



Pregnancy Factors in Relation to Childhood Obesity

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Obesity in the Early Childhood Years
IOM's Roundtable on Obesity Solutions

Why pregnancy?

- Programming of obesity in utero
- Transmission of obesity from mother to child

“...[P]regnancy may be an especially powerful ‘teachable moment’ for the promotion of healthy eating and physical activity behaviors among women.”

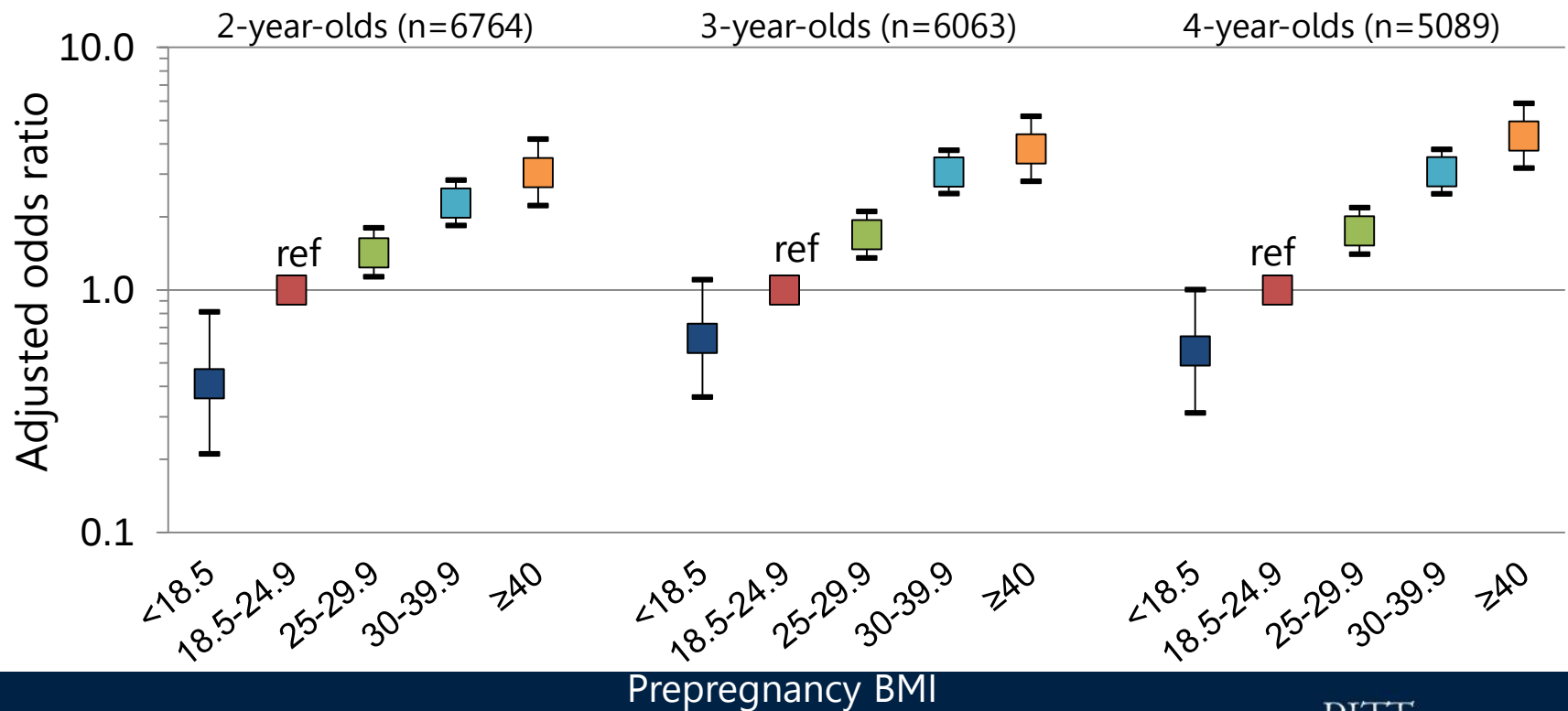
- S. Phelan, Am J Obstet Gynecol 2010

Pregnancy factors related to childhood obesity

