



Macrosomia, gestational diabetes mellitus and early childhood obesity

findings from the Growing Up in Ireland Cohort
Study

Regien Biesma (RCSI),

Fiona Boland (RCSI) and Mark Ward (TCD)

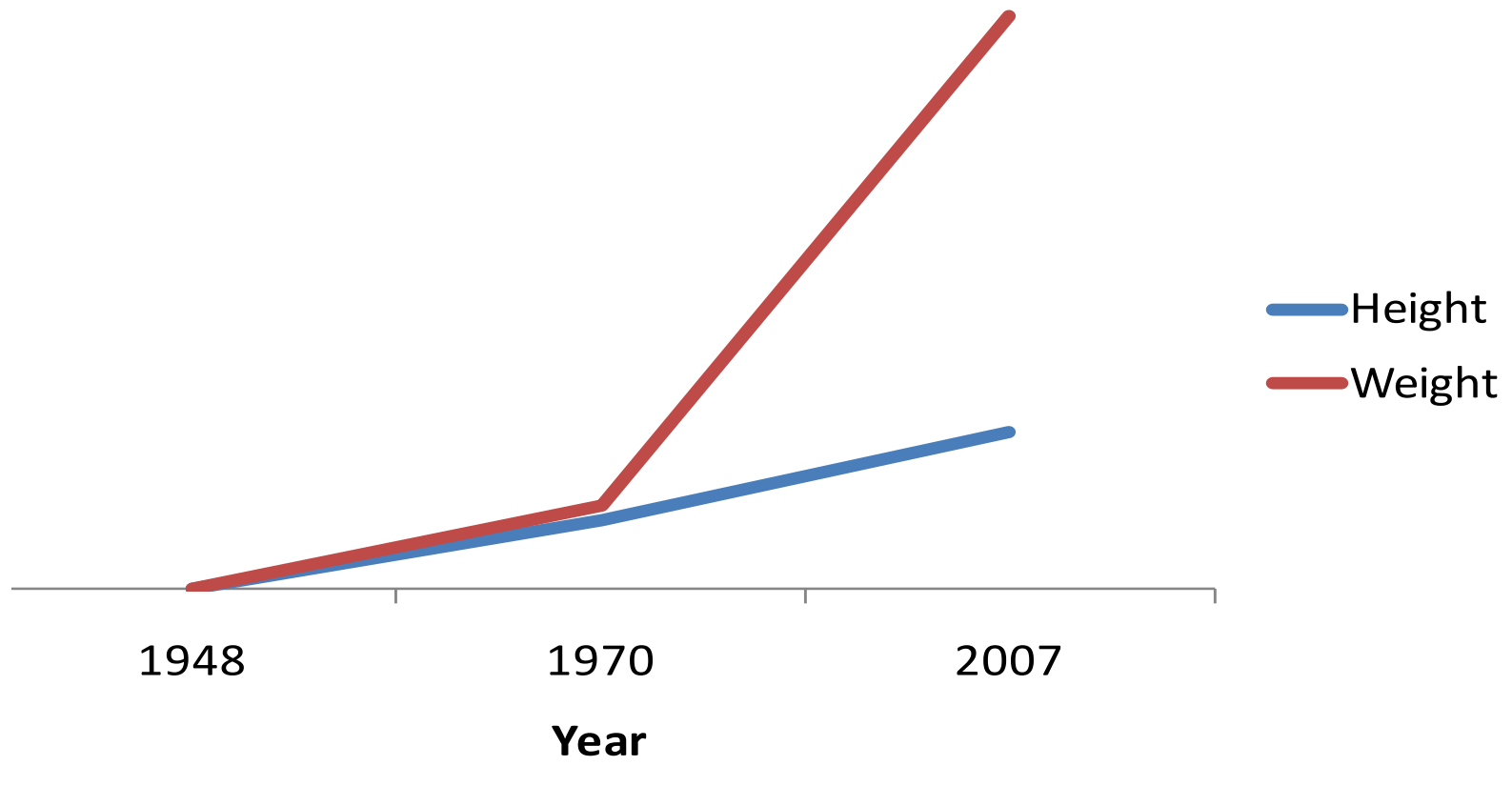
Ireland set to be most obese country in Europe, WHO says

