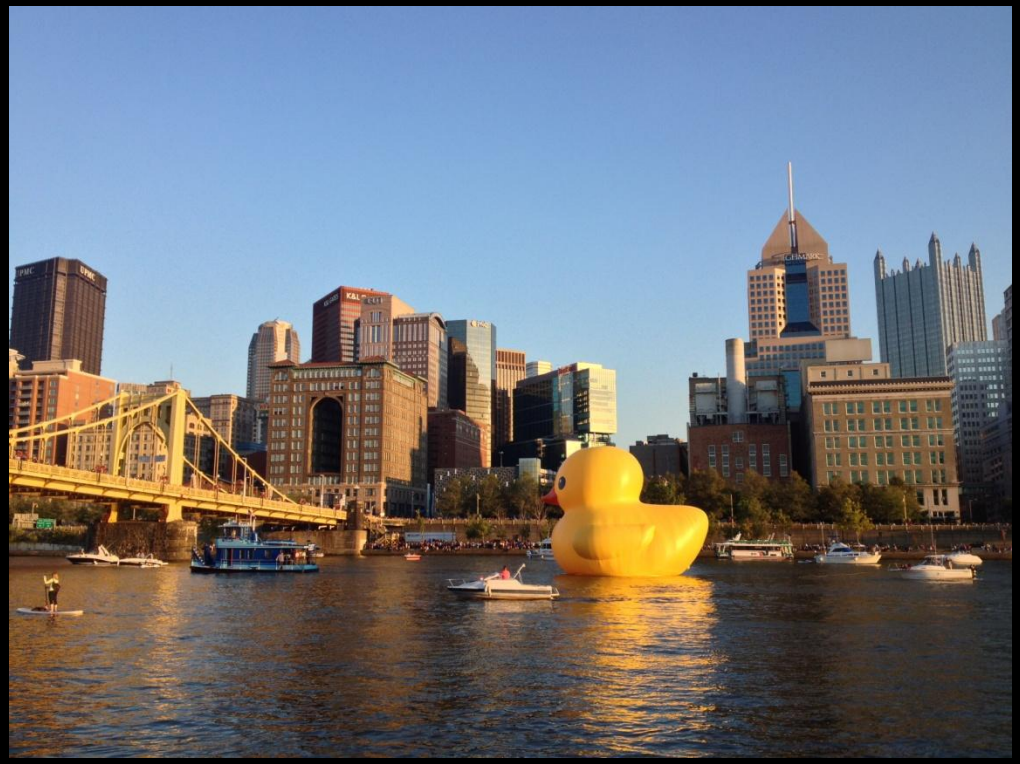
Biological pathways of inequalities in children's health



Karen A. Matthews, Ph.D.
University of Pittsburgh

Overview of talk

- Some basics: health disparities, poverty, and pathways
- Key environmental exposures correlated with poverty and low SES
- Focus on cardiometabolic risk, sleep disturbance, and cognitive development

Health Disparities Definition:

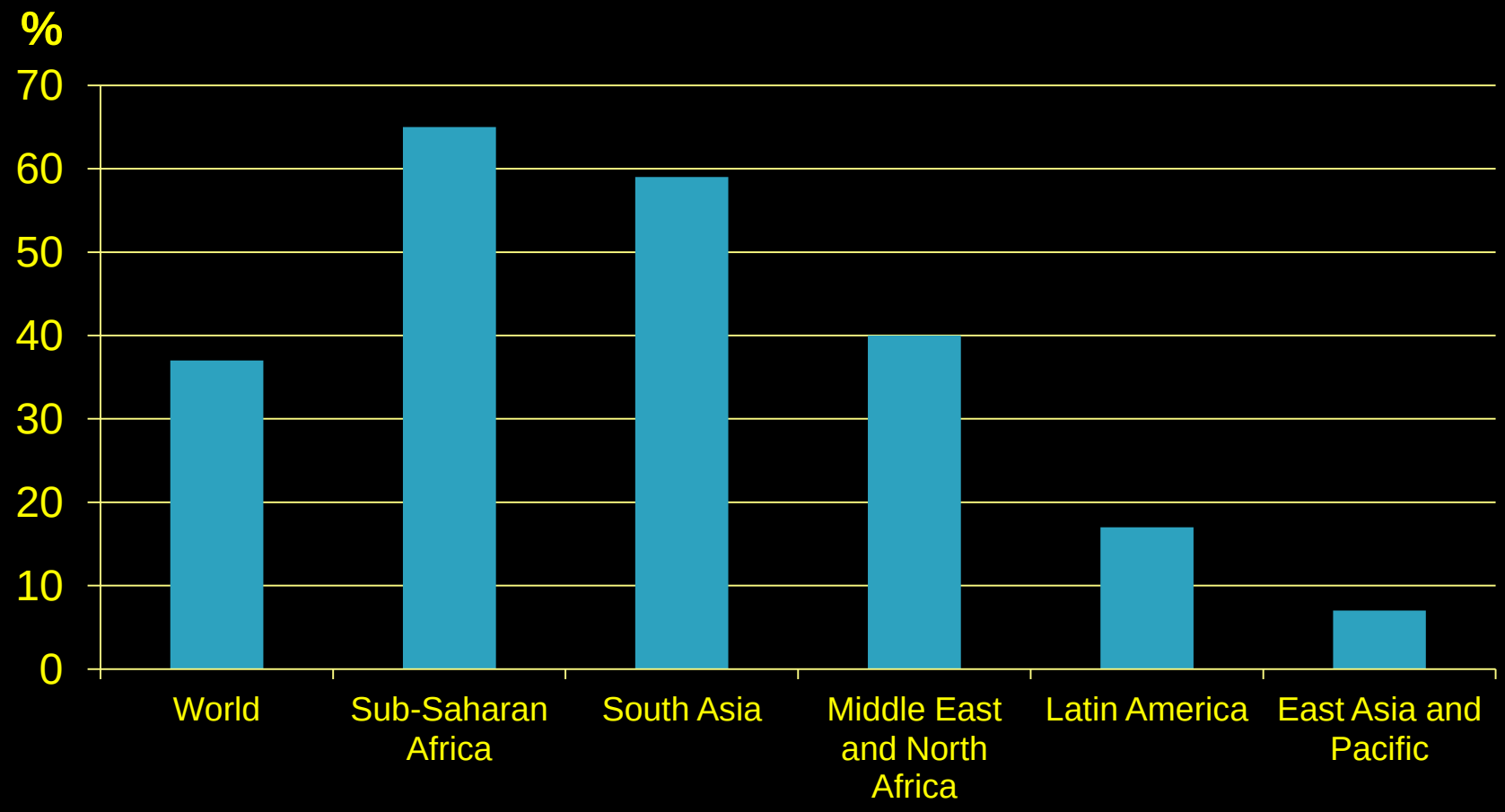
- **Systematic, plausibly avoidable health differences affecting subgroups of population**
- **Some definitions focus on subgroups that are disadvantaged socially**
- **Highlights potential for prevention**

Braveman et al. 2011 Am J Public Health

How is poverty defined internationally?

- Level of personal income below a government standard (World Bank 2016)
- Basic needs indicators, including food, safe drinking water, sanitation, health, shelter, education, and information. (Gordon et al 2003)
- Minimum rights at society level

Percentage of children in absolute poverty in developing world



Gordon et al. Child poverty in the developing world. 2003

How is poverty defined in U.S. census?

- Definition based on income relative to size of family household, number of children under 18 years, and age of adults ≥65.
- Income based in nutritional needs of families based on work in the 1960's
- Income updated for inflation and money income prior to taxes and excludes capital gains and noncash benefits
- Thresholds do not vary by area.
- Example for family of 5 with 2 children in 2015: $24,036

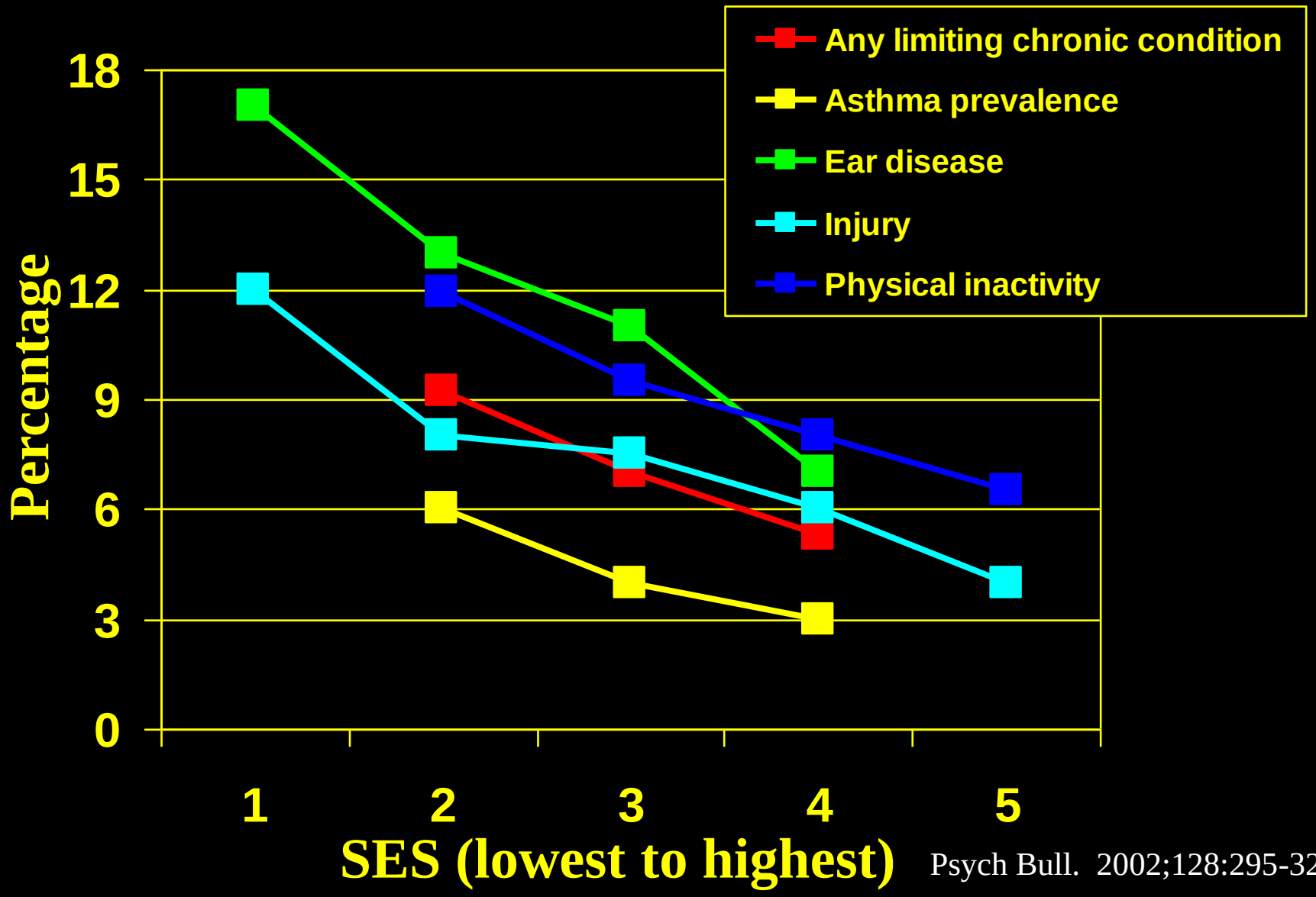
Who lives below poverty line in 2015 in U.S.?

Children under age 18:

All	19.1%	14,509,000
Non-Hispanic whites	12.1%	4,563,000
Hispanics (any race)	28.9%	5,269,000
Blacks	31.6%	4,146,000
Asians	11.4%	539,000

Source: U.S. Census Bureau, Table B2. Income and Poverty in the United States, 2015.

Prevalence of Health Problems in Children



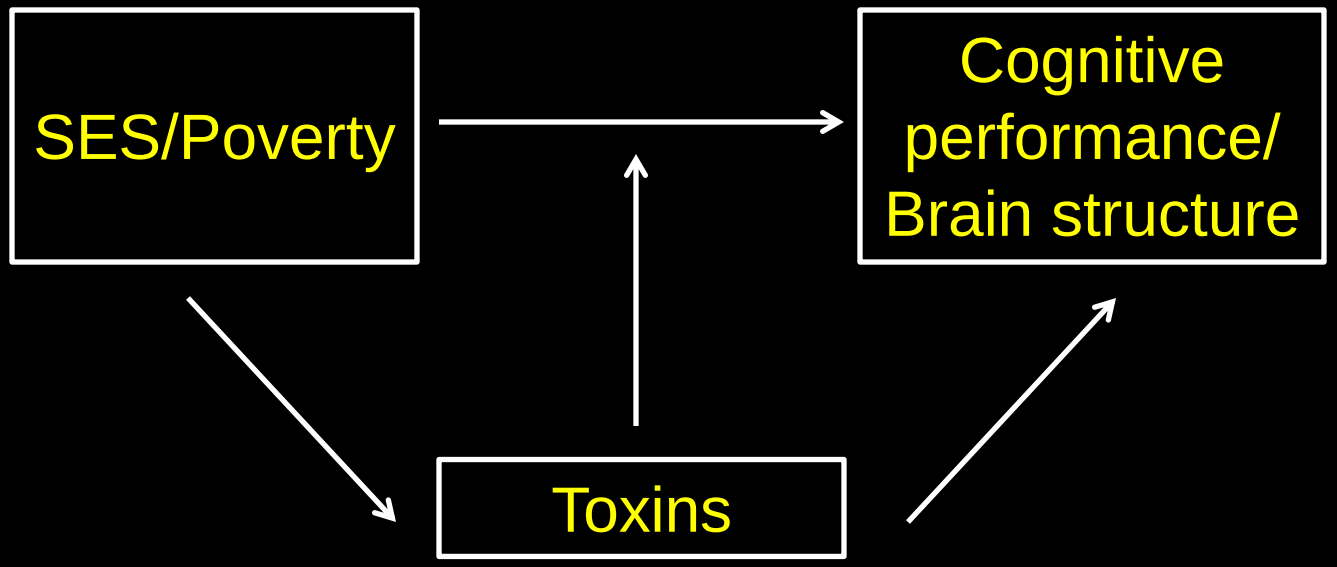
Psych Bull. 2002;128:295-329

Pooled random effects estimates for low SES by groups of disabling chronic conditions