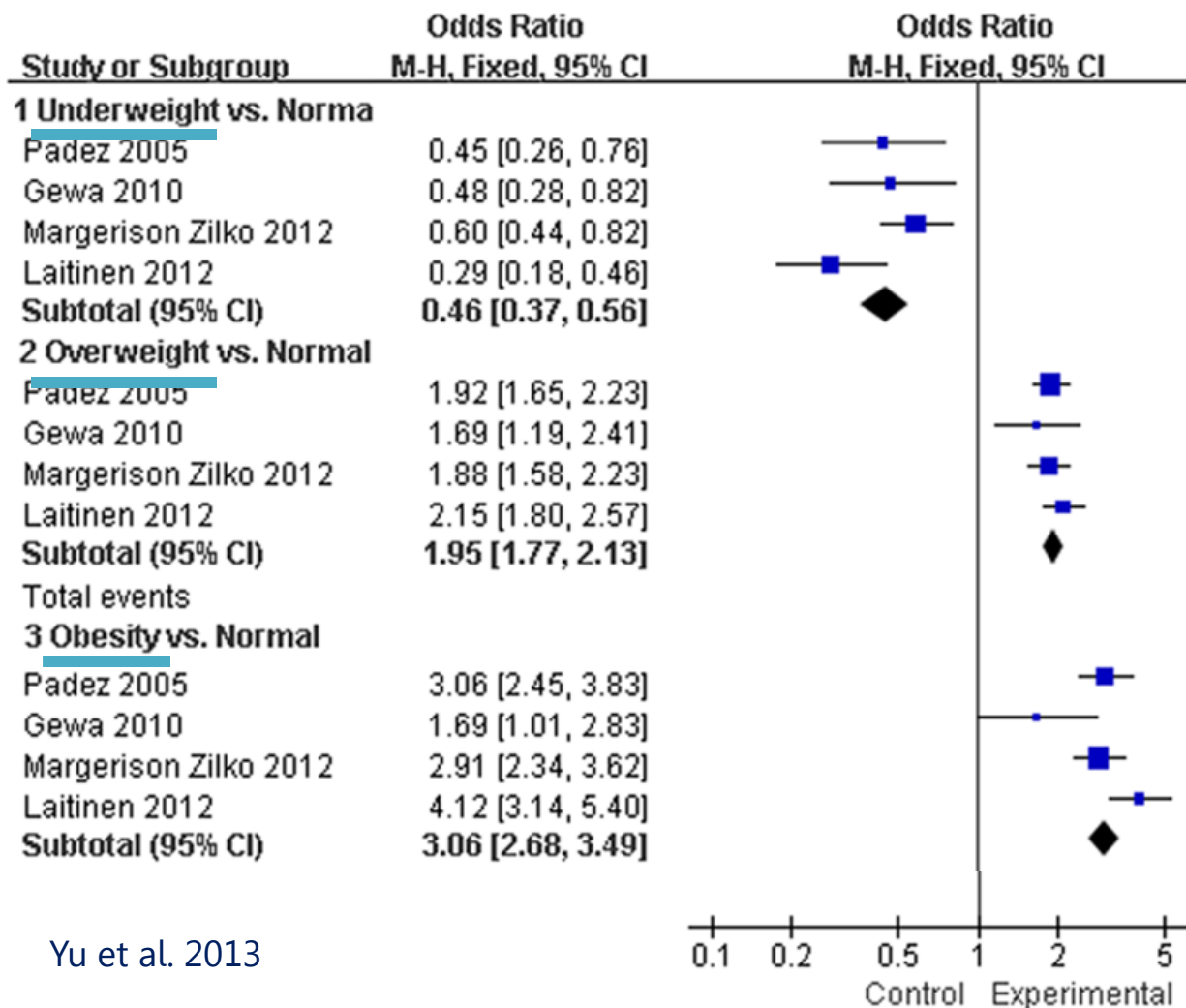
- Maternal prepregnancy body mass index (BMI)
- Gestational weight gain
- Gestational diabetes
- Smoking during pregnancy

Prepregnancy BMI

- Whitaker 2004
 - 8494 low-income families in Ohio
 - Measured height and weight from WIC linked to birth certificate.
 - Childhood obesity: BMI z-score $\geq 95^{\text{th}}$ percentile



Prepregnancy BMI: association with child obesity



Meta-analysis: Adjusted OR (95% CI)

Underweight:
0.46 (0.37, 0.56)

Overweight
2.0 (1.8, 2.1)

Obese
3.1 (2.7, 3.5)

How much weight should pregnant women gain?