Irish men at forefront of trend, leading an 'overweight' table of 53 countries





Increase in 9 year old children's height (cm) and weight (kg) in Ireland



Pathways to childhood obesity

1. Developmental mismatch
2. Maternal obesity and GDM



Prenatal environment, parental lifestyle and nutrition preconception

childhood adiposity and obesity

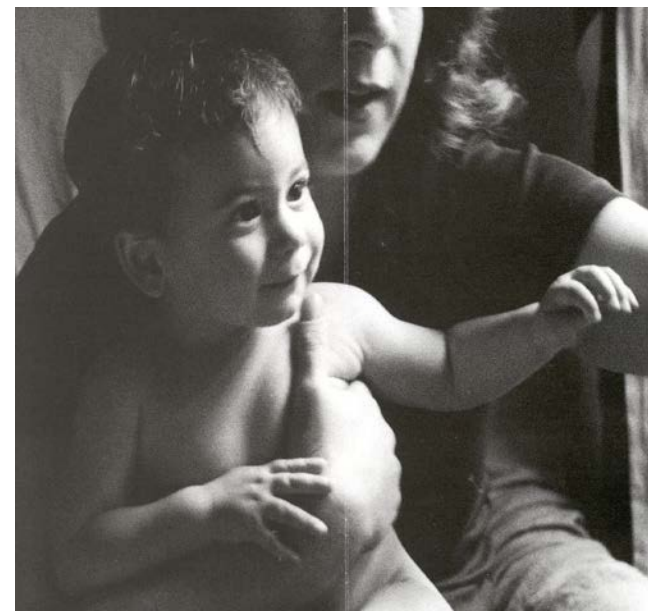
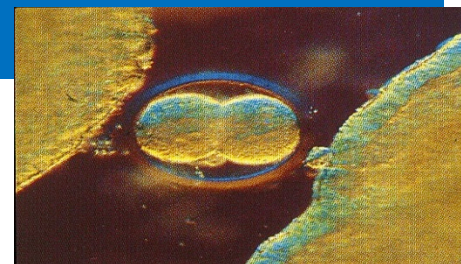
Obesity in adolescents and adults





1. Developmental mismatch

- Mother's body influences her child's development from moment of conception
- Her body composition, diet and lifestyle teach her baby about the world in which she lives



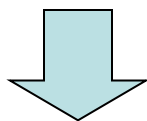
But what if his world turns out to be different?

Courtesy Mark Hanson

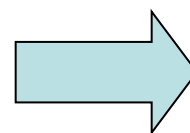


2. Maternal Obesity and Gestational Diabetes Mellitus

- Almost 50% women in UK of childbearing age are overweight or obese
- 16% of women are obese at the start of pregnancy (Heslehurst et al., 2010)
- Using IADPSG criteria **16% of women** develop GDM (previous estimate was 8%).
- **50% of such babies** result in macrosomic babies



Altered regulation of metabolic genes (epigenetic/environmental factors)



Obesity begets obesity





Growing up in Ireland (GUI)

- ***Growing Up in Ireland* is the national longitudinal study of children (infant cohort and child cohort).**
- **A nationally representative sample of infants born in the Republic of Ireland between December 1st 2007 and June 30th 2008:**
 - Baseline 9 months: 11,134 old infants
 - Follow up at 3 years: 8,407 children
- **Funded by the Department of Health & Children through the Office for the Minister for Children and Youth Affairs in association with the Department of Social and Family Affairs and the Central Statistics Office.**
- **Carried out by a consortium of researchers led by the Economic and Social Research Institute (ESRI) and Trinity College Dublin.**



Research questions:

- **What is the prevalence of childhood obesity, macrosomia and GDM in infants in Ireland?**
- **What is the association between macrosomia, GDM and early childhood obesity?**





Methods:

- Population-based cohort study
- 8,000 nine month old infants and their caregivers in Ireland and included 2 waves - 9 and 36 months.
- Ordered logit regression analysis to determine the association between macrosomia and childhood obesity in 3 year old children.
 - Anthropometric measurements in infants and parents
 - Survey questionnaire



Anthropometric indicators

- Birth weight – mothers recall at nine months
- Birth length – missing
- 9 months - Length and weight measured using a SECA 210 measuring mat and SECA 835 weight scale.
- 36 months - Length and weight measured using Leicester portable height stick and SECA 835 weight scale.
- Mothers – measured height and weight at 9 and 36 months.

