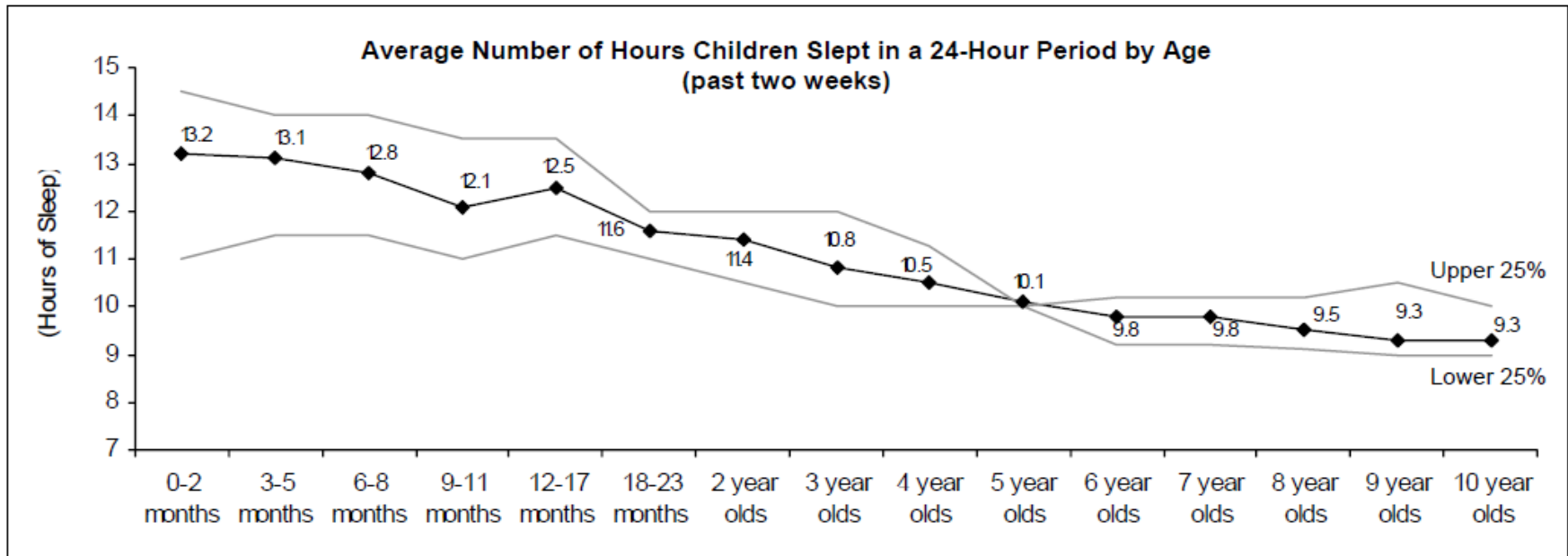
“There was never a child so lovely...but his mother was glad to get him to sleep.”