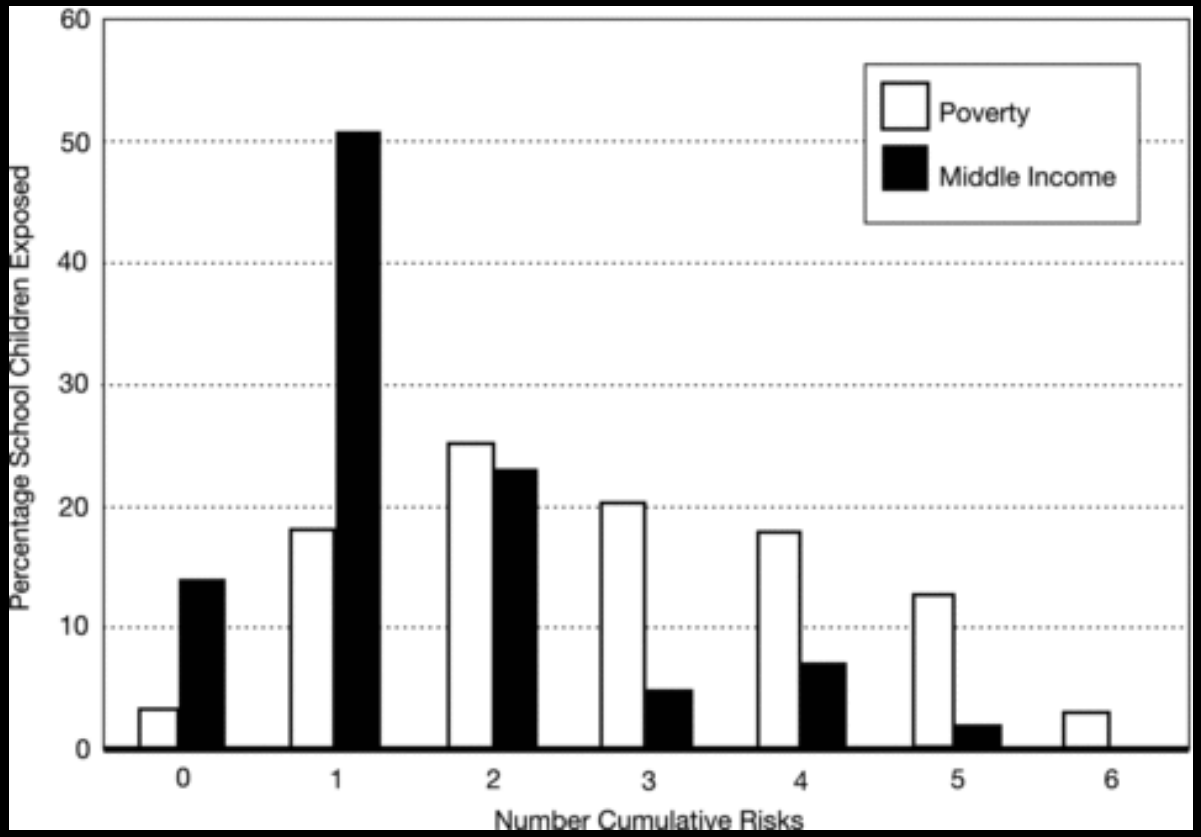
Disabling chronic condition	Studies	OR (95% CI)	Heterogeneity (I^2 statistic)
All-cause disabling chronic conditions	20	1.72 (1.48 to 2.01)	95.0% (94.7% to 95.7%)
Psychological disorders	55	1.88 (1.68 to 2.10)	93.6% (92.6% to 94.3%)
Intellectual disability	21	2.41 (2.03 to 2.86)	98.1% (97.9% to 98.3%)
Activity-limitation or hospital admission for asthma	13	2.20 (1.87 to 2.85)	96.9% (96.2% to 97.4%)
Cerebral Palsy	6	1.42 (1.26 to 1.61)	64.0% (0% to 83.1%)
Congenital abnormalities	13	1.41 (1.24 to 1.61)	91.2% (87.6% to 93.4%)
Epilepsy	6	1.38 (1.20 to 1.59)	23.4% (0% to 67.5%)
Sensory impairment	9	1.70 (1.39 to 2.07)	57.3% (0 to 77.2%)

Spencer et al. BMJ Open 2015

What do we mean by mechanisms or pathways?

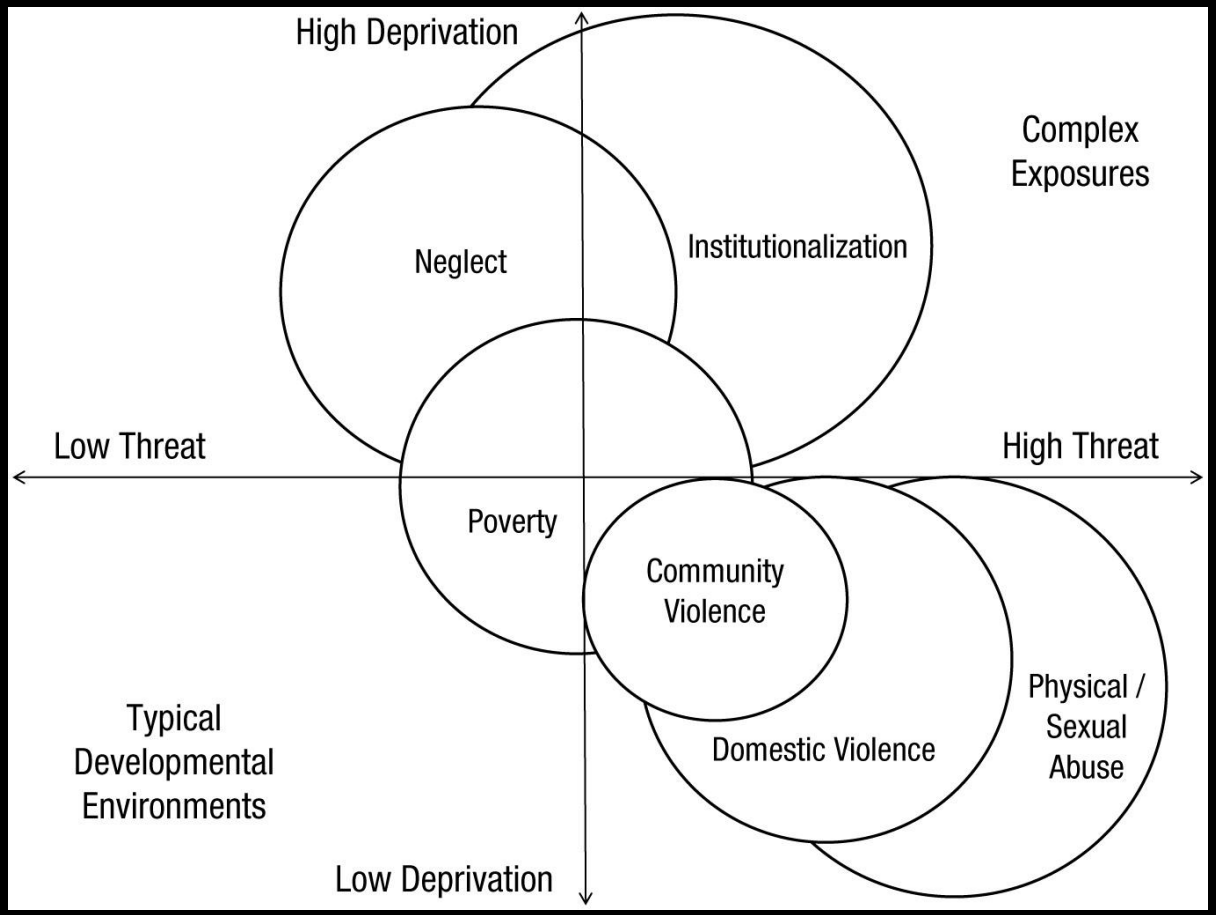


Poverty in childhood is not simply low income relative to needs, but also exposure to disadvantaged environments more generally



Evans and Kim 2010 Ann NY Acad Sci

A dimensional model of childhood adversity involving two central dimensions of threat and deprivation



McLaughlin & Sheridan Curr Dir Psychol Sci. 2016

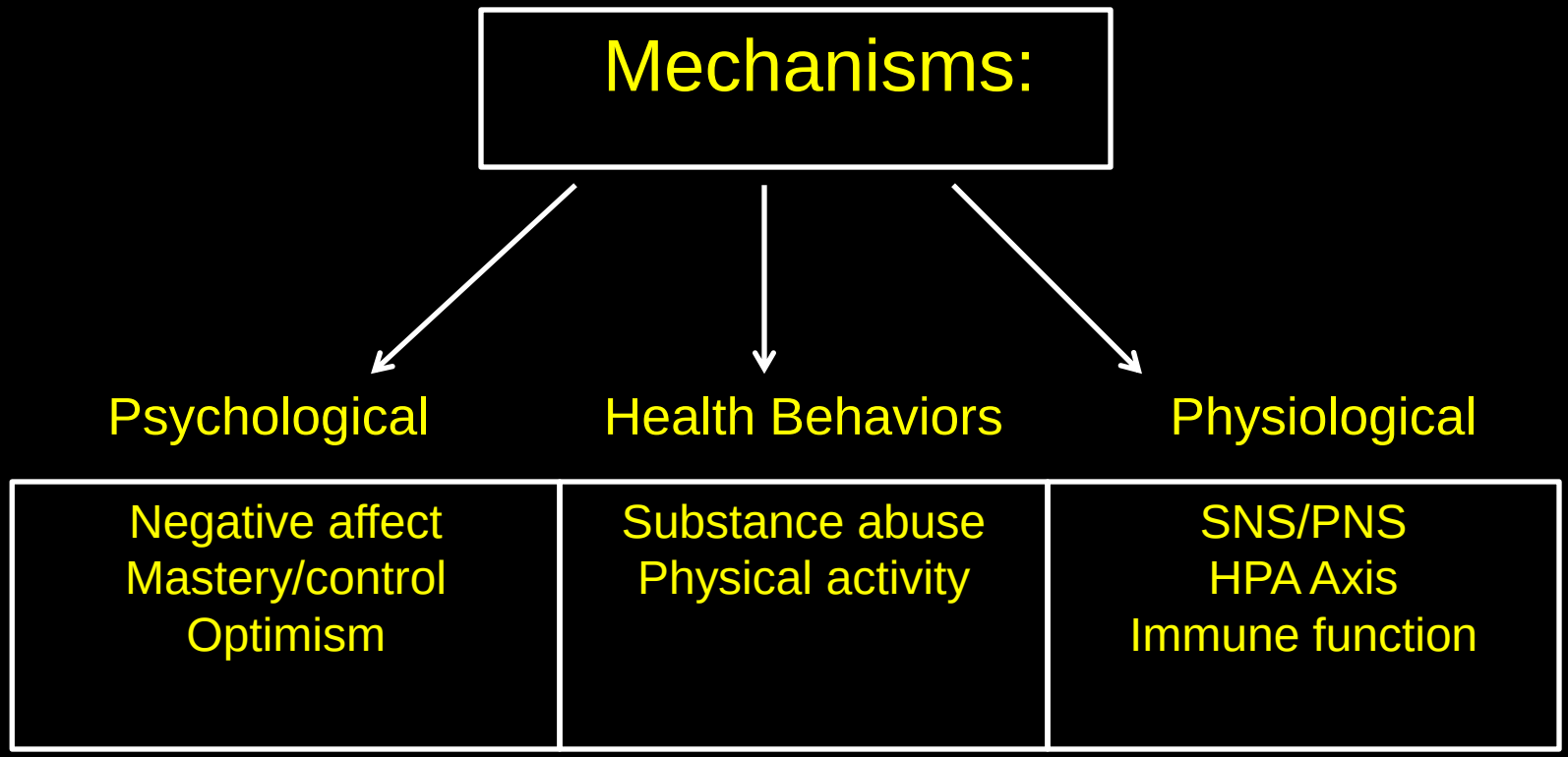
Childhood Socioeconomic Status/ Poverty

Environmental Exposures

	Home	Neighborhood	School
Physical	Toxins Housing quality Crowding	Air & water quality Public Spaces Noise Food options	Conditions of building/ grounds
Psychosocial	Warmth Conflict Abuse/neglect Parental health habits	Crime Violence Social Capital	Social climate Order Quality of education