2009 IOM recommendations:
total gestational weight gain
at term

lb

kg

Underweight

25-40

12.5-18

Normal weight

25-35

11.5-16

Overweight

15-25

7-11.5

Obese

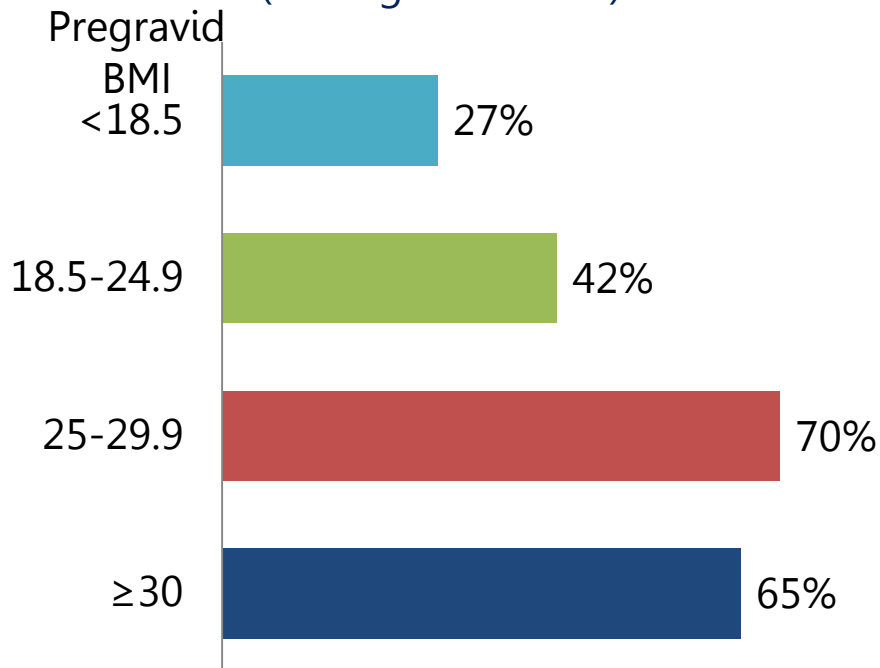
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Gestational weight gain

Prevalence of excessive gestational weight gain by pregravid BMI in U.S. births

(Truong et al. 2015)