Ralph Waldo Emerson

Secular trends in childhood sleep

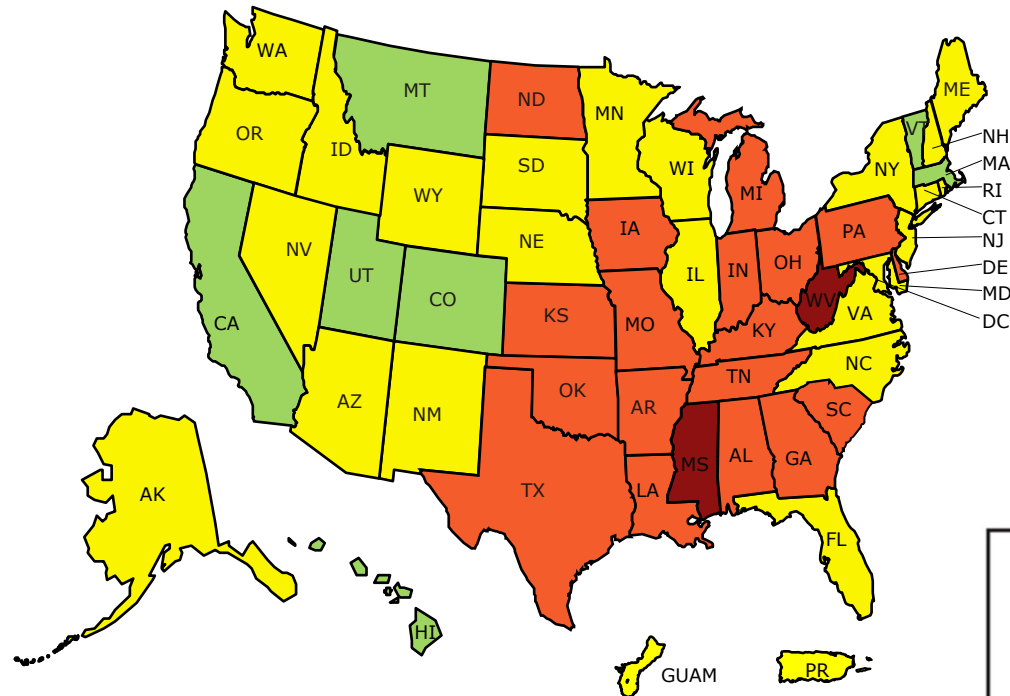
- The rising prevalence of childhood obesity has been paralleled by secular trends of shorter sleep durations in children;
- Meta-analysis of almost 700,000 children from 20 countries, going back over 100 years found that, on average, children today sleep about **20-25 minutes less** each day than their parents did when they were their age. (Matricciani, Olds & Petkov, 2012)
- Across childhood, evidence suggests a decrease in sleep duration over the last 20 years, due largely in part to **later bedtimes**.

Patterns of Sleep Duration

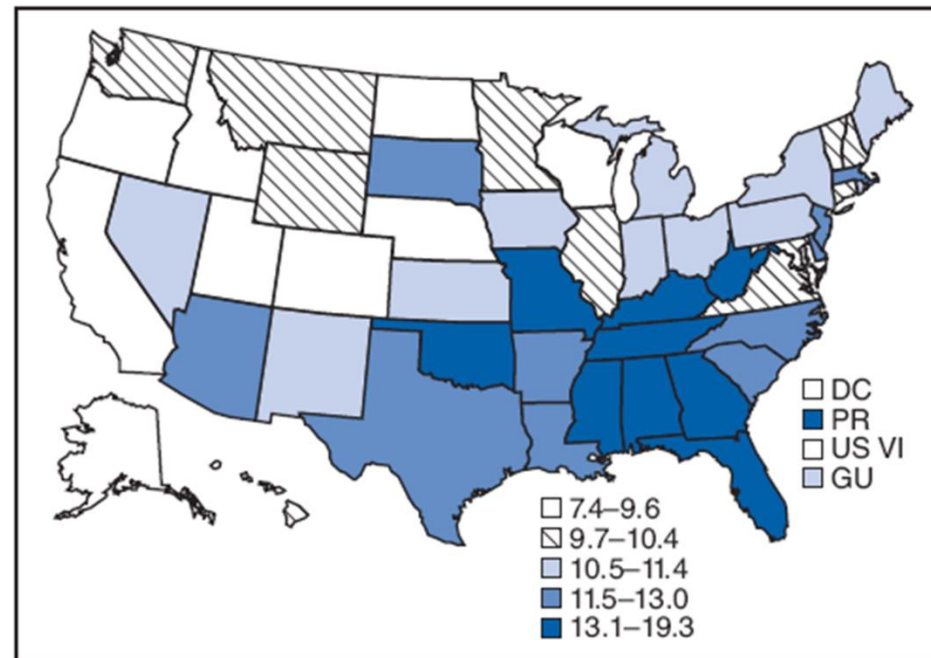


- Infants/Toddlers in the lower 25% of sleep:
 - More likely to be put to bed asleep v. drowsy/awake ----->
Poor **self-regulation of sleep**
- Children in the lower 25% of sleep:
 - More likely to share a room or bed; More likely to drink ≥ 1 **caffeinated beverage** during the day; More likely to have a **TV in the room** where they sleep