Adapted from Cohen et al. Ann NY Acad Sci 2010

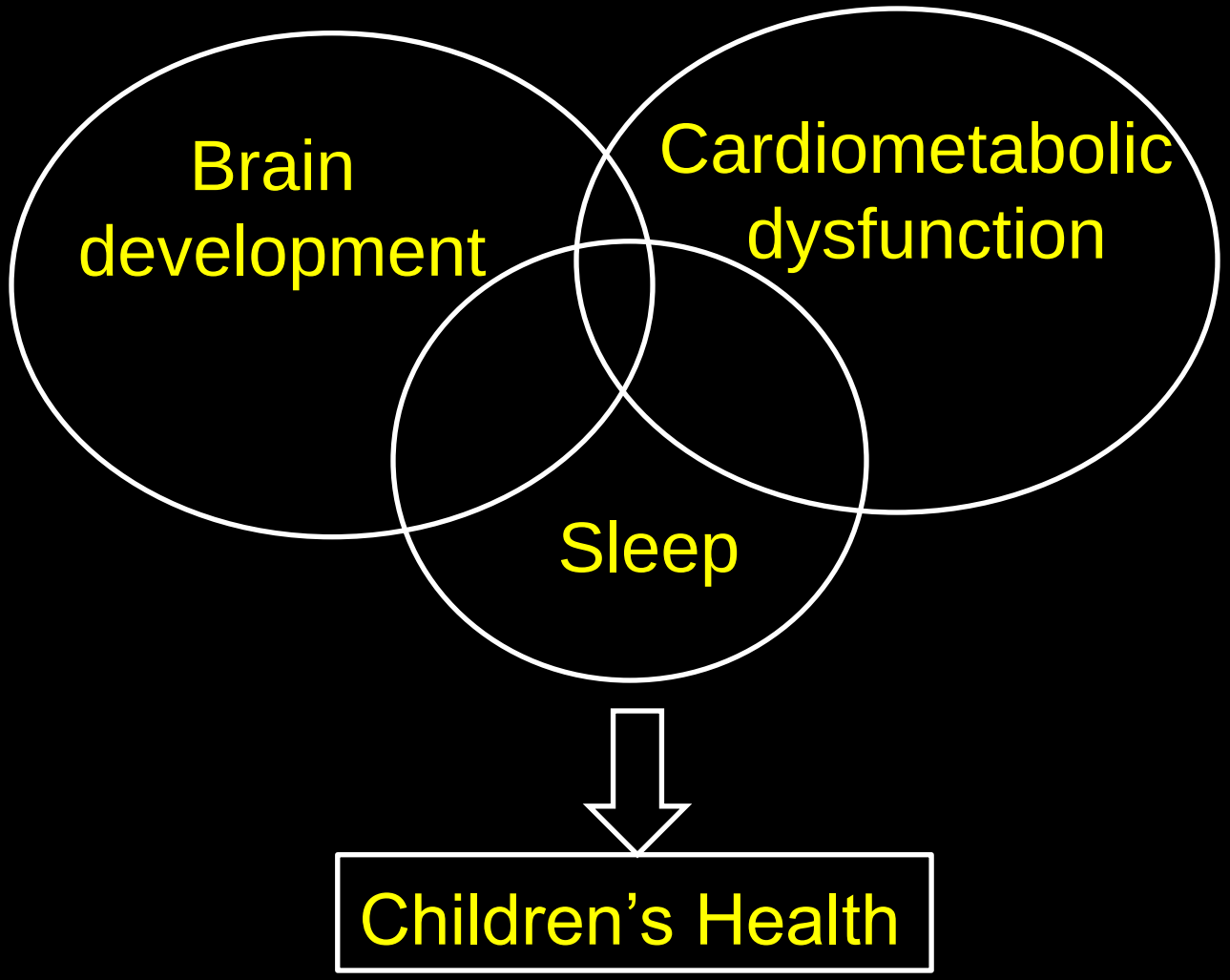
Childhood Socioeconomic Status/ Poverty



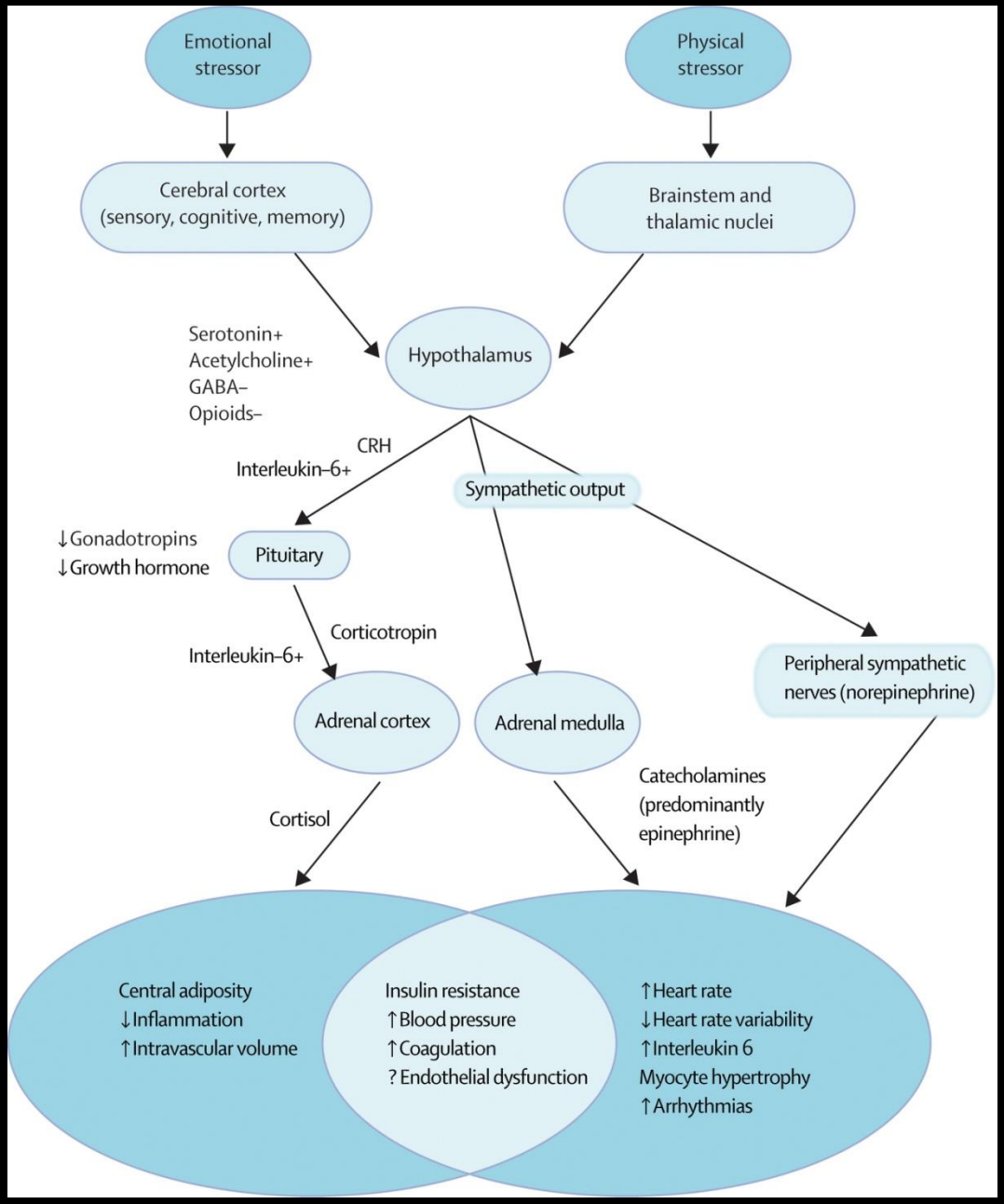
Which child health indices?

- Prevalence
- Related to important child health outcomes
- Child health indices related to adult health
- Inter-related to one another, suggesting common exposures

Childhood Socioeconomic Status/ Poverty

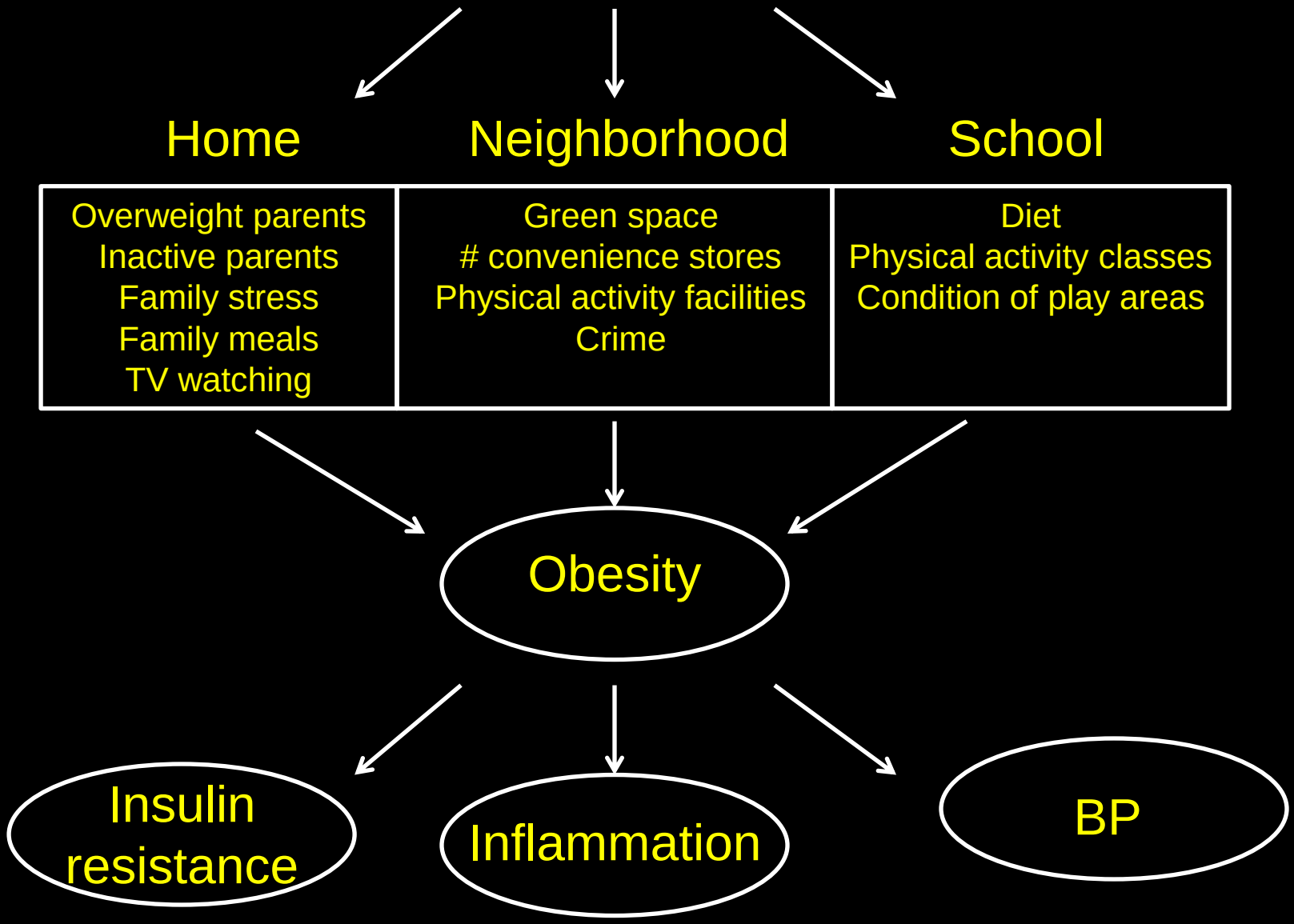


Cardiometabolic Effects of the Stress Response



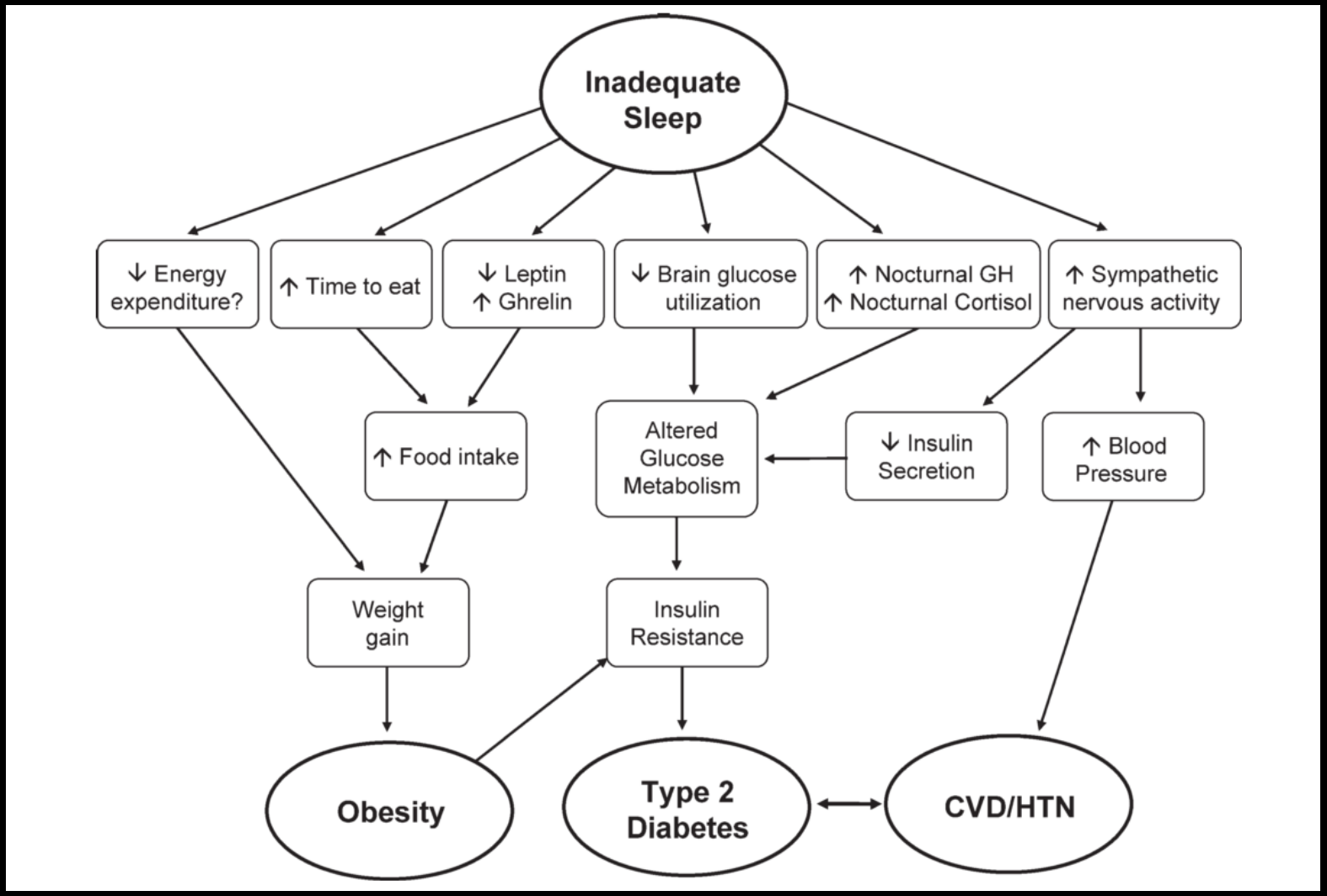
Lancet 370:1089-1100, 2007

Childhood Socioeconomic Status/ Poverty



Abstracted from Schreier & Chen Psych Bull 2013

Possible mechanistic pathways linking inadequate sleep to obesity, diabetes, CVD, and hypertension



Knutson Am J Human Biol 2012

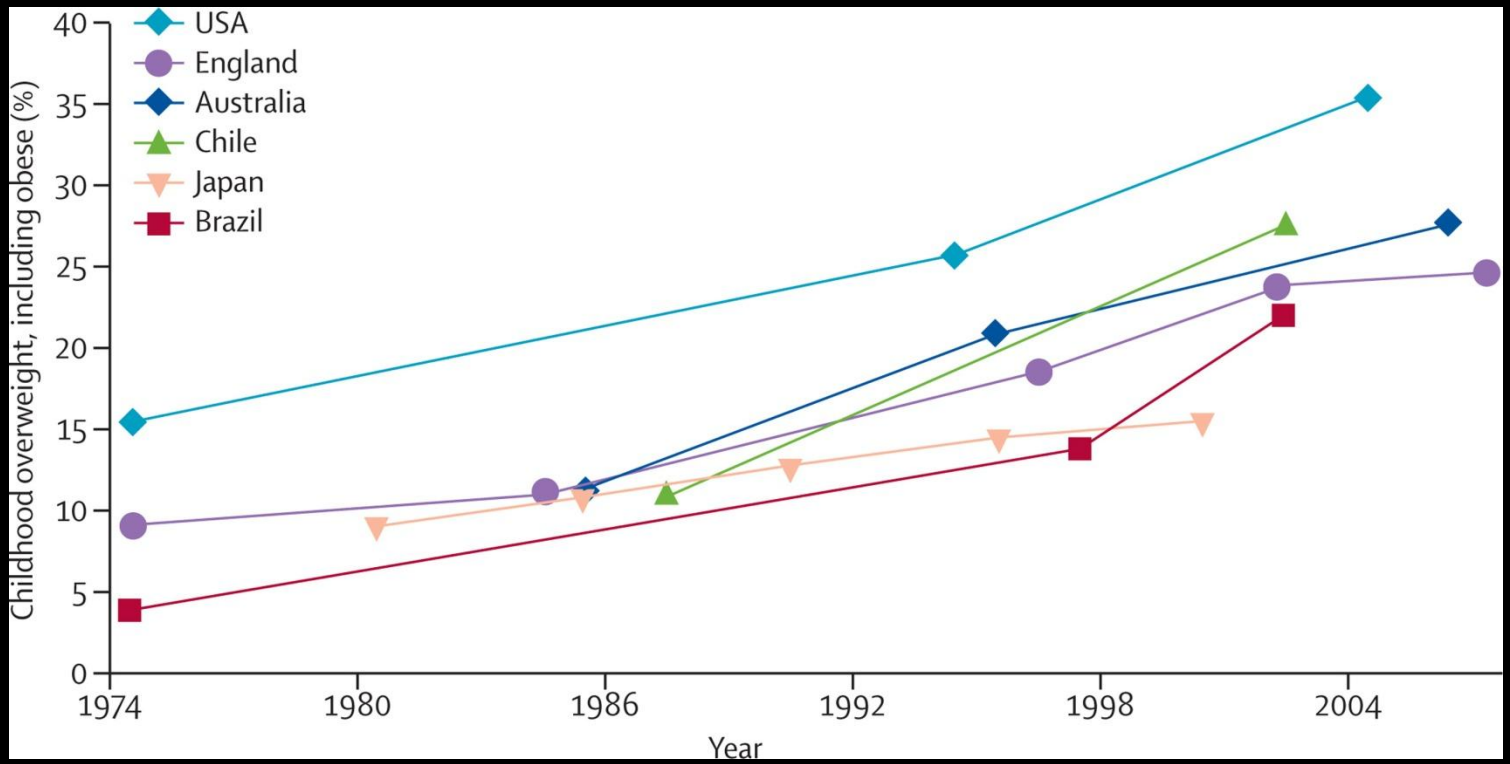
AHA Special Report:

"…many CVDs with ultimate outcomes in adulthood actually have their origins during childhood."