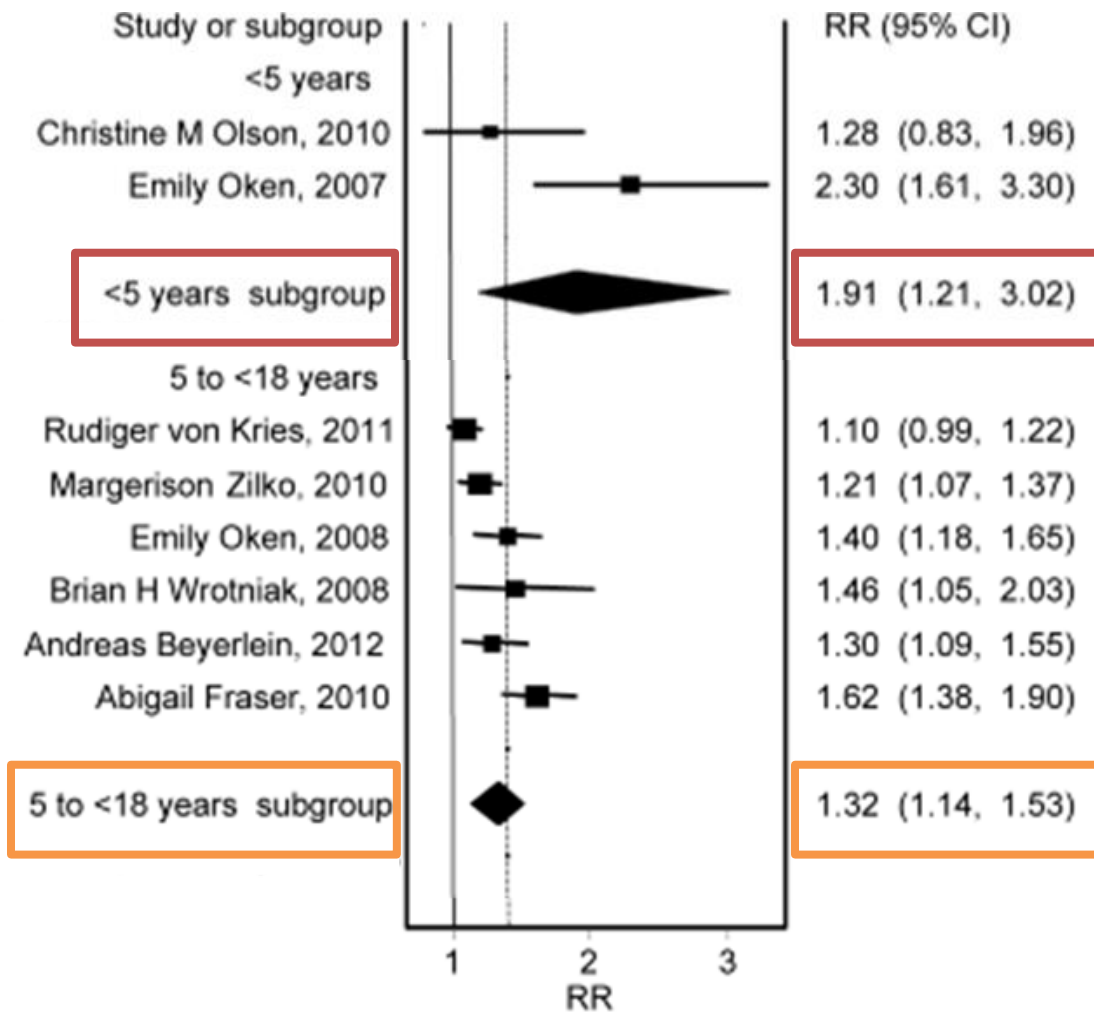


Oken et al. 2007

- n=1044 mother-child pairs at 3 years
- Per 5-kg increase in total pregnancy weight gain:
 - 0.13 (95% CI: 0.08, 0.19) unit increase in **BMI z-score**
 - 0.26 (0.02, 0.51) mm increase in **triceps skinfold thickness**
 - 0.60 (0.06, 1.13) mmHg increase in **systolic BP**

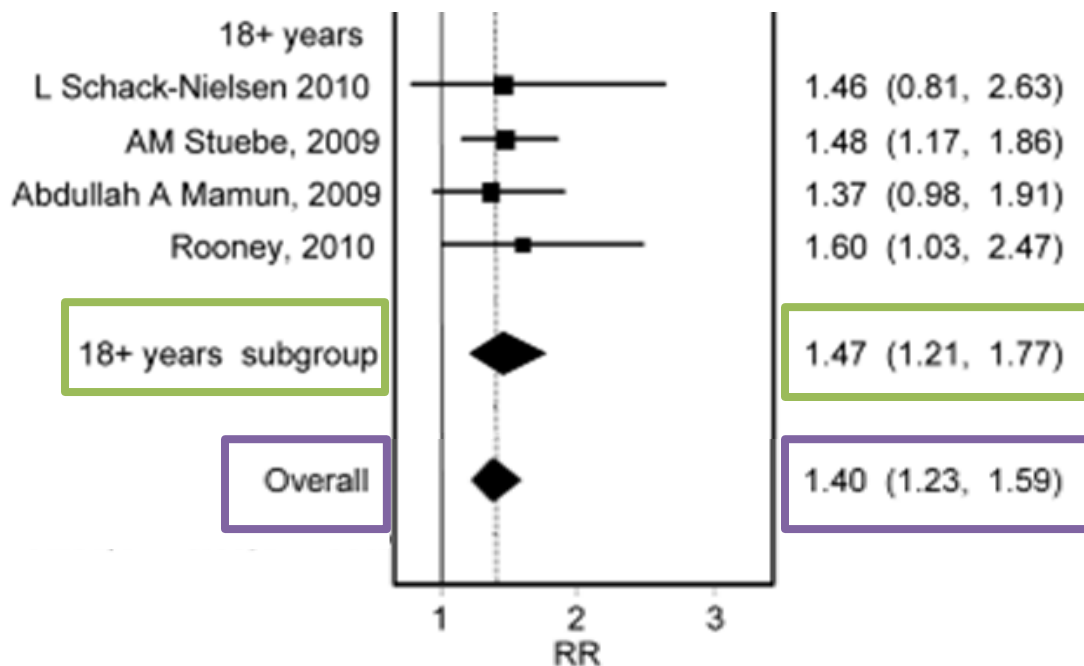
Gestational weight gain: association with child obesity