Prevalence* of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2013



Prevalence* of Insufficient Sleep Among U.S. Adults BRFSS, 2008



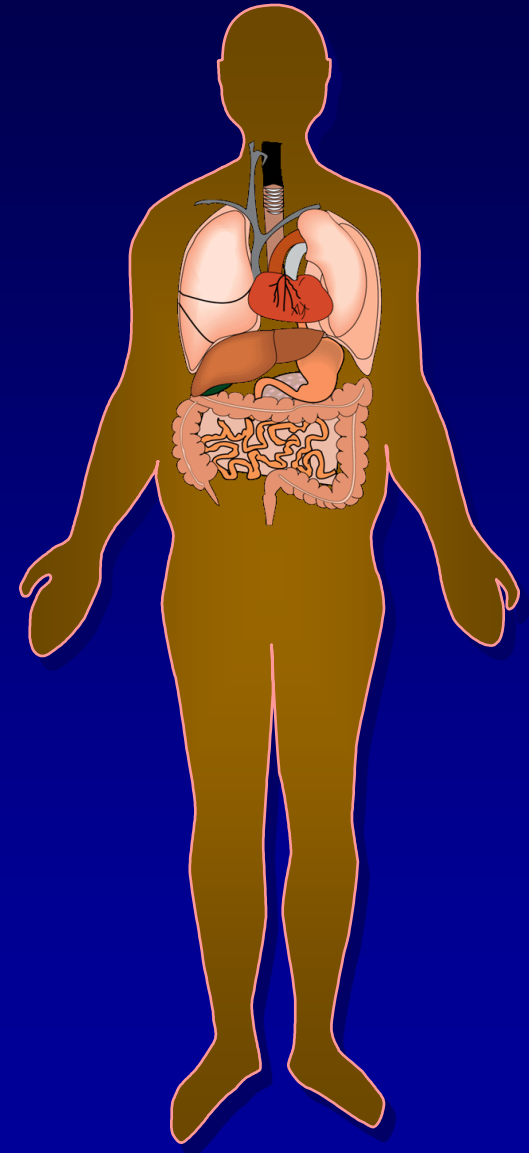
Source: Behavioral Risk Factor Surveillance System, CDC.

Sleep Duration & Chronic Disease Risk

- All cause mortality; Life expectancy
- Immune function; Cancer
- Obesity

Pooled odds ratio for short sleep duration and obesity in adults = 1.55 (95% CI: 1.42-1.68). (Cappuccio et al. 2008)

- Diabetes; Insulin Resistance
- Coronary heart disease:
 - Dyslipidemias
 - Hypertension
 - Early atherosclerosis