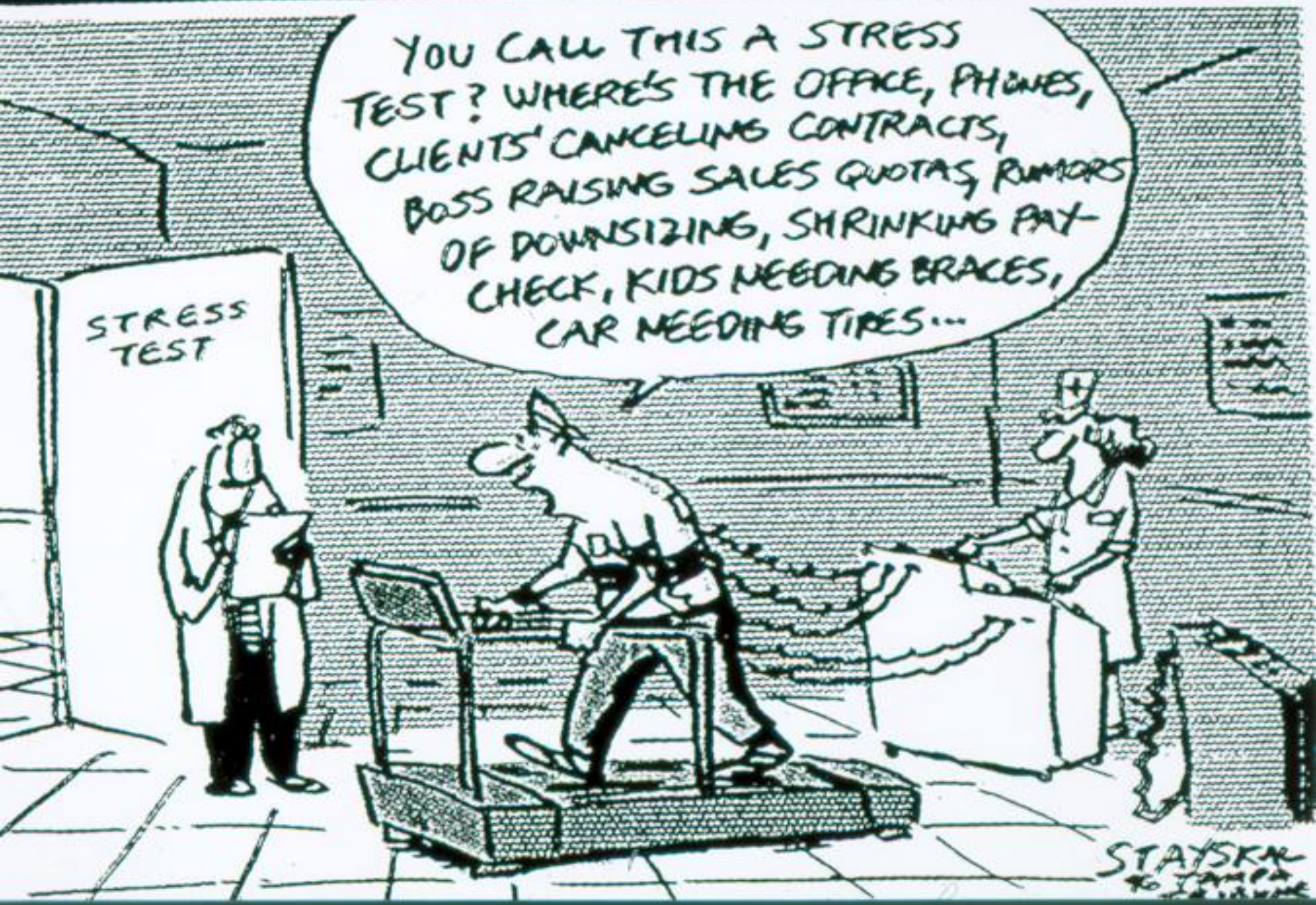
"…primordial prevention has relevance and urgency in the high-income nations of today, given the substantial burden of obesity and *the adverse health behaviors and environment* that often begin in childhood and are present in most high-income nations, especially the United States."

Circulation. 2010; 21:586-613.

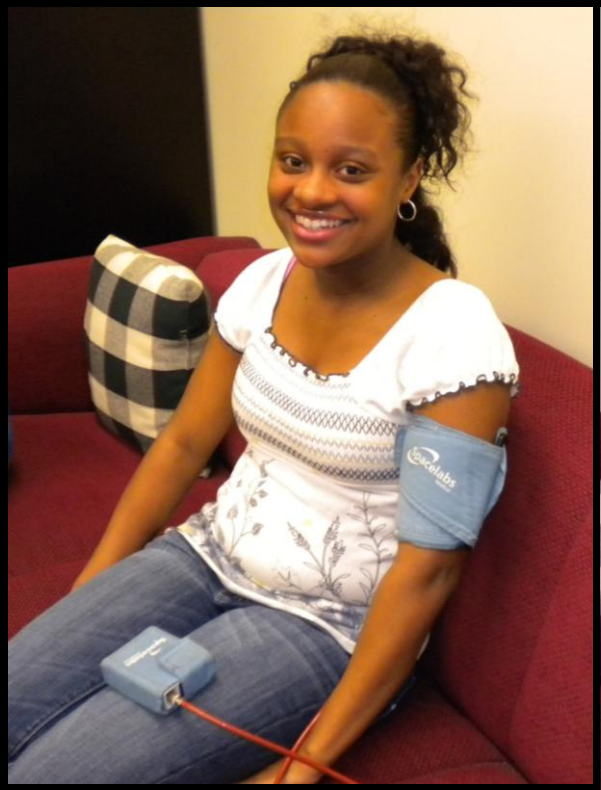
Estimates of percentage of childhood population overweight, including obese (with use of International Obesity Taskforce cutoffs) in a selection of countries



Swinburn et al. Lancet 2011


YOU CALL THIS A STRESS TEST? WHERE'S THE OFFICE, PHONES, CLIENTS' CANCELING CONTRACTS, BOSS RAISING SALES QUOTAS, RUMORS OF DOWNSIZING, SHRINKING PAY-CHECK, KIDS NEEDING BRACES, CAR NEEDING TIRES...
STRESS TEST

Studies of healthy black and white adolescents



Protocols

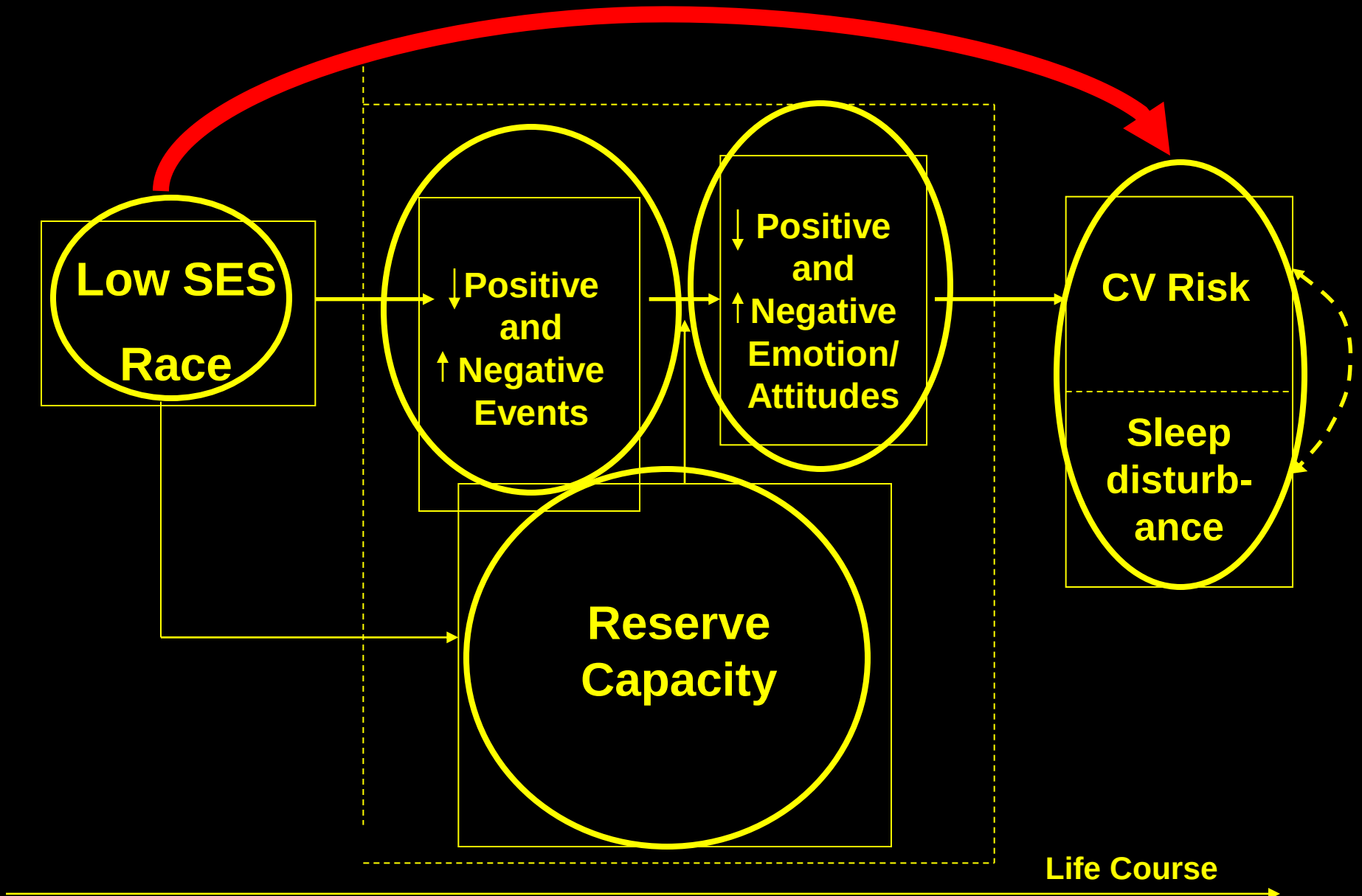
Project Pressure I

225 healthy black and white adolescents ages 14-16 followed for 3 years for CV reactivity to stress, vascular stiffness, carotid IMT, and night/day ambulatory BP

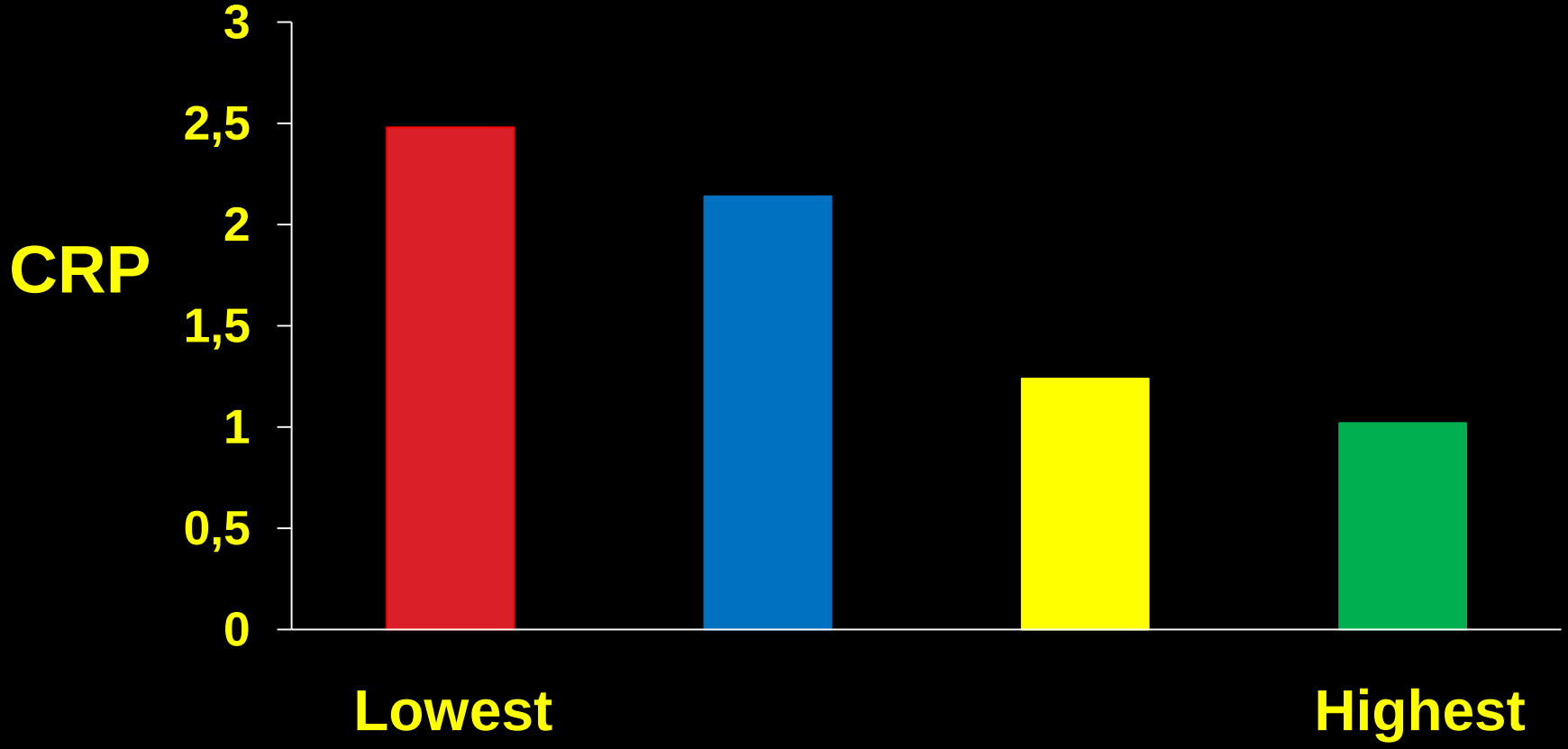
Project Pressure II

250 healthy black and white high school students examined for metabolic syndrome, night/day ambulatory BP, and sleep (actigraphy & diary)