Mamun et al. 2013 meta-analysis of 12 studies

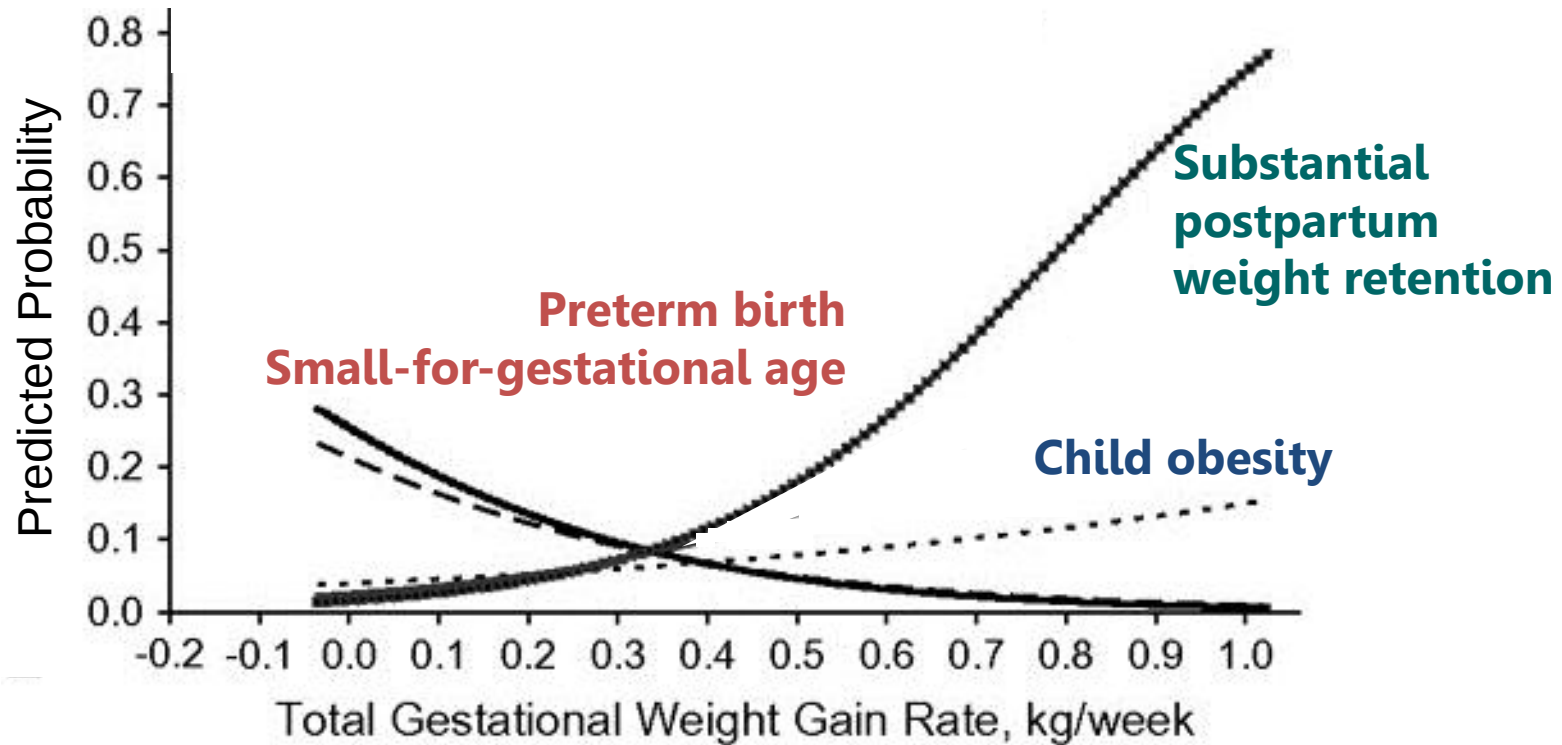


Gestational weight gain: association with child obesity

Mamun et al. 2013 meta-analysis of 12 studies

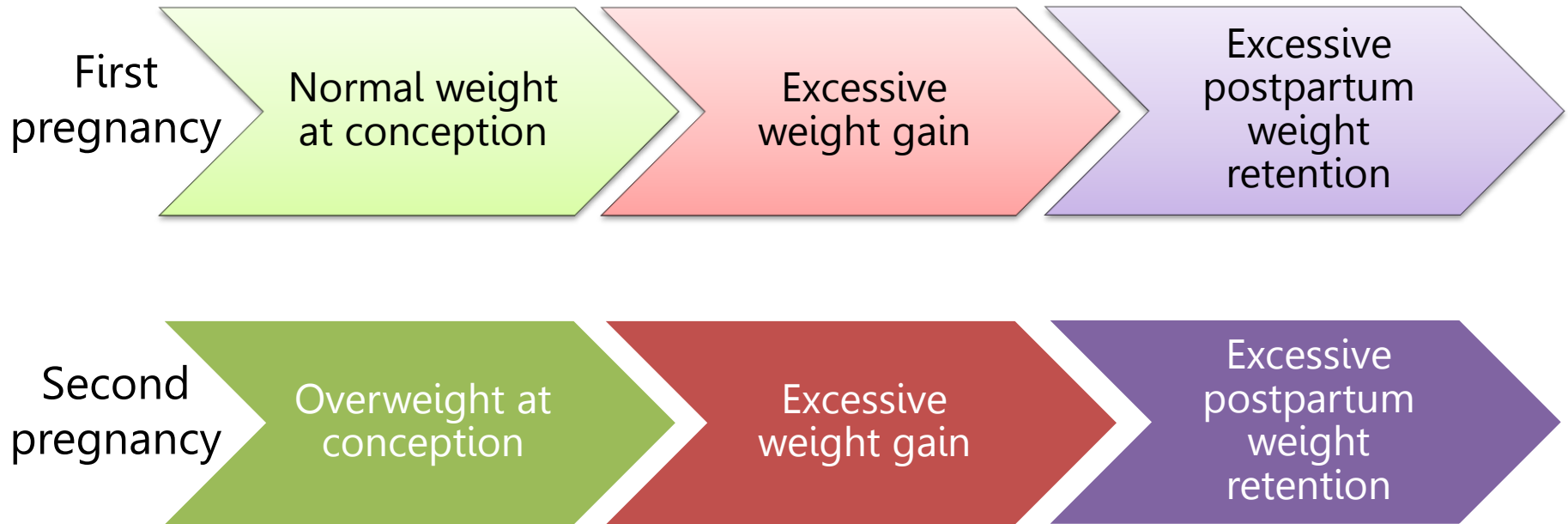


Gestational weight gain balancing act



Oken et al. 2009

The cycle of maternal obesity



Pérez-Escamilla & Kac 2013

Gestational weight gain: do interventions work?