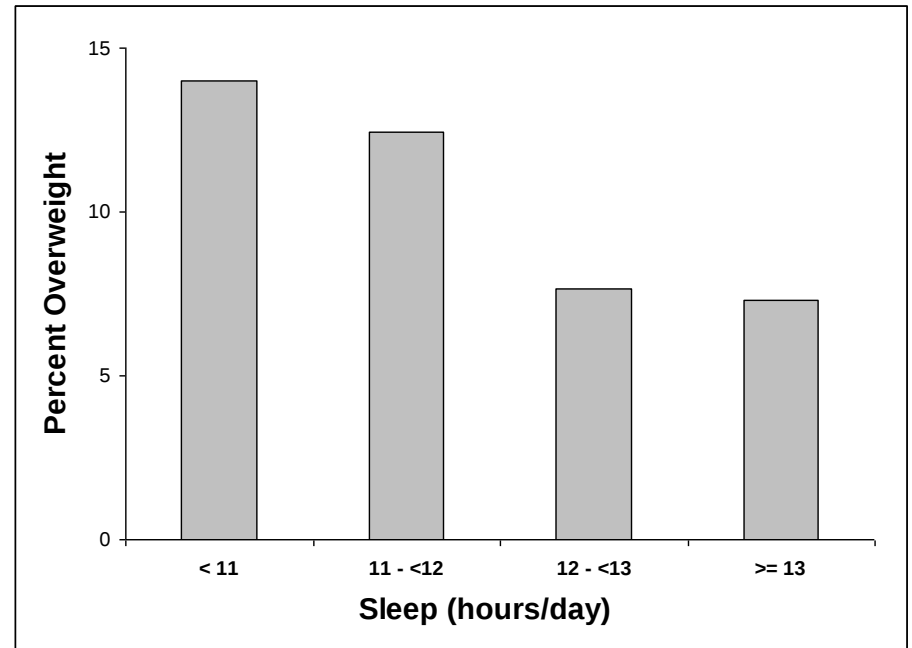


Sleep & Obesity in Infants and Children

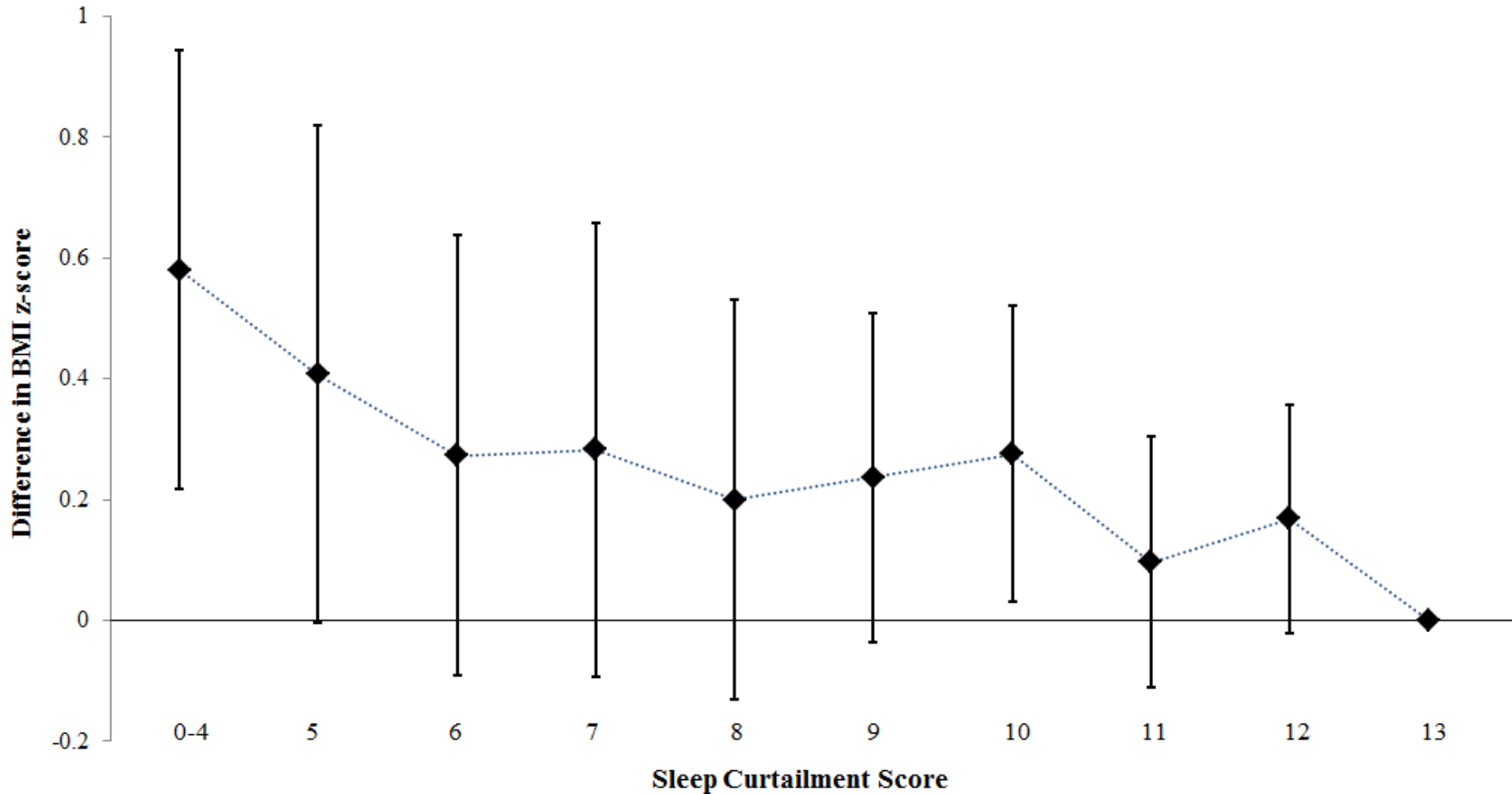
- **Systematic review:** 29 studies conducted in 16 countries suggest that short sleep is associated with an increased risk for being or becoming overweight/obese. Later bedtimes also found to be a risk factor for overweight/obesity. (Hart et al. 2011)
- **Some debate about sleep & obesity in infancy:** Some studies have reported inverse associations between sleep duration and adiposity in infancy, others have had null findings, and at least one RCT of an infant sleep intervention did not have an effect on future overweight. (Lumeng et al. 2015)

Infant Sleep Duration & Childhood Obesity

- Cross-sectional studies have found an inverse association between sleep duration and weight in children (Patel et al. 2008; Hart et al 2011)
- In multivariable analyses, infants who slept <12 h/d:
 - higher BMI z-score (β 0.16; 95% CI: 0.02, 0.29)
 - increased odds of obesity (OR 2.04; 95% CI: 1.07, 3.91).