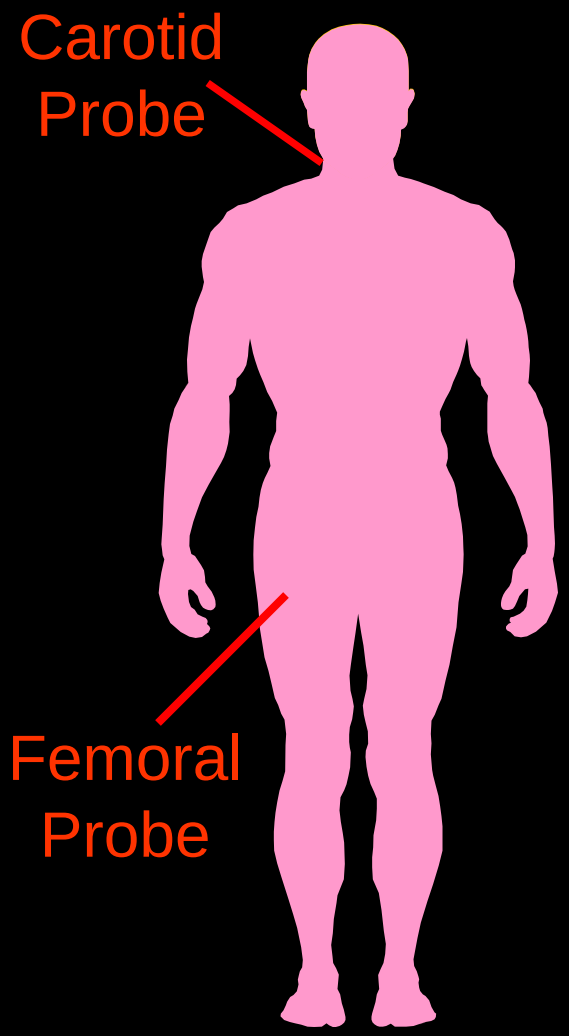
Reserve Capacity Model



Higher CRP is associated with lower family SES



Pulse Wave Velocity- Methods



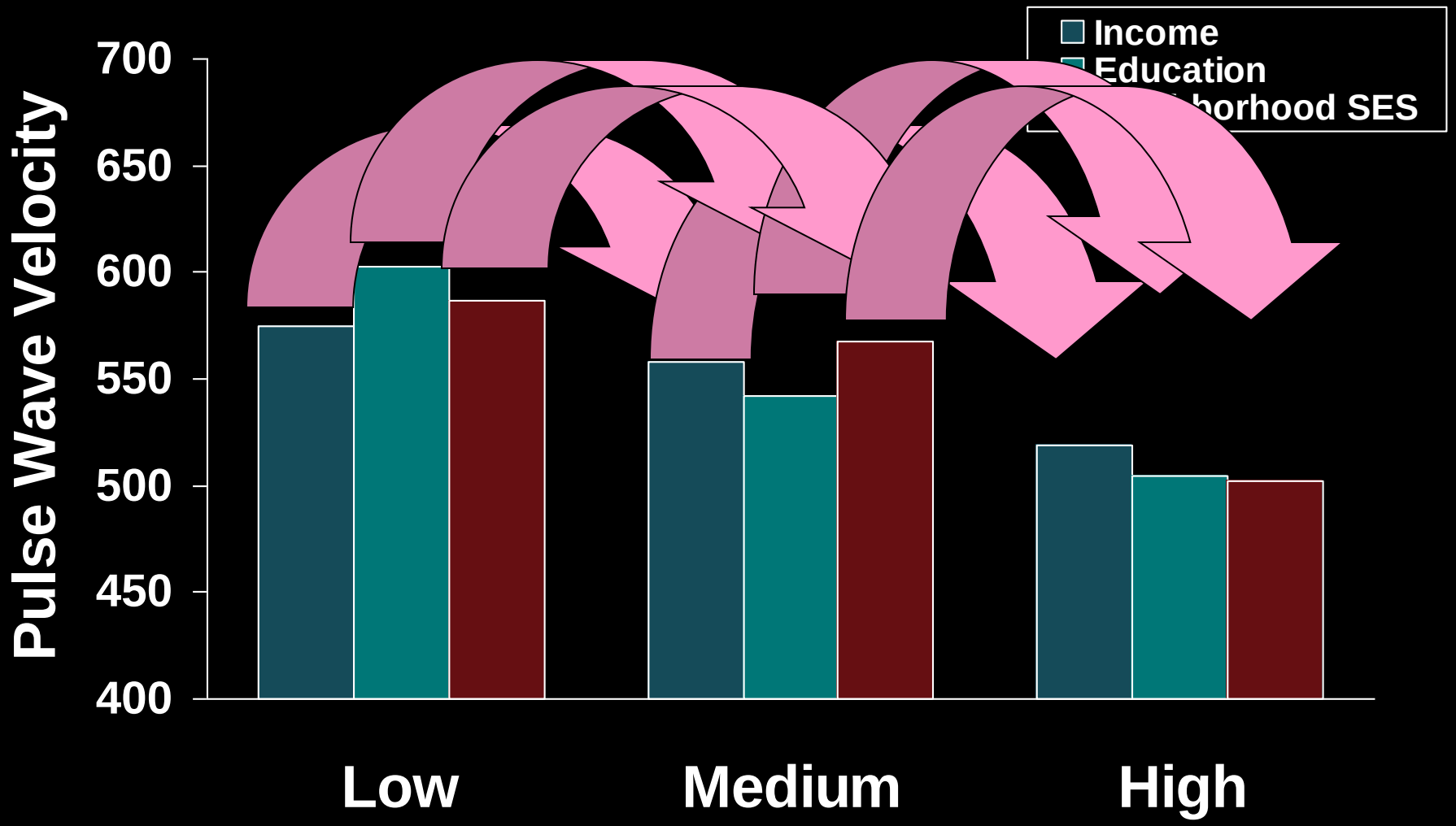
Pulse Wave Velocity = Distance / Time

Distance = The distance between the two points measured over the body.

Time = The time the foot of the pressure wave takes to travel between sites.

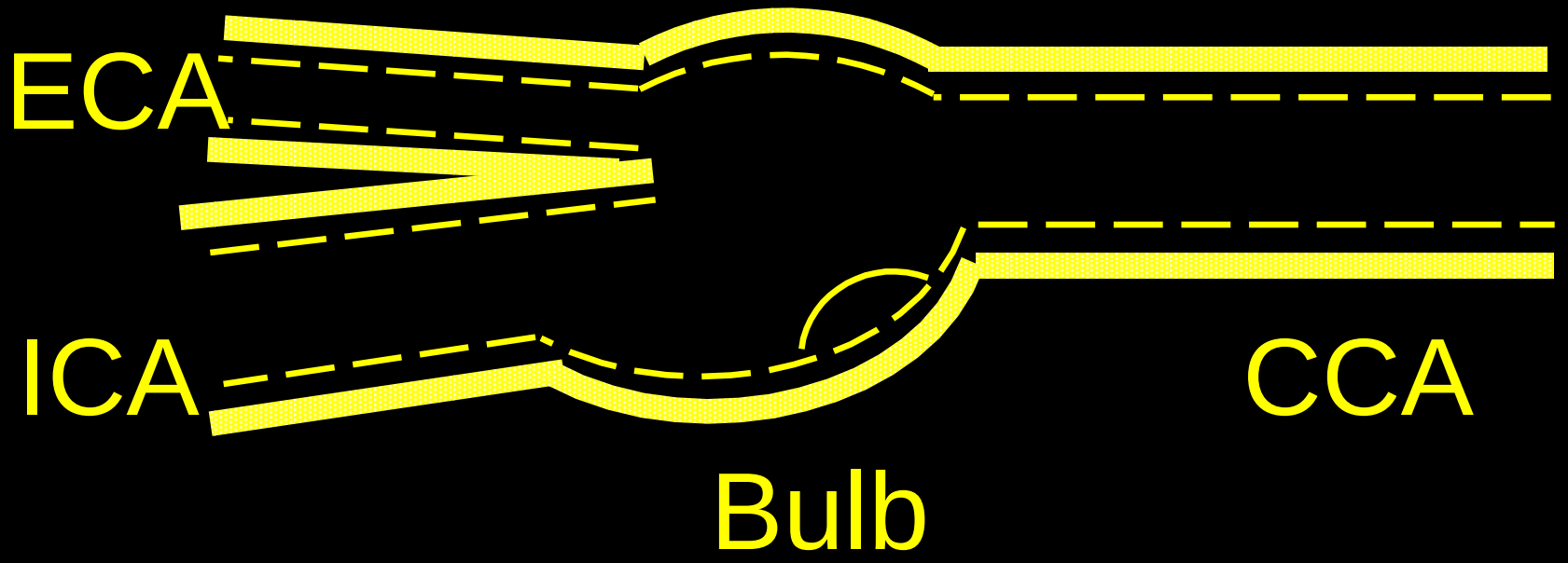
Higher values = Stiffer vessels

Lower SES is associated with greater arterial stiffness in adolescents



Thurston & Matthews, 2009

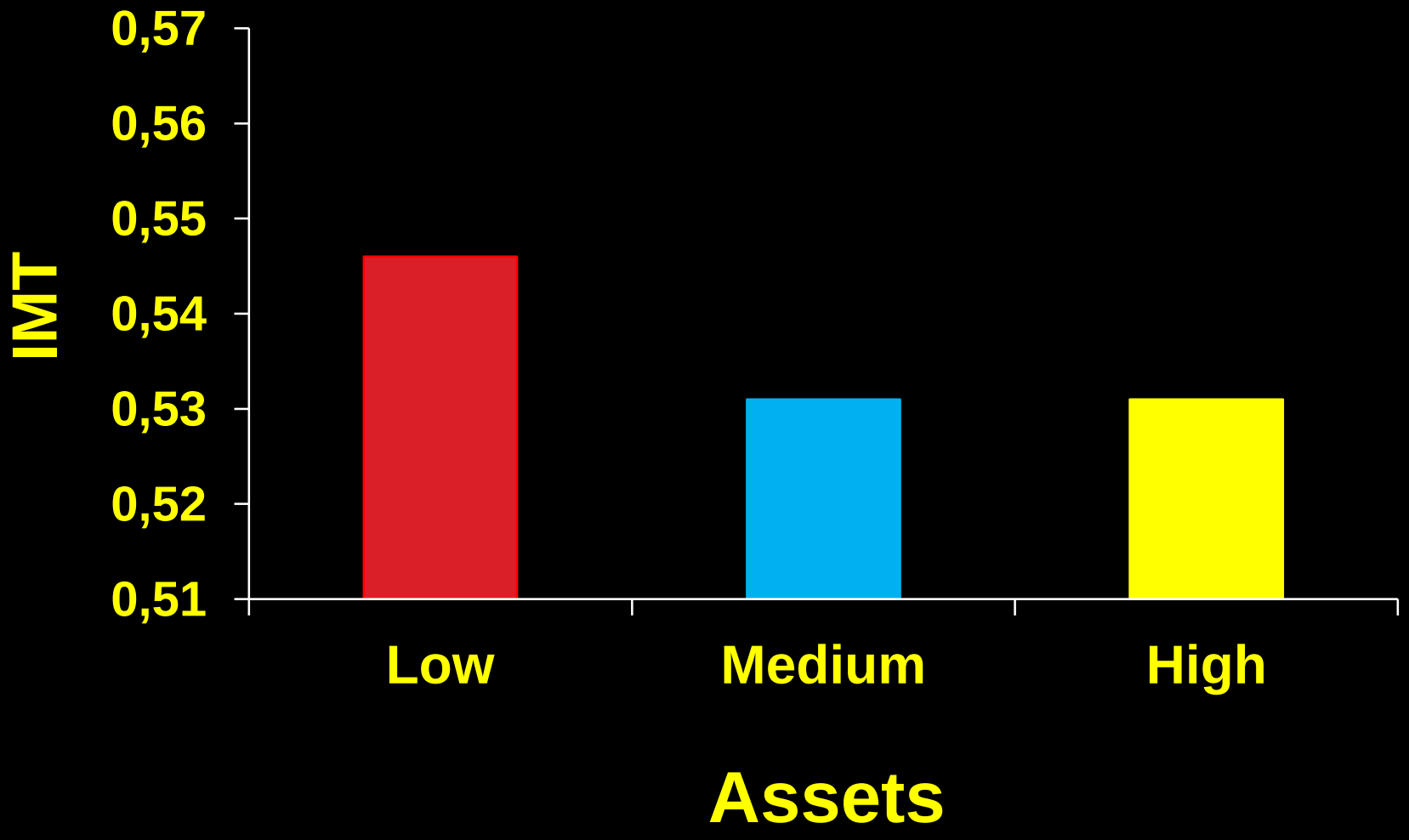
Carotid Atherosclerosis-Methods



Intima-Media Thickness (IMT): Average from the near and far walls of the CCA, and far walls of the bulb, ICA.

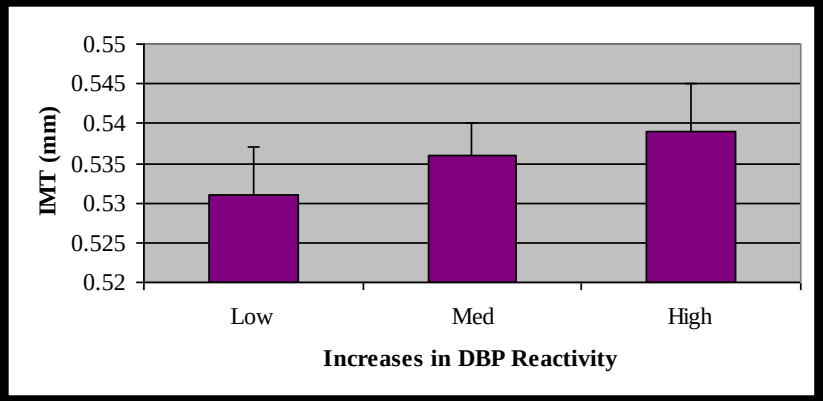
Plaque Index: Measure of focal plaque based on the number and size of plaques in the CCA, bulb, ICA and ECA.

Low assets are associated with carotid IMT in adolescents

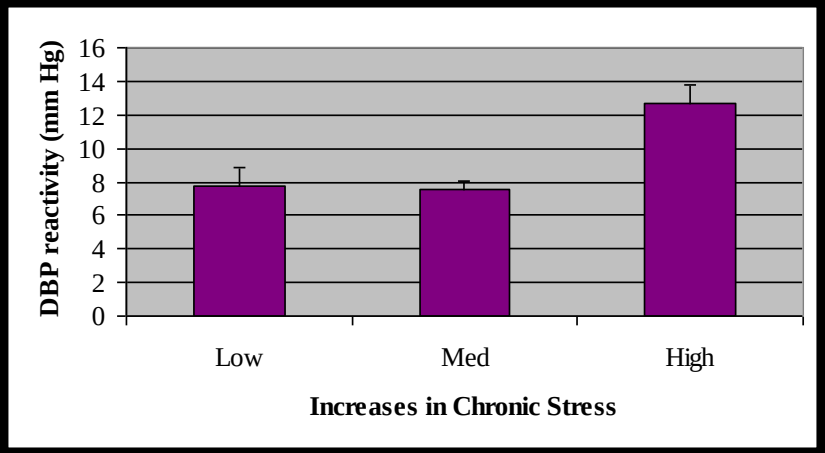


Thurston & Matthews, 2009, Soc Sci Med

Increasing DBP reactivity to acute stress is associated with carotid IMT



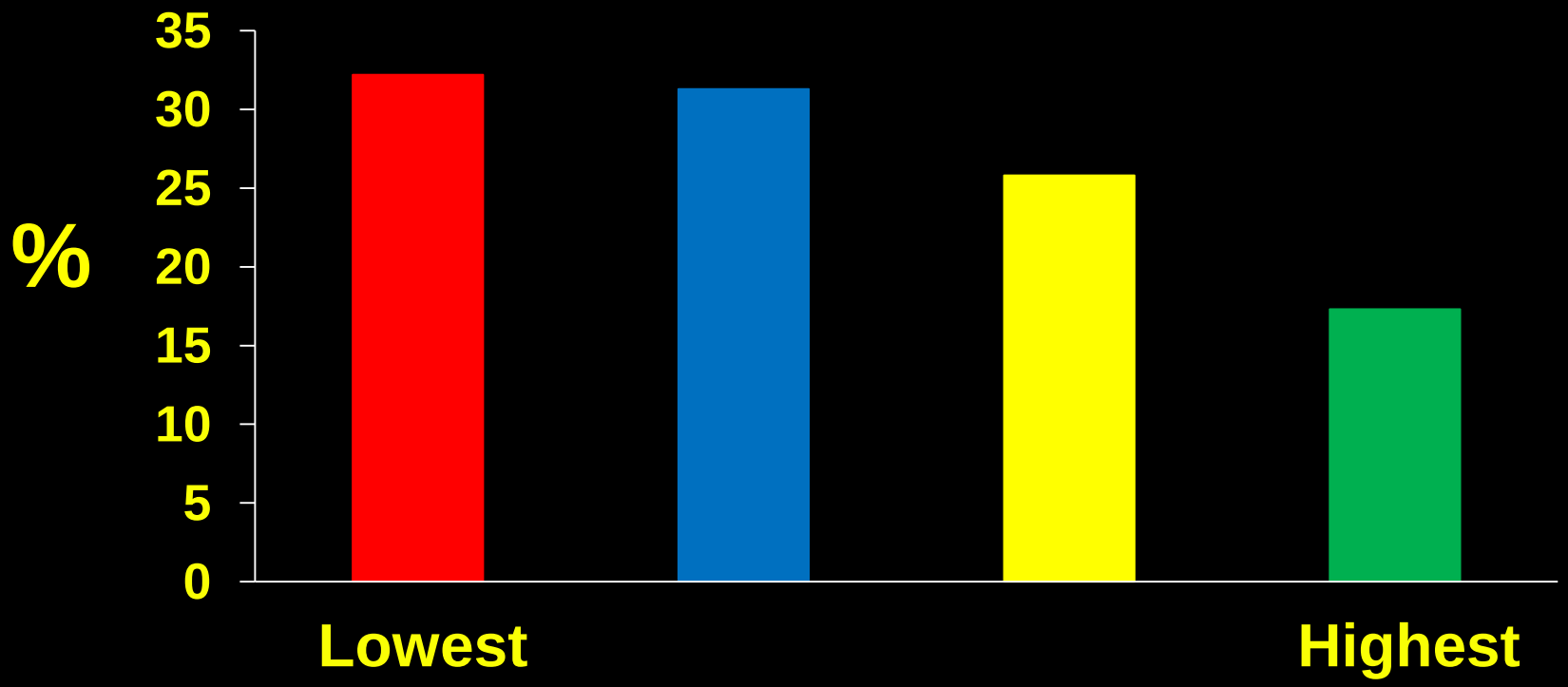
- **Increasing DBP reactivity associated with IMT (β = .18)**