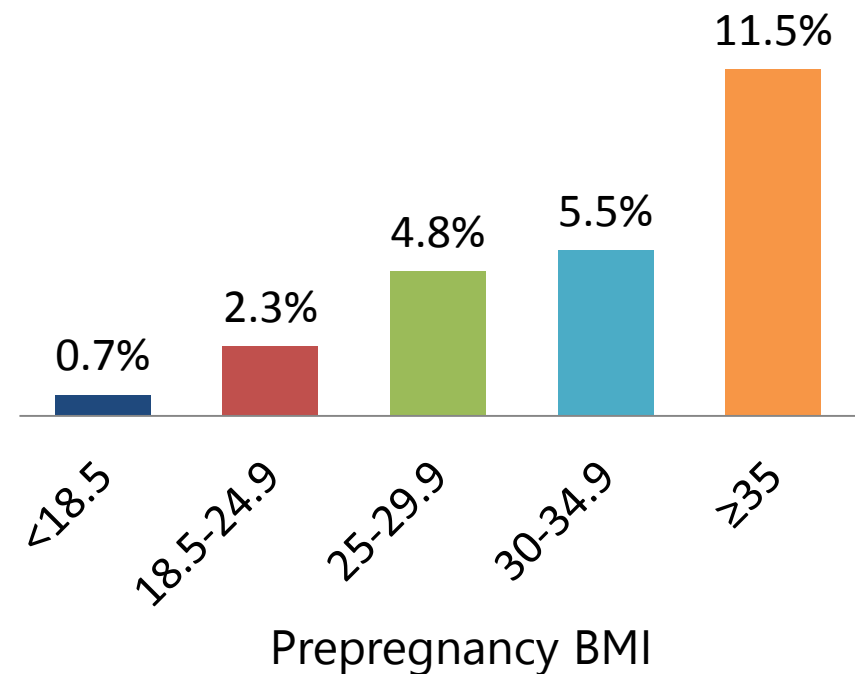
- Muktabhant et al. 2015, *Cochrane Database Syst Rev*
 - 49 RCTs involving 11,000+ women
 - Interventions: diet only, exercise only, and combined

	Average risk ratio (95% CI)
Excessive weight gain	0.80 (0.73, 0.87)
Infant macrosomia (BW >4000g)	0.93 (0.86, 1.02)
Among overweight, obese or at risk of GDM:	0.85 (0.73, 1.0)
Postpartum weight retention	0.78 (0.63, 0.97)
Childhood obesity	??