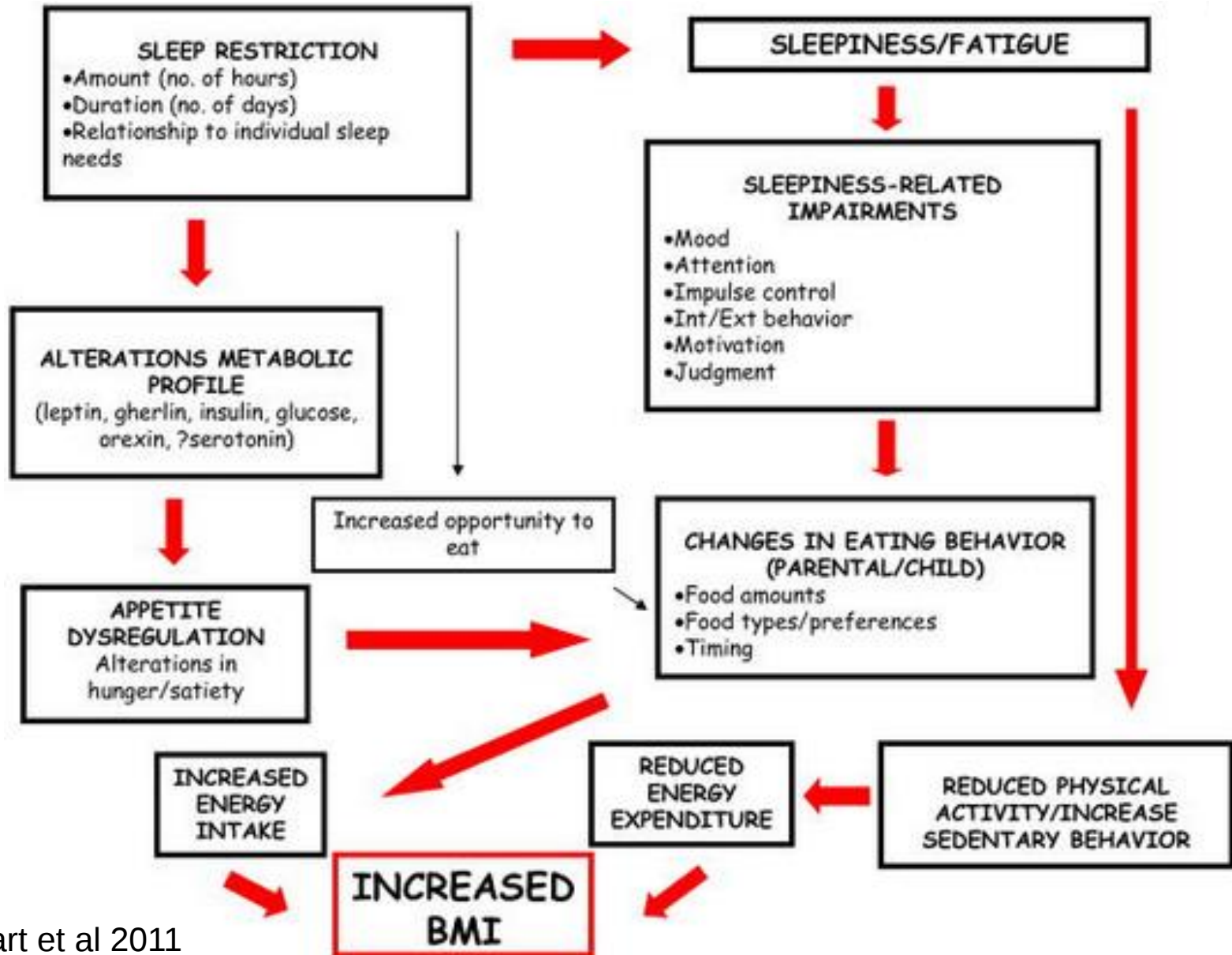
Chronic Insufficient Sleep is Associated with Higher BMI z-score in Mid-Childhood



Taveras et al, *Pediatrics*, 2014

Sleep score ranges from 0 (maximal curtailment) to 13 (no curtailed sleep). Adjusted for maternal age, education BMI, parity; household income; child race/ethnicity & mid-childhood TV.