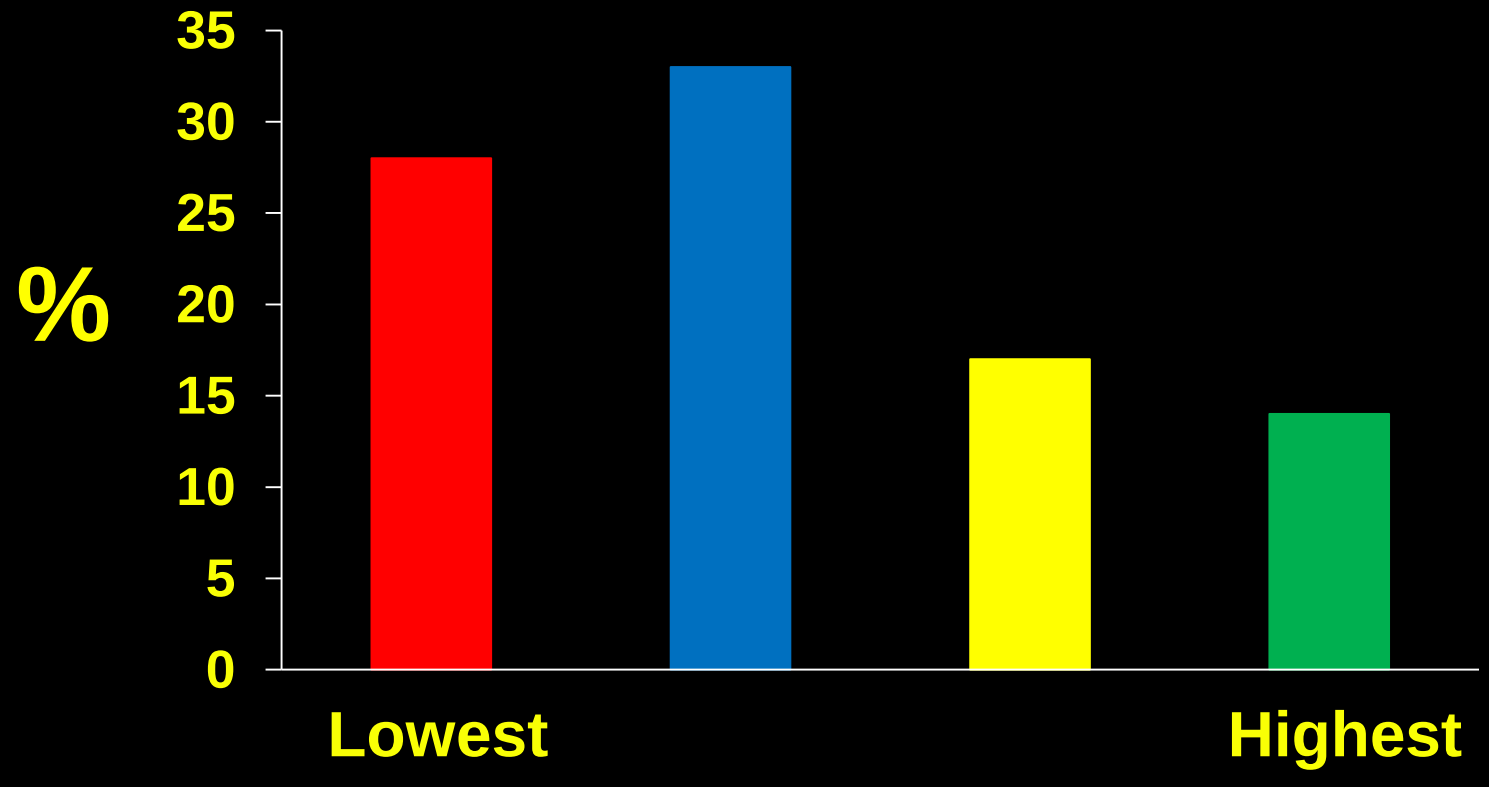
- **Increasing negative events associated with DBP reactivity (β = .19)**

Low et al. Psychosom Med. 71:927-31, 2009.

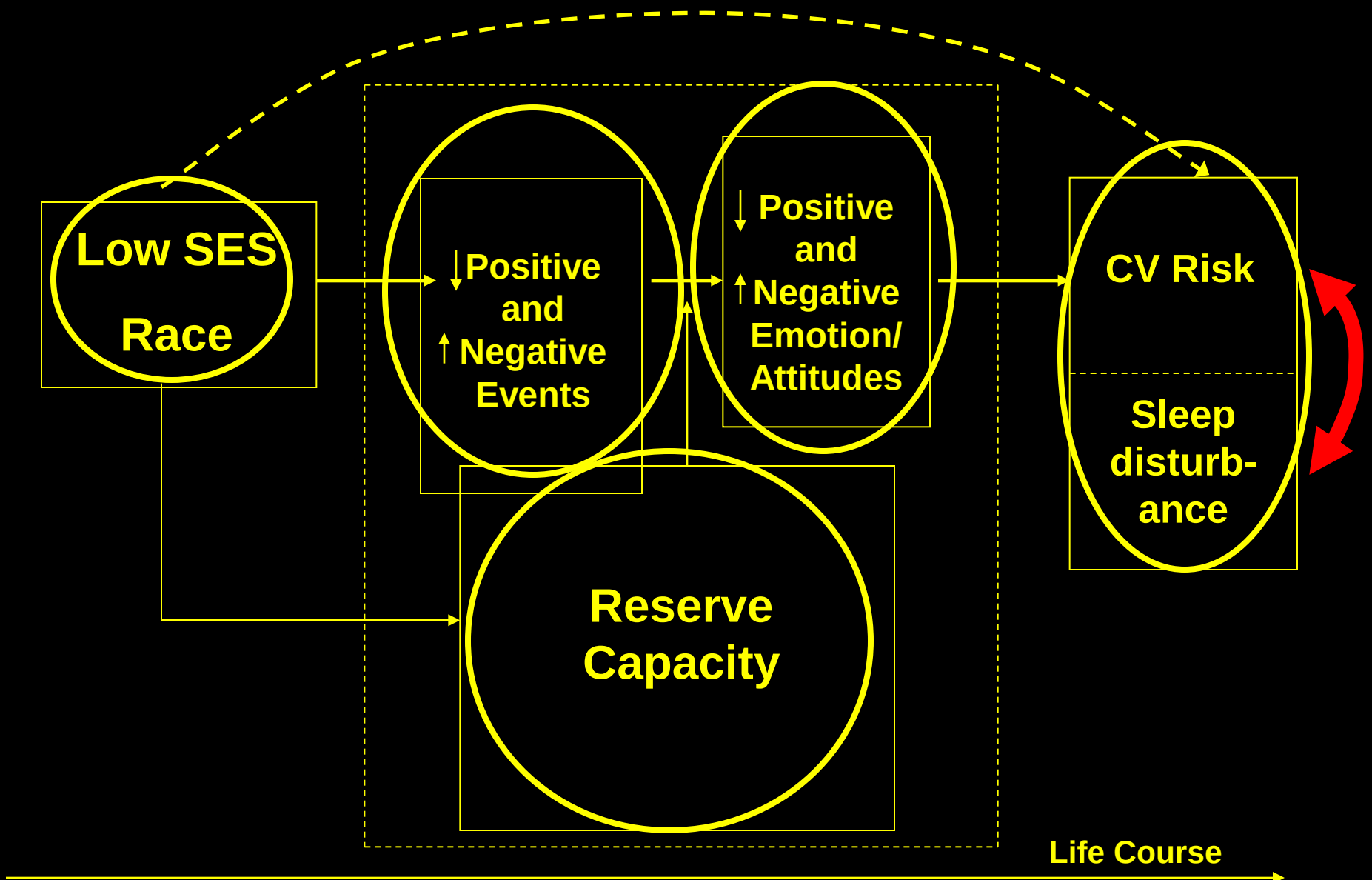
Percent SBP nondippers increases with decreasing family income



Percent with 2+ Metabolic Syndrome Components by Quartiles of Family SES

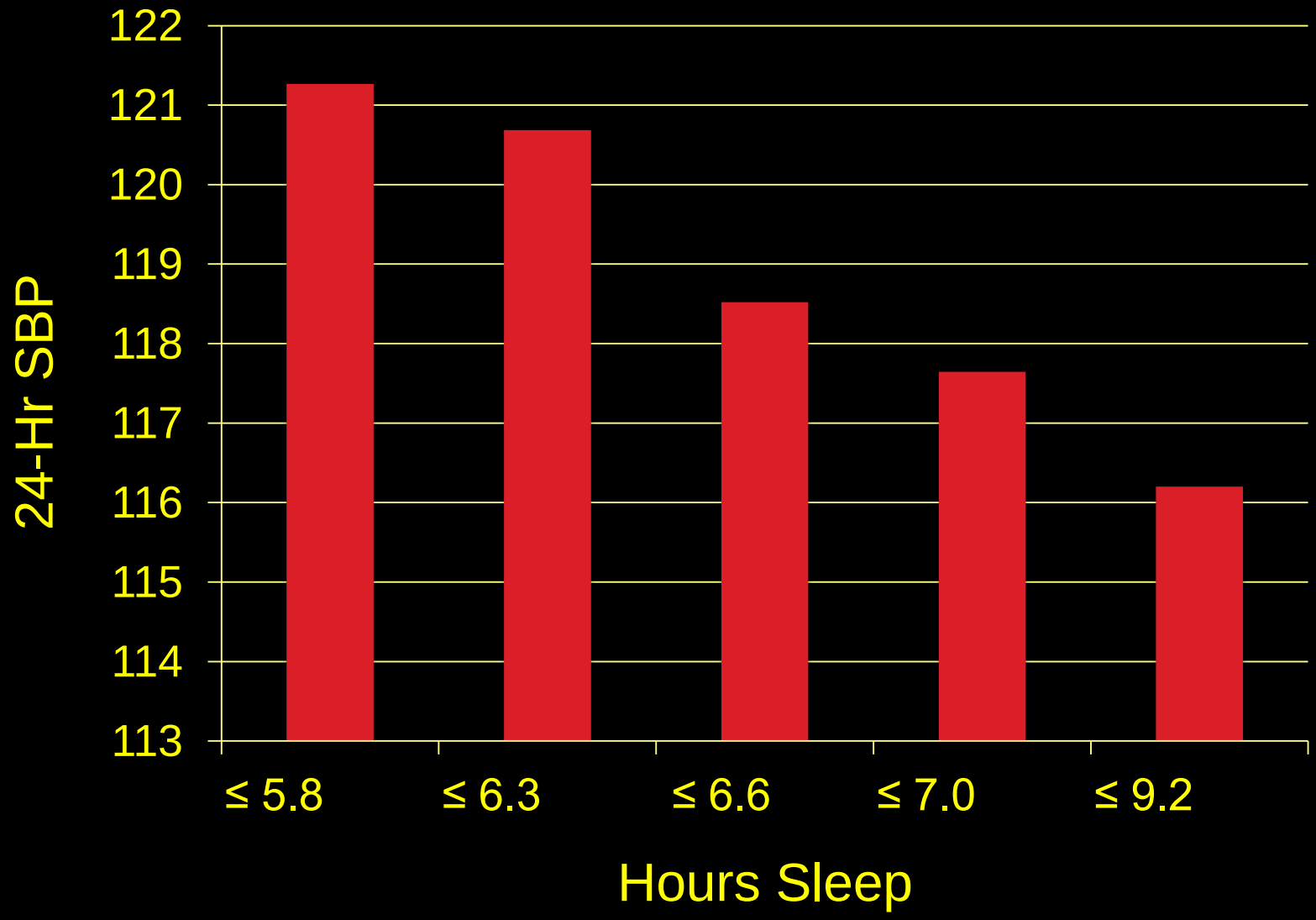


Reserve Capacity Model

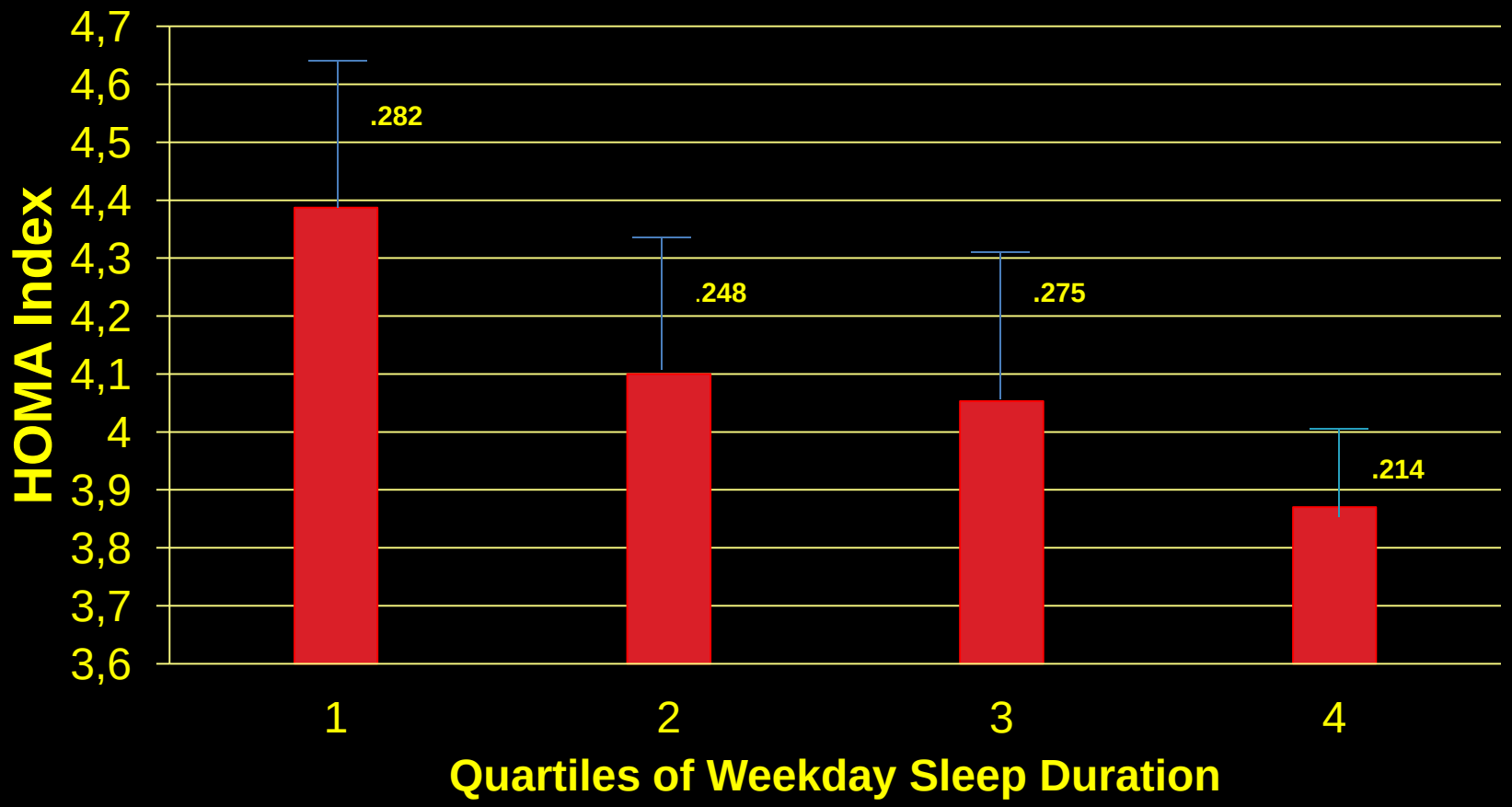


"Come back to bed. You know sleep deprivation lowers your sales resistance."