Gestational diabetes

- Incidence: 4-6%
- Associated with higher birth weight and greater fetal adiposity.
- Confounded by prepregnancy BMI

**Incidence of GDM by
pregravid BMI in U.S. births**
(Kim et al. 2010)

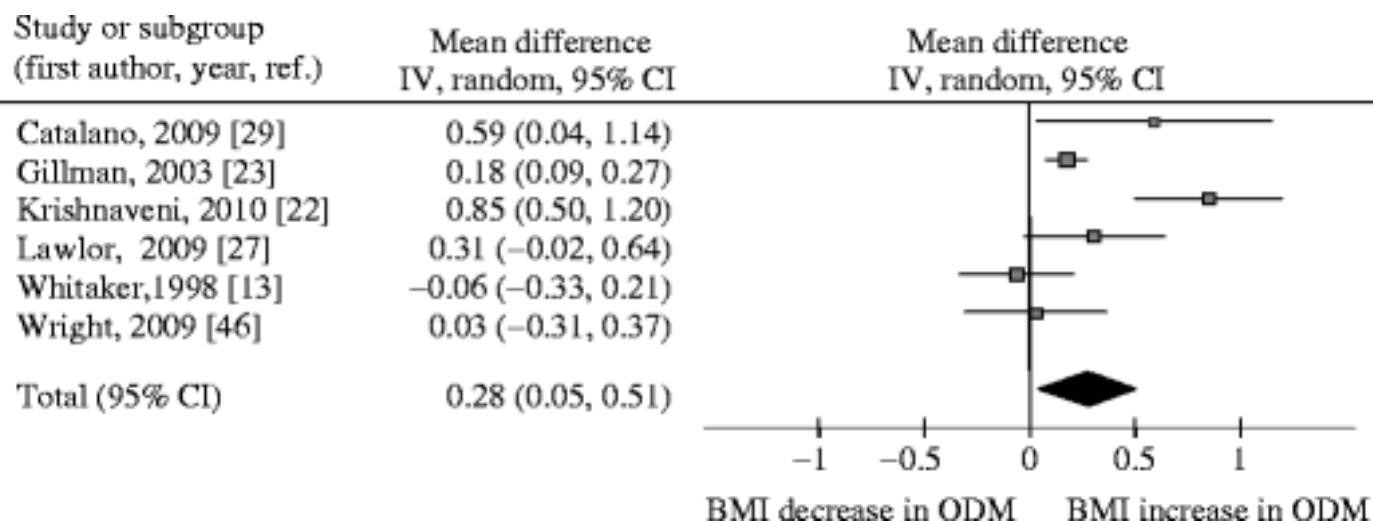


Gestational diabetes

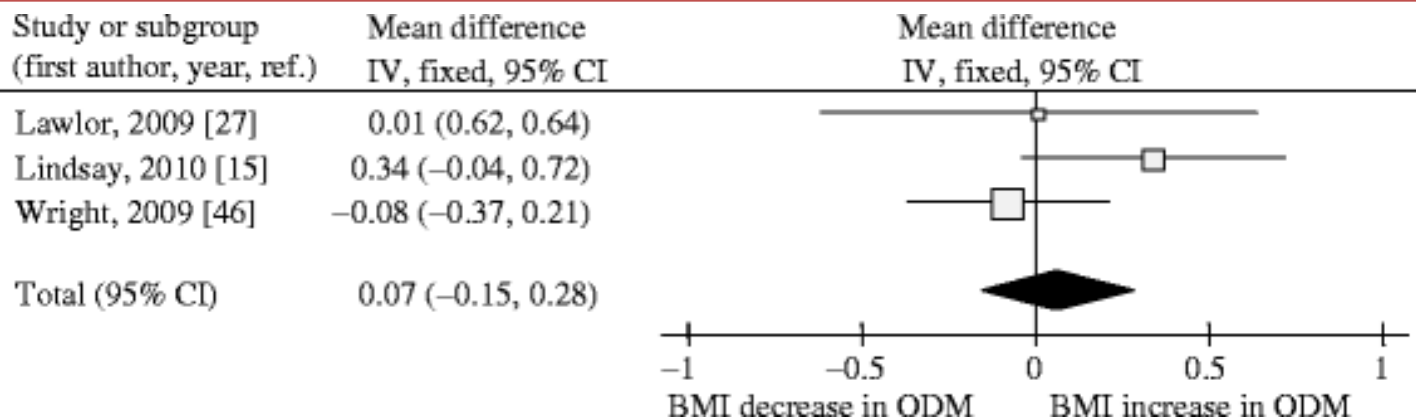
BMI difference by offspring exposure to GDM