Potential Mechanisms (older children)



Research Gaps in Sleep-Obesity Literature

- Few studies providing evidence of underlying biological mechanisms in **infancy**/early childhood;
- Most studies have focused on sleep duration and have not examined other features of sleep, e.g. Quality, Timing, Consolidation, Regularity, Ecology, Circadian Alignment
- Measurement challenges – Validated, objective measures of sleep characteristics are needed;
- Good evidence of the efficacy of behavioral interventions in improving features of sleep in infancy but RCTs testing the effects of these interventions on future adiposity are lacking.

Physical Activity & Sedentary Behavior



“Children are programmed to enjoy physical activity. Our environments and policies socialize them out of it.”

Steven Gortmaker, PhD

Physical Activity & Sedentary Behavior (Infants)

- Little is known about the normal range of physical activity and sedentary behavior in infancy and its association with energy balance.
- Accurate measurement of infant activity remains a major challenge, although some work has successfully used accelerometry. (Van Cauwenberghe et al. 2011)
- Only 1 study has quantified an effect between infant screen time and childhood overweight. In the Generation R study of 3,610 preschool children no association between television viewing in infancy and child obesity.(Heppe et al. 2013)

Physical Activity & Sedentary Behavior (Infants)

- The evidence linking motor behaviors in **infancy** with adiposity is limited and observational.
 - Longitudinal study of 741 mother/ infant dyads. Exposures were age of rolling over, sitting up, crawling, & walking. None of the milestones were associated with BMI z-score. Later age at walking associated with greater overall adiposity at age 3 yrs. (Benjamin Neelon et al. 2012)
 - Longitudinal study of low-income African-American mother-infant dyads assessed from 3 to 18 months. Delayed infant motor development associated with overweight and high subcutaneous fat. (Slining et al. 2010)
- No published RCTs have evaluated the effect of a physical activity intervention in infancy on increasing accelerometry-measured physical activity or preventing obesity.

Physical Activity & Sedentary Behavior (EC)

- Among older children, the association between sedentary behavior, as a result of TV viewing, and childhood obesity is robust and confirmed by multiple longitudinal studies and RCTs.
- Similarly, studies that have tracked activity and sedentary behavior using electronic accelerometers have generally shown that higher levels of moderate to vigorous physical activity is consistently associated with smaller gains in BMI and decreased risk of obesity and other measures of adiposity. (Monasta et al. 2010)

Summary

- Insufficient sleep in infancy and in early childhood is associated with higher risk of obesity.
 - Need studies that examine mechanistic pathways linking adverse sleep patterns with weight gain that extend beyond just duration and that use validated measures of sleep assessment.
- Paucity of evidence relating physical activity or sedentary behavior in infancy to obesity. Yet, robust associations of inactivity and sedentary behavior with obesity in early childhood.
 - Measurement issues limit the available evidence.