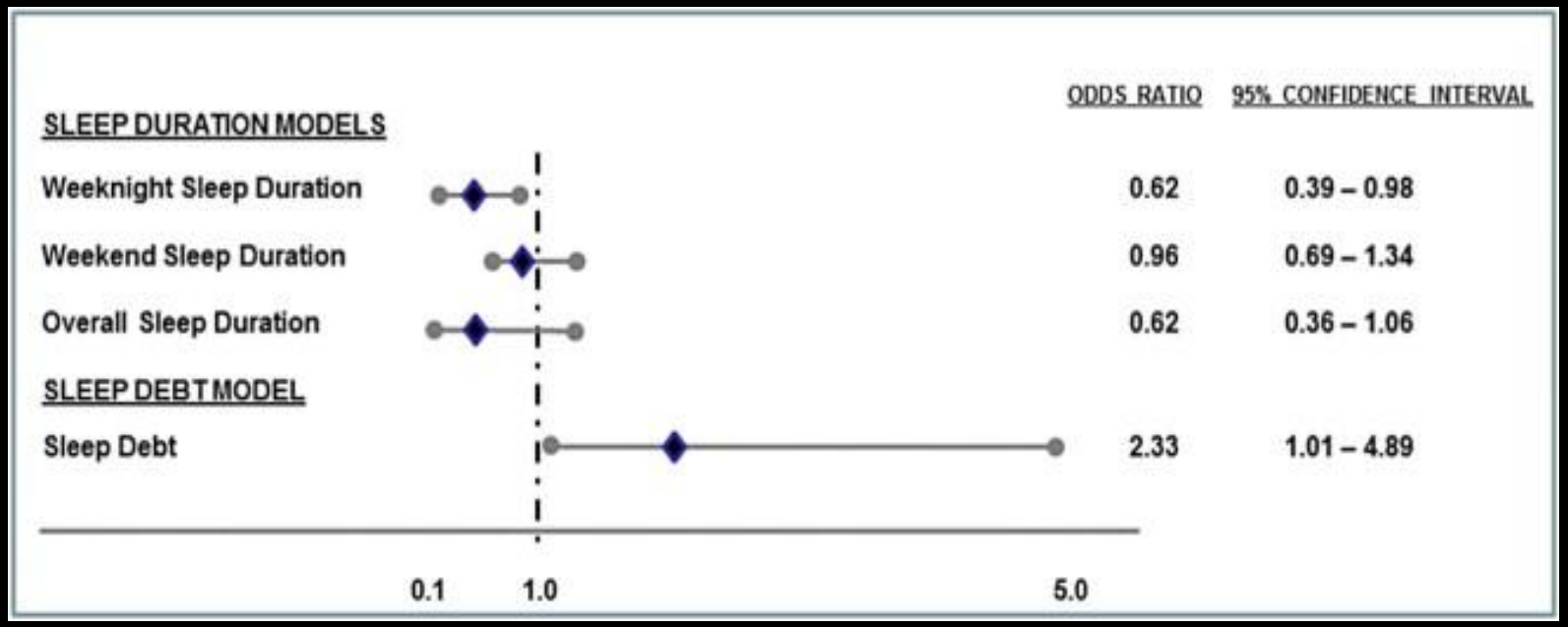
Is sleep duration associated with 24-hr SBP?



Is sleep duration associated with insulin resistance?



Is sleep duration associated with CRP?



Hall et al. Sleep Med 2

Is Sleep Duration Associated With Childhood Obesity?

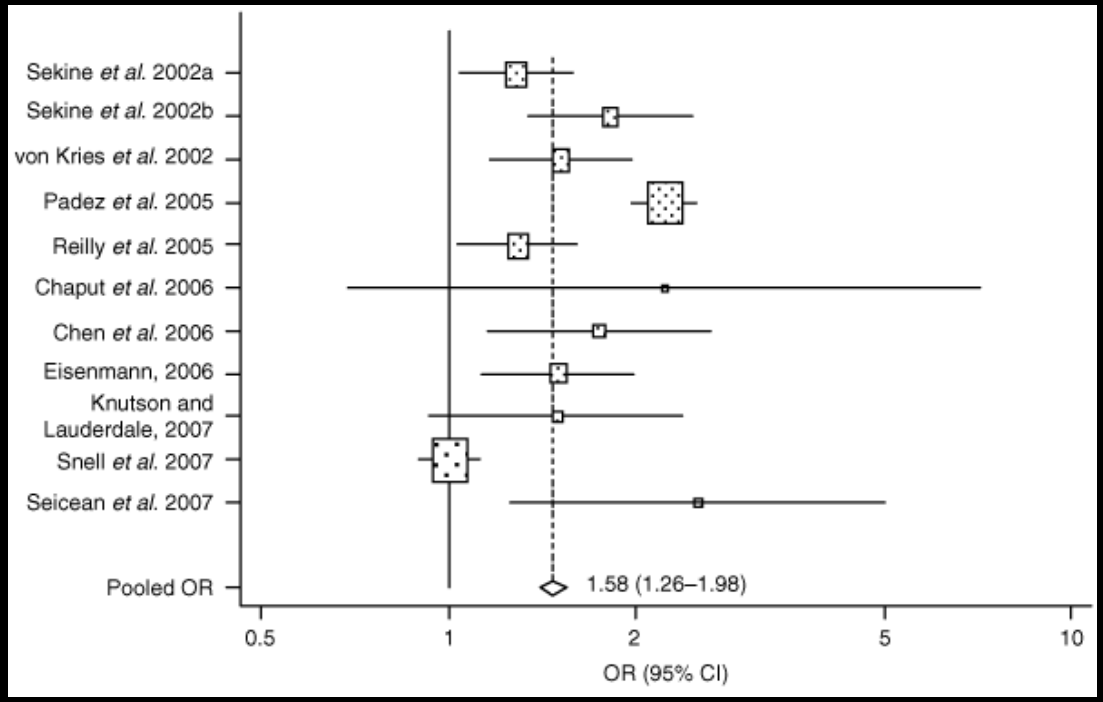


Figure 1. : The association between short sleep duration and risk for overweight/obesity: Pooled odds ratio (OR) and 95% confidence interval (95% CI). Shorter vs. longer sleep duration (based on individual study's criteria); Test for heterogeneity: $Q = 174.9$, $P < 0.001$; pooled OR and 95% CI were based on random-effects model.

Obesity
Volume 16, Issue 2, pages 265-274, 6 SEP 2012 DOI: 10.1038/oby.2007.63
http://onlinelibrary.wiley.com/doi/10.1038/oby.2007.63/full#f1

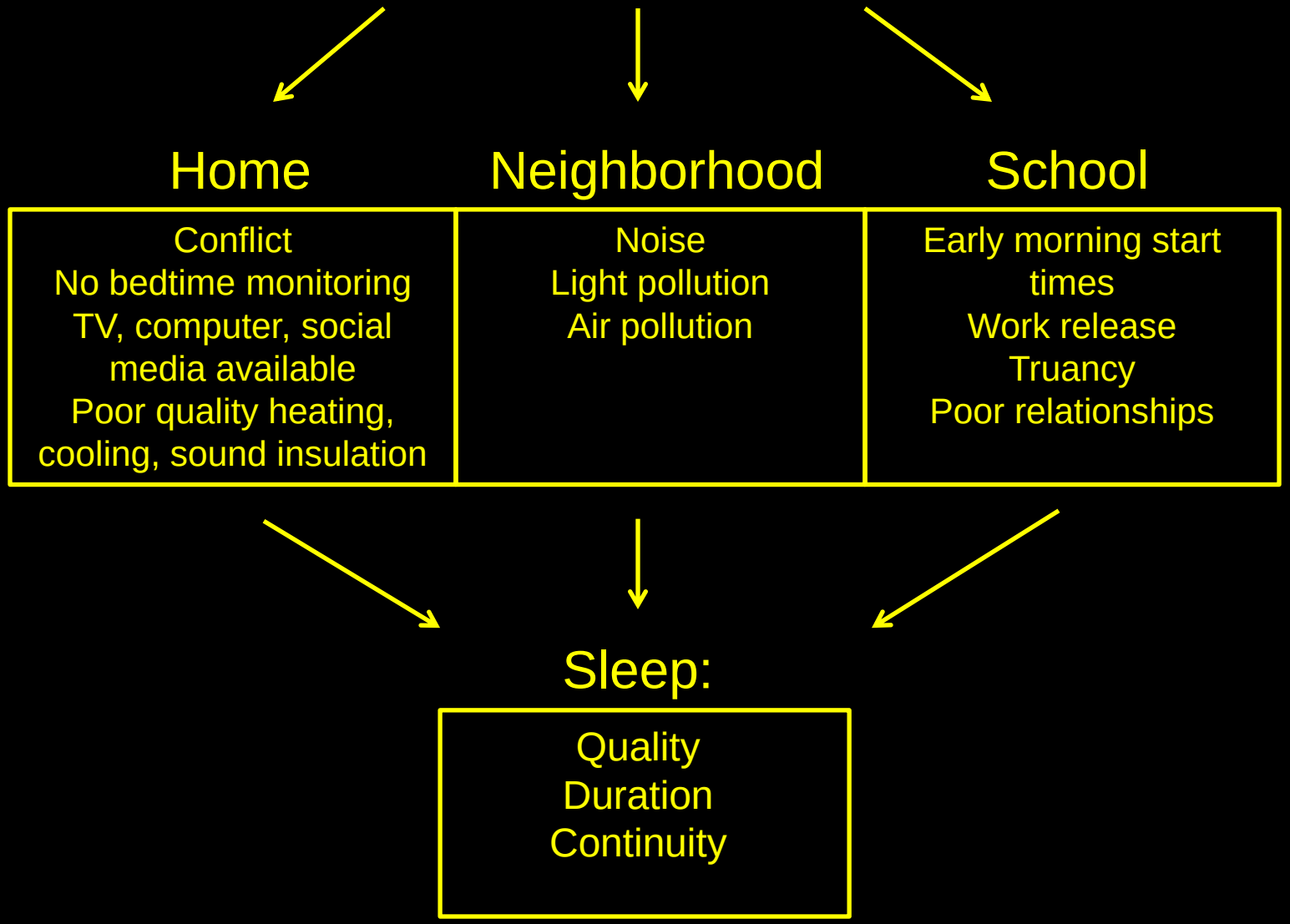
Why poor sleep may be linked to metabolic factors and BP:

- Obesity
- Increases in SNS and decreases in PNS activation affecting BP
- Leptin secretion inhibited by SNS and ghrelin secretion inhibited by PNS
- Glucocorticoids facilitate visceral fat accumulation, affecting insulin resistance

Poor quality, insufficient sleep in children linked to:

- Lower SES families and lower subjective social status (Gellis 2005; Jarrin et al. 2014)
- Fatigue, emotionally lability, inability to concentrate (Dahl & Harvey 2007)
- Internalizing problems (Gregory & Eley 2005)
- Poor cognitive performance among children from lower SES families (Buckhalt et al. 2007, 2009)
- Buckhalt hypothesis: SES is related to achievement gap in part due to poor sleep (Child Dev Perspectives 5:59-65)

Childhood Socioeconomic Status/ Poverty

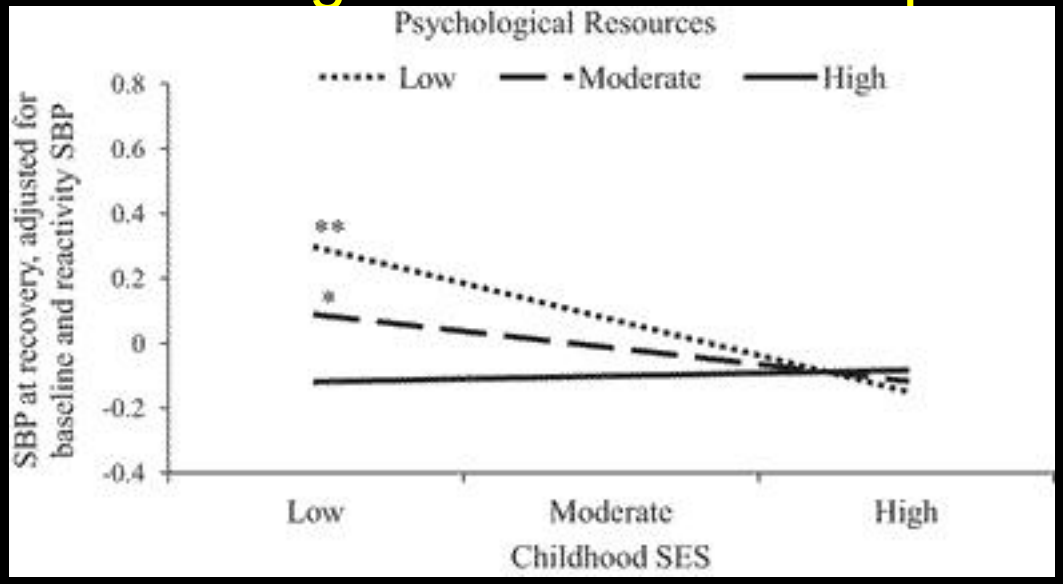


Positive resources may protect men from low childhood SES: Case of post-stress recovery

- 246 men age 32 who participated in laboratory stress protocol and had prospective measures of family SES across 10 years from ages 6 to 16.
- Psychological resources were a composite of positive affect, optimism, purpose in life, self-esteem, and self-mastery.
- Lower childhood SES was related to prolonged recovery of HR and SBP post-stress.

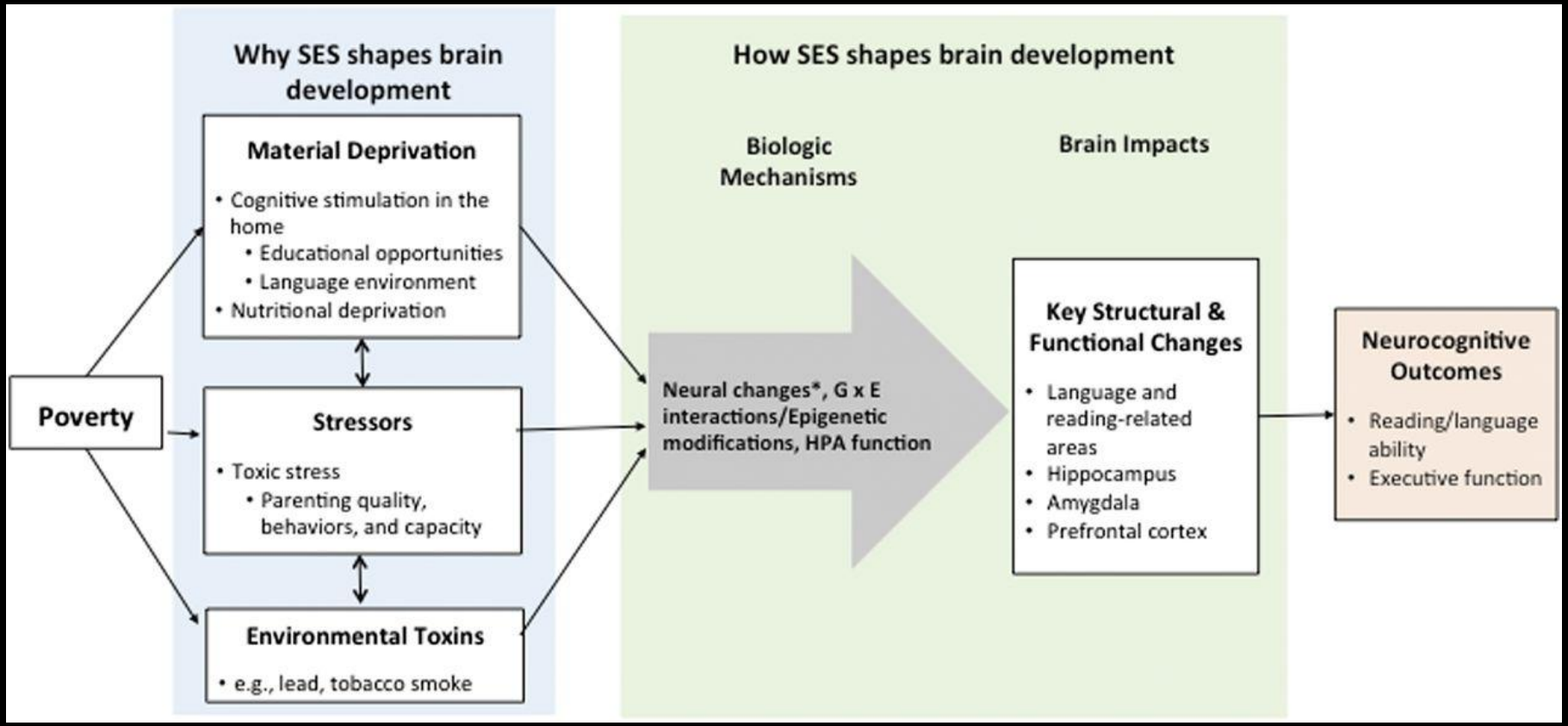
Positive resources may protect men from low childhood SES

- Associations with prolonged SBP recovery was only apparent among men with fewer psychological resources
- Associations stronger for childhood and early adolescence SES than later adolescence but not a lot of change in SES—critical period?