Meta-analysis (Philipps et al. 2011)

Unadjusted



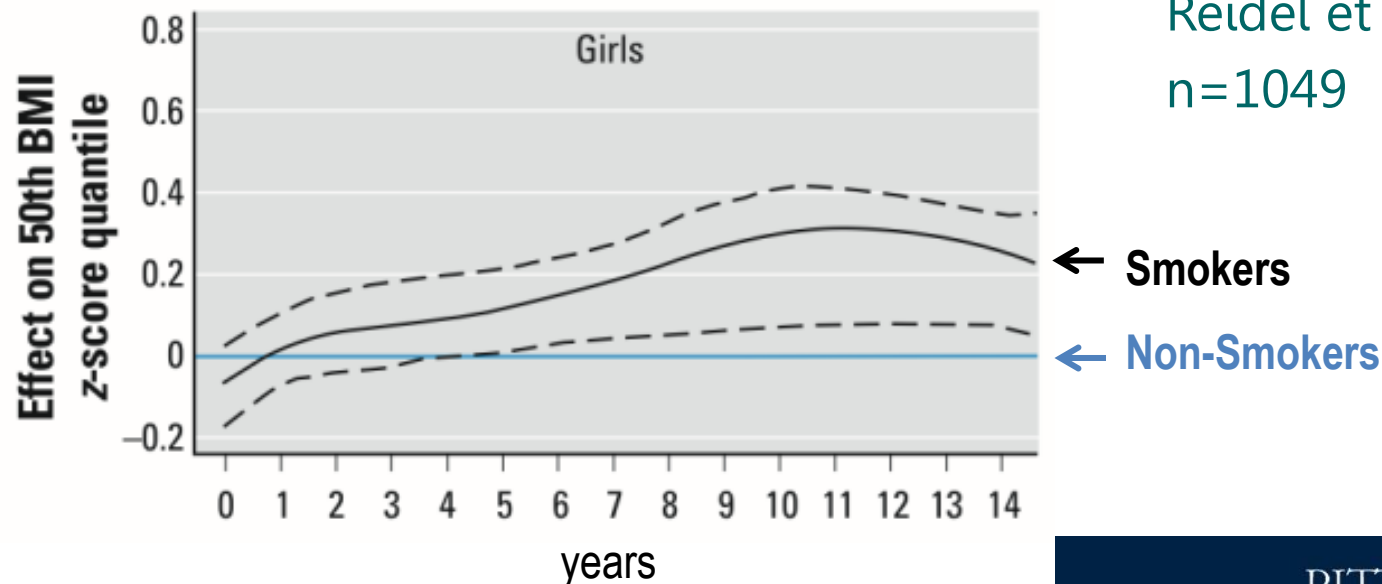
Prepregnancy BMI-adjusted



Smoking during pregnancy

- Meta-analyses of maternal smoking and child obesity
 - Oken et al. 2008: 14 studies of overweight at 3 to 33 years
 - Pooled adjusted OR (95% CI): 1.5 (1.4, 1.7)
 - Similar to Ino 2010.
- Longitudinal analysis of BMI z-score from birth to 14 yr

Reidel et al. 2014
n=1049



Ambient chemical exposure

- Secondhand smoke exposure during pregnancy
 - Increases risk of childhood obesity
 - After adjustment for in utero exposure (Griffiths et al. 2010, Raum et al. 2011, McConnell et al. 2015)

Knowledge gaps

- Other (more specific) nutrition markers
 - Maternal body composition / fat distribution
 - Dietary intake
 - Metabolic perturbations during pregnancy
- Do early-life nutrition & physical activity modify long-term risk?
- Other chemical insults

Symonds ME et al. 2013; Behl et al. 2013