***Early Life Origins of
Racial/Ethnic Disparities in
Childhood Obesity***

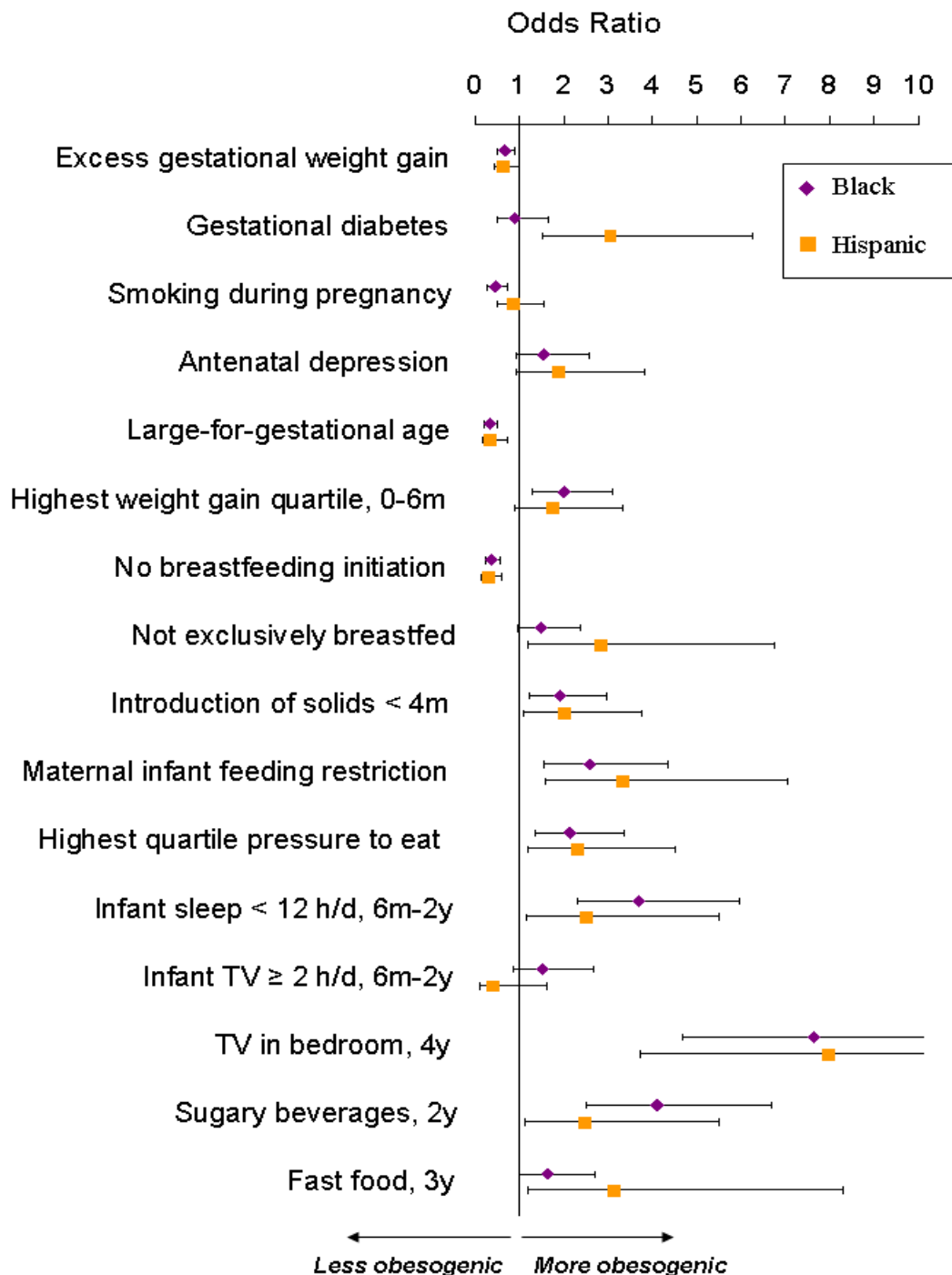


Childhood obesity prevalence is at historically high levels (NHANES 2009-2010)

- 8.1% of infants and toddlers <2 years have a high weight-for-recumbent length (WFL >95th based on CDC charts); 7.1% based on World Health Organization >97.7th cutpoint
- 8.4% of children 2 – 5 years are obese (BMI ≥ 95th)
 - Highest prevalence among **Hispanic boys** (18%) and **Hispanic girls** (15%)
- 17.7% of children age 6 – 11 years are obese
 - Highest prevalence among **Hispanic boys** (28.6%) and **non-Hispanic black girls** (25.9%)