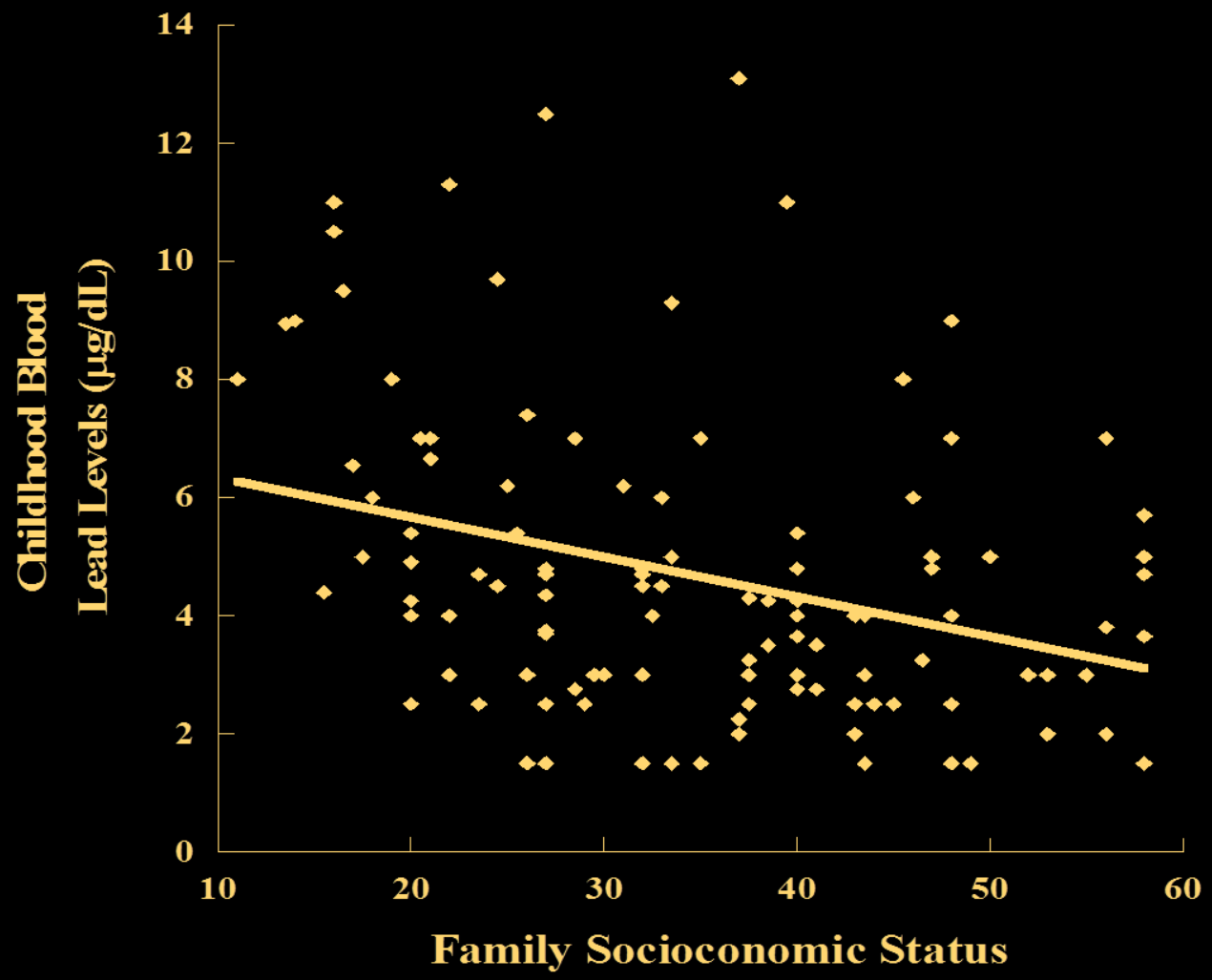
Boylan et al.
Health Psycho1 2016

A framework based on animal neuroscience research



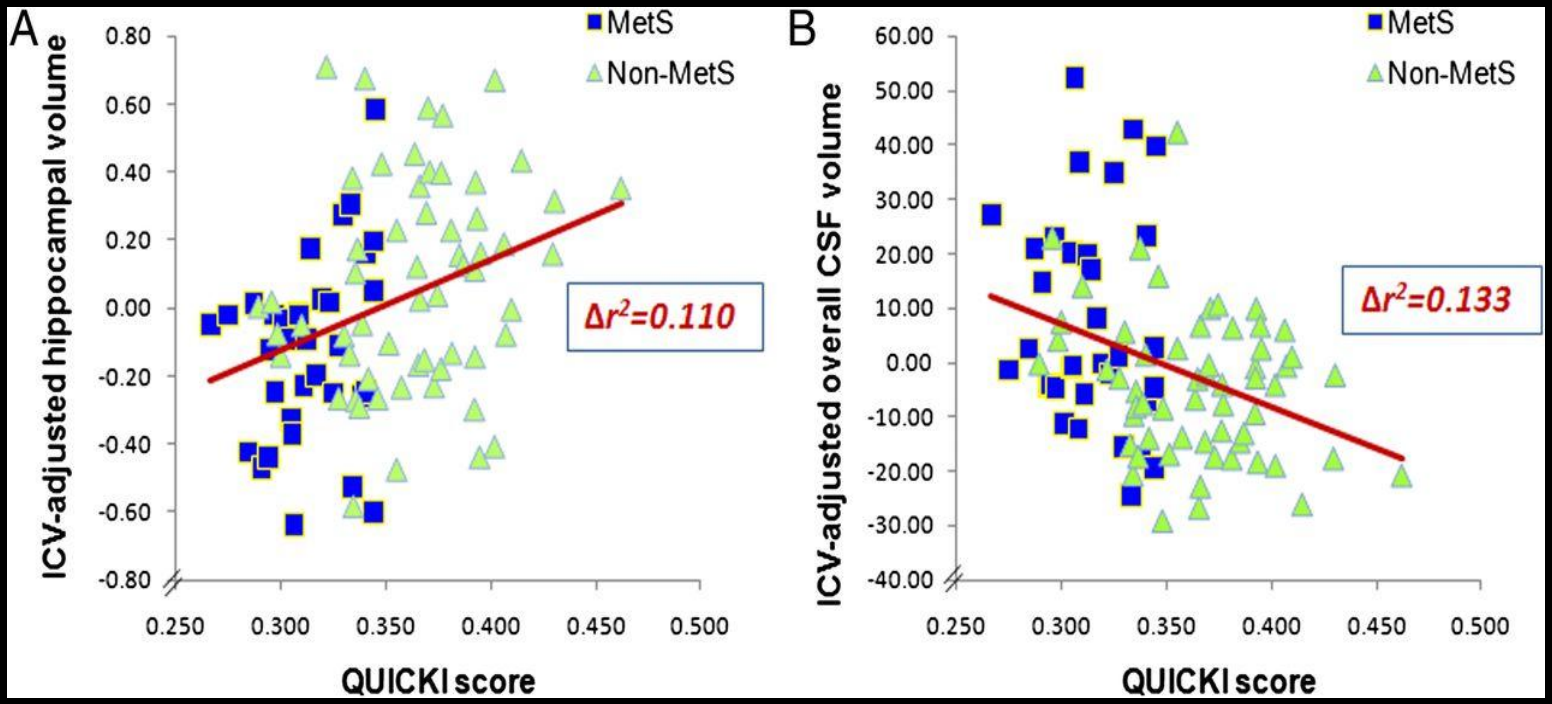
Johnson et al. Pediatrics 2016

Children's Family Socioeconomic Status as a Function of Childhood Lead Levels



Gump et al. Health Psych 26, 2007, 296-304

Lower cognitive performance with increasing number of MetS components present.



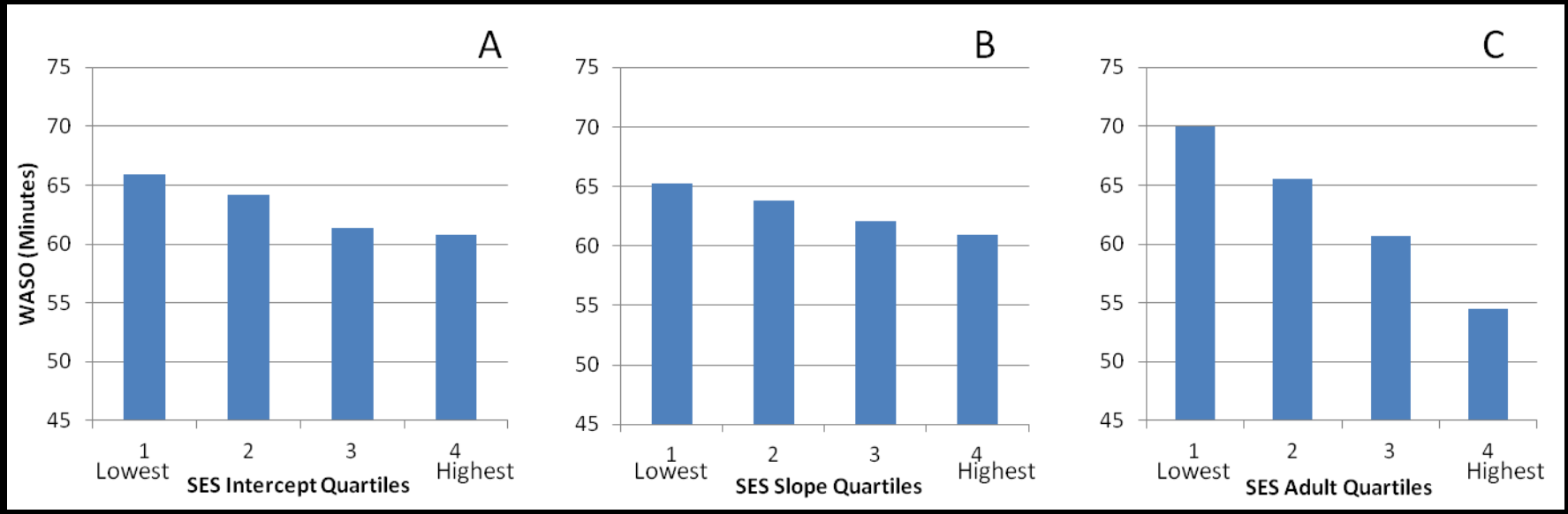
Po Lai Yau et al. Pediatrics 2012

Thank you for your attention

Snapshots

Monks don't get paid much, but there's a lot of "upward mobility."

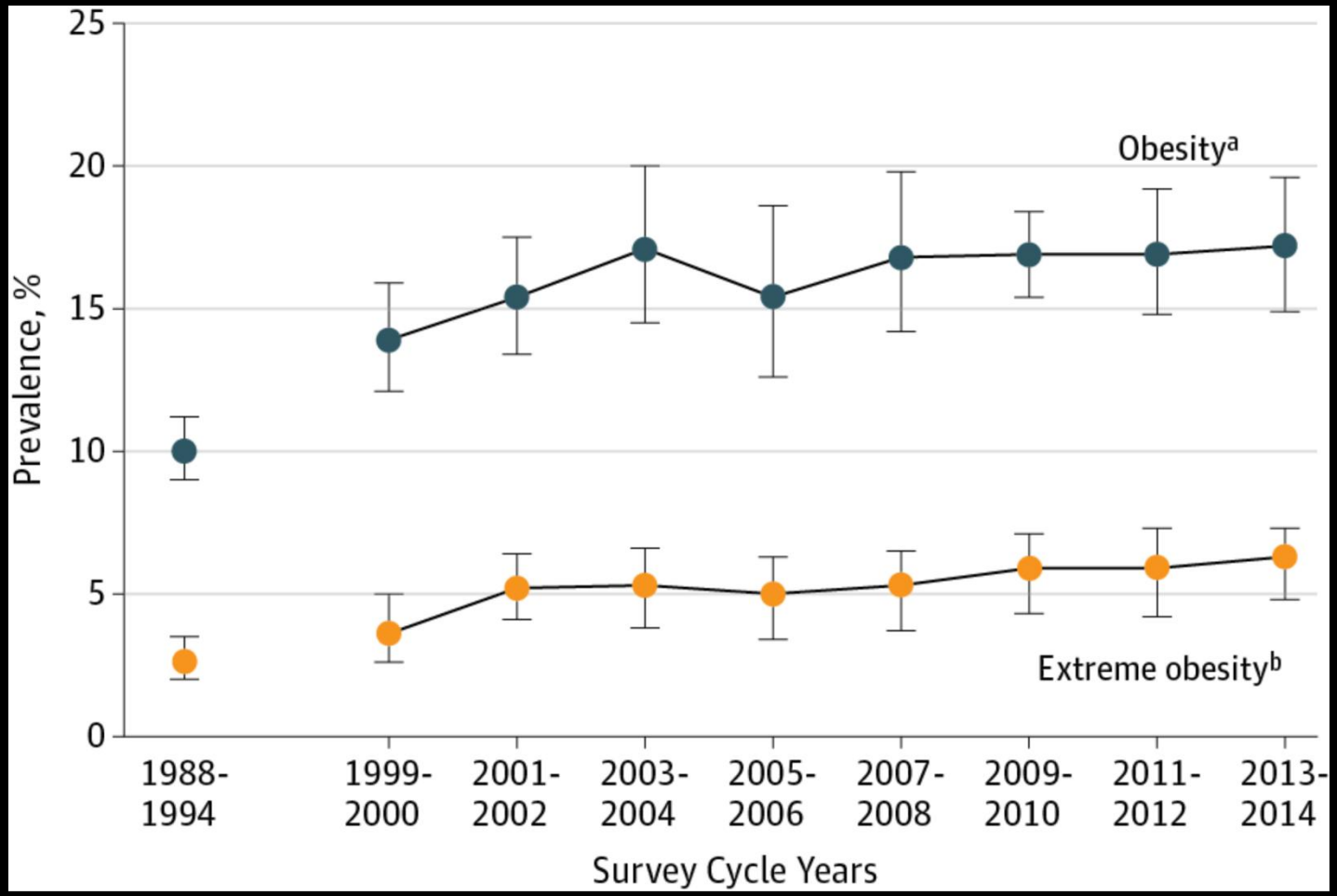
SES associations of WASO with SES at age 7 (A), SES change between 7 and 16 (B), and adult SES at age 32 (C)



Accumulation of standard CVD risk factors in childhood predicts:

- Coronary calcification in midlife (JACC 1996 Muscatine, Iowa Study)
- Maximum carotid IMT in midlife (JAMA 2003 Finnish cohort)
- Mean carotid IMT in young and middle-age adults (JAMA 2003 Bogalusa)
- Fatty streaks and fibrous plaque postmortem (NEJM 1998)
- What about the accumulation of adverse environments associated with SES and poverty?

Prevalence of Obesity and Extreme Obesity in US Children and Adolescents Aged 2 to 19 Years From 1988-1994 Through 2013-2014



Ogden et al. JAMA 2016

Socioeconomic Status:

One's social position linked to both access to resources and prestige in a social hierarchy.

Common Measures:

- Education
- Occupational rank
- Income

Other Measures:

- Subjective rank
- Childhood SES
- Income loss/gain
- Wealth (savings, materials resources)