Results: Prevalence of early childhood obesity, macrosomia and GDM

Table 1. Distribution of key indicators

	N	%
BMI classification at 3 years (IOTF)		
Healthy	6216	75.93
Overweight	1513	18.48
Obese	458	5.59
BMI classification at 3 years (WHO)		
Healthy	4629	56.54
Overweight	2194	26.8
Obese	1364	16.66
Macrosomia		
<= 4000 g	6991	83.16
>4000<= 4500 g	1073	12.76
>4500 g	343	4.08
GDM		
No GDM	8141	96.84
GDM	266	3.16
Weight for gestational age		
Missing	113	1.34
Small	557	6.63
Healthy	6579	78.26
Large	1158	13.77

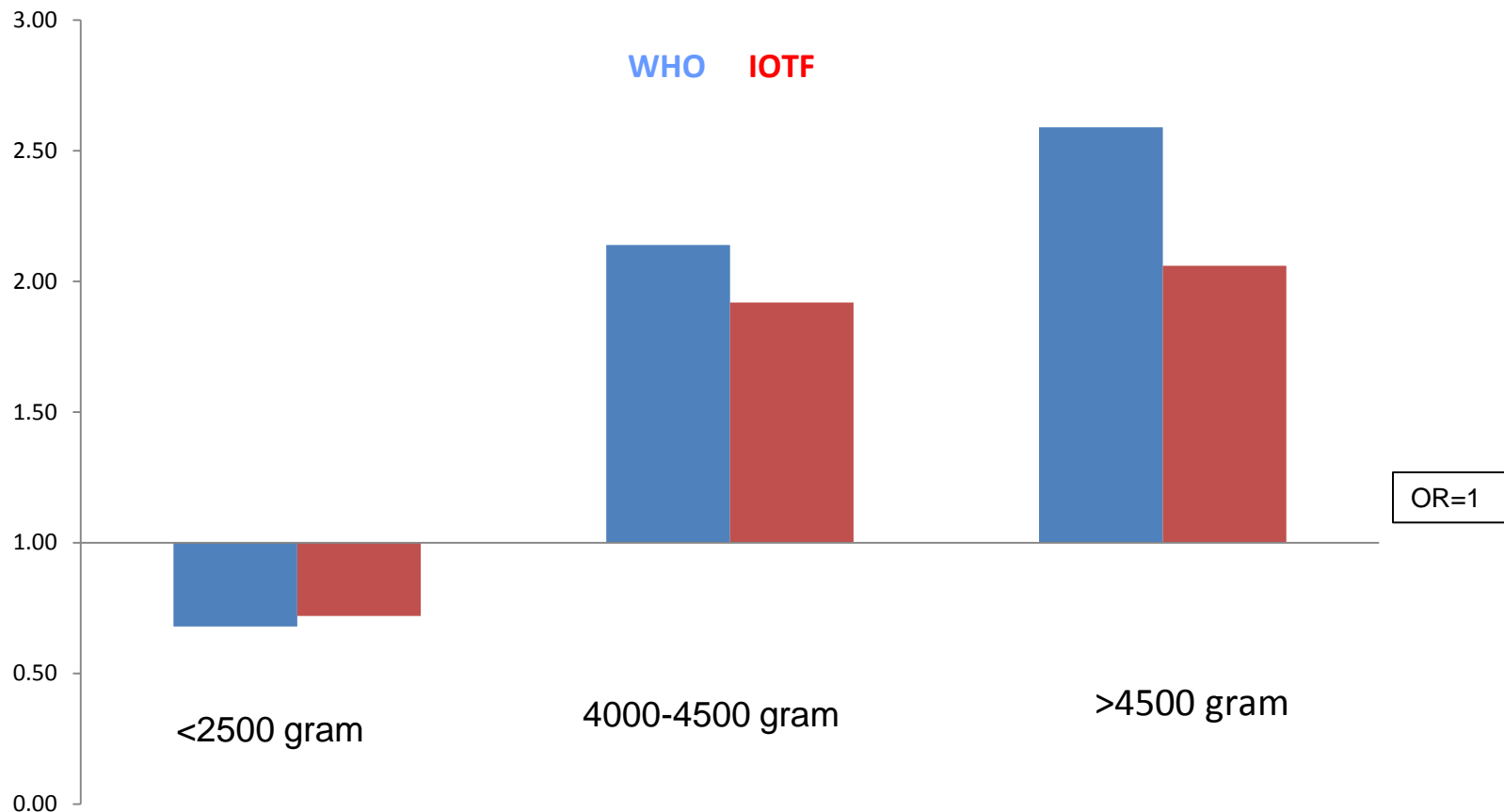


Association between macrosomia, maternal BMI and GDM

- **Children born to overweight or obese mothers**, as opposed to underweight or normal mothers, were more likely to be macrosomic ($\chi^2(12)=64.72$, $p<0.001$).
- Significant association between **gestational weight gain and macrosomia** ($\chi^2(9)=161.29$, $p<0.001$).
- No association between GDM and macrosomia ($p=0.327$).



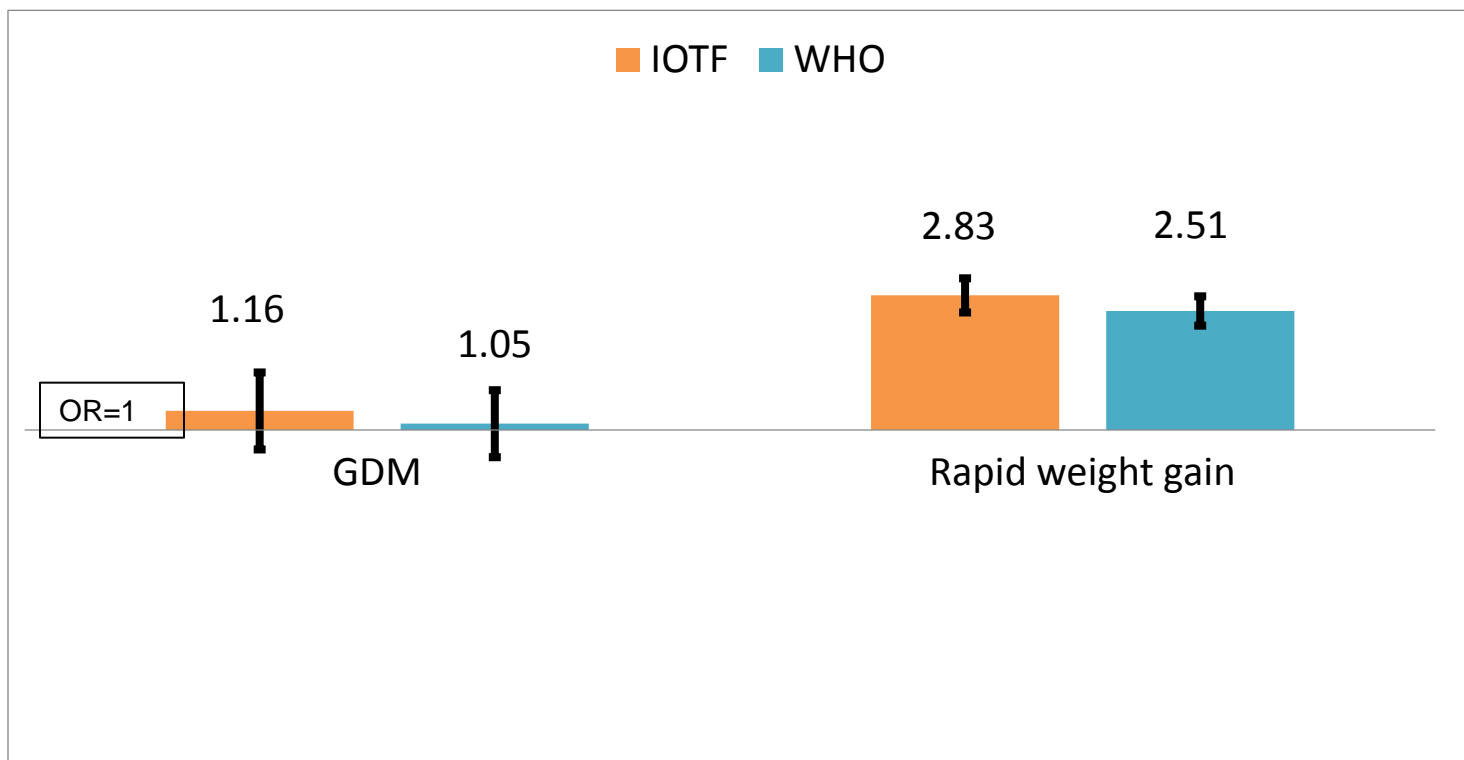
Macrosomia and Childhood obesity



Adjusted for gender, **parity**, gestational period, **gestational weight gain**, **rapid weight gain**, mothers age, GDM, **maternal and paternal BMI**, duration breastfeeding, intro solid food, **smoking**, hours slept, maternal education, social class, income and ethnicity



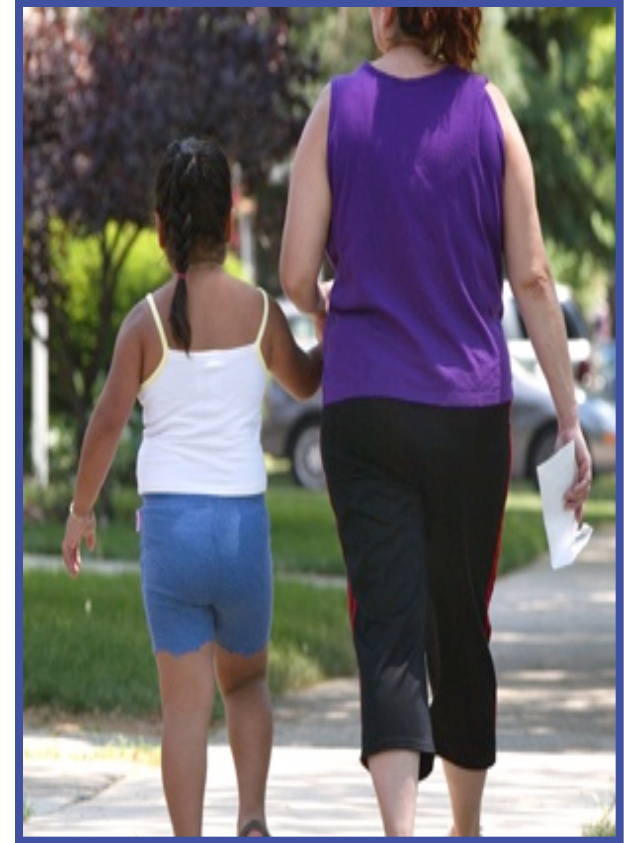
GDM, rapid weight gain and childhood obesity



Adjusted for gender, **parity**, **macrosomia**, gestational period, **gestational weight gain**, mothers age, GDM, **maternal and paternal BMI**, duration breastfeeding, intro solid food, **smoking**, hours slept, maternal education, social class, income and ethnicity

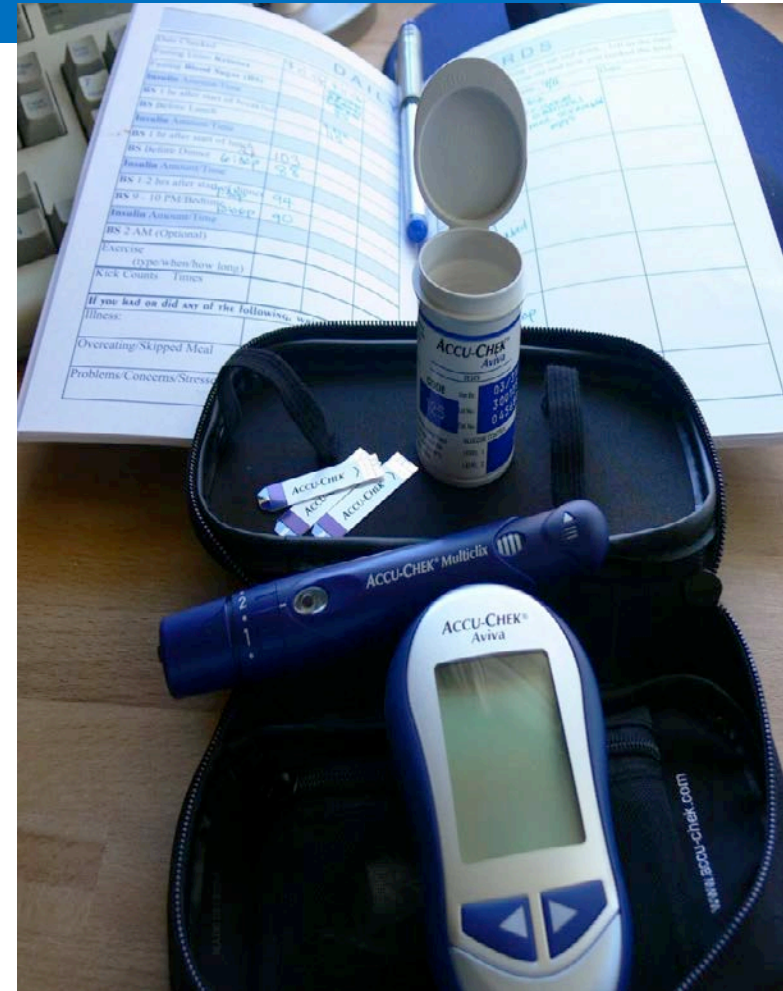
Discussion

- Our finding that **macrosomia**, in the absence of maternal gestational diabetes, **is a strong predictor of childhood obesity** is consistent with other studies.
- Similar to other studies we also find that the majority of **macrosomia** occurs in **obese women** and women with **high gestational weight gain**



(Controlled) GDM and childhood obesity?

- **GDM** not associated with the odds of **macrosomia at birth or obesity at the age of 3**
 - conflicting with many studies that found a strong link between GDM, macrosomia and childhood obesity
- Emerging evidence suggest that **lesser degrees of maternal hyperglycemia** (uncontrolled), not necessarily GDM (controlled), increases the risk of childhood obesity