Selected Determinants of Childhood Obesity

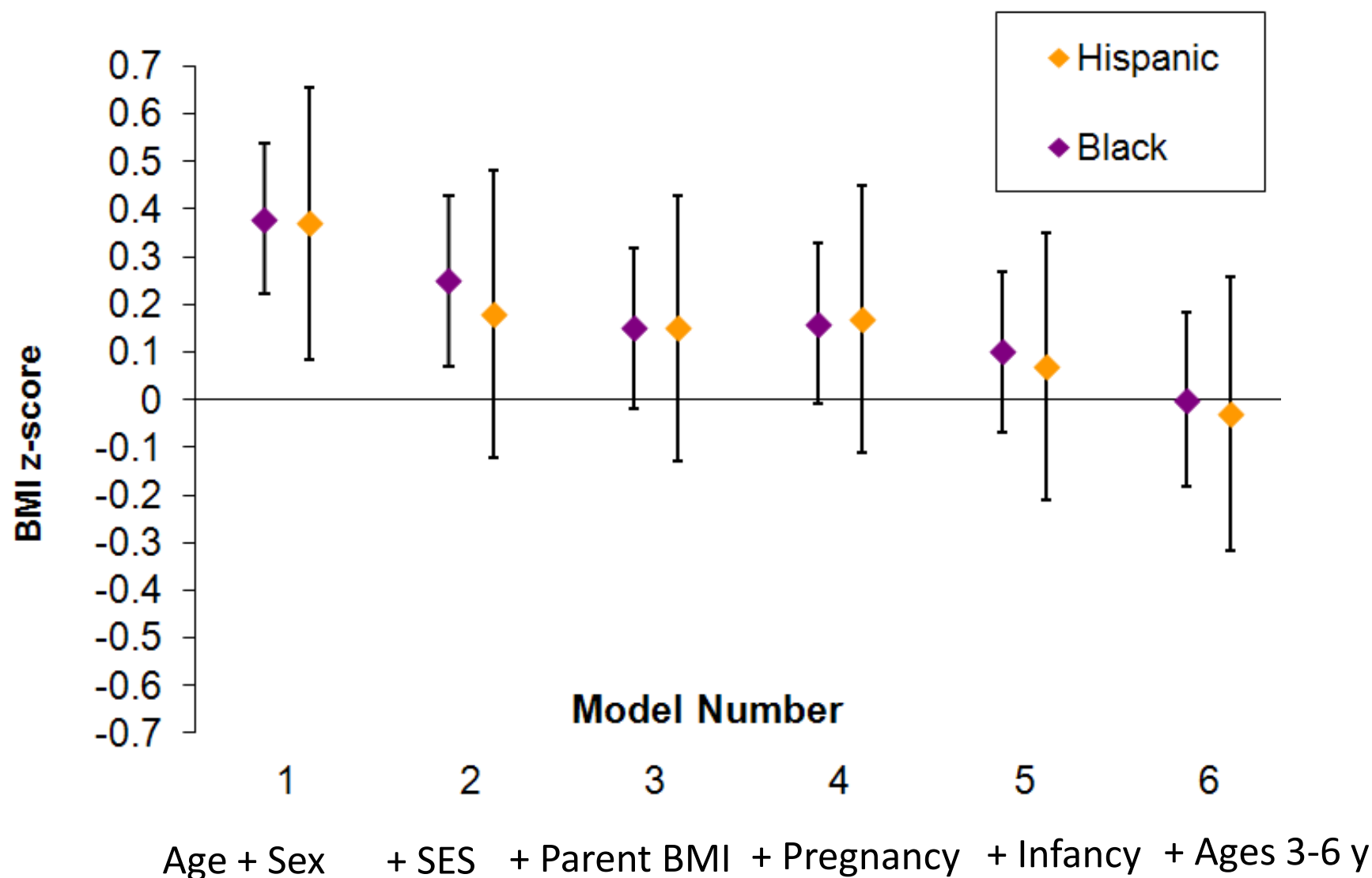
- Gestational weight gain and Gestational Diabetes
- Maternal smoking during pregnancy
- Accelerated infant weight gain
- Breastfeeding
- Sleep duration and quality
- Television viewing & TV sets in bedrooms
- Food supply & marketing environments
- Responsiveness to infant hunger and satiety cues
- Parental feeding practices, eating in the absence of hunger
- Portion sizes
- Fast food intake
- Sugar-sweetened beverages
- Physical activity
- Socio-cultural, recreation, & transport environments



- Racial/ethnic differences exist in many early life risk factors for childhood obesity

Reducing Racial/Ethnic Disparities in Childhood Obesity

The Role of Early Life Risk Factors



White House Task Force Report on Childhood Obesity, May 2010



SOLVING THE PROBLEM
OF CHILDHOOD OBESITY
WITHIN A GENERATION

White House Task Force on Childhood Obesity
Report to the President

MAY 2010



“Racial and ethnic differences in obesity may be partly explained by differences in risk factors during the prenatal period and early life.”



MassGeneral Hospital
*for Children*SM

Contact information:

Elsie.Taveras@mgh.harvard.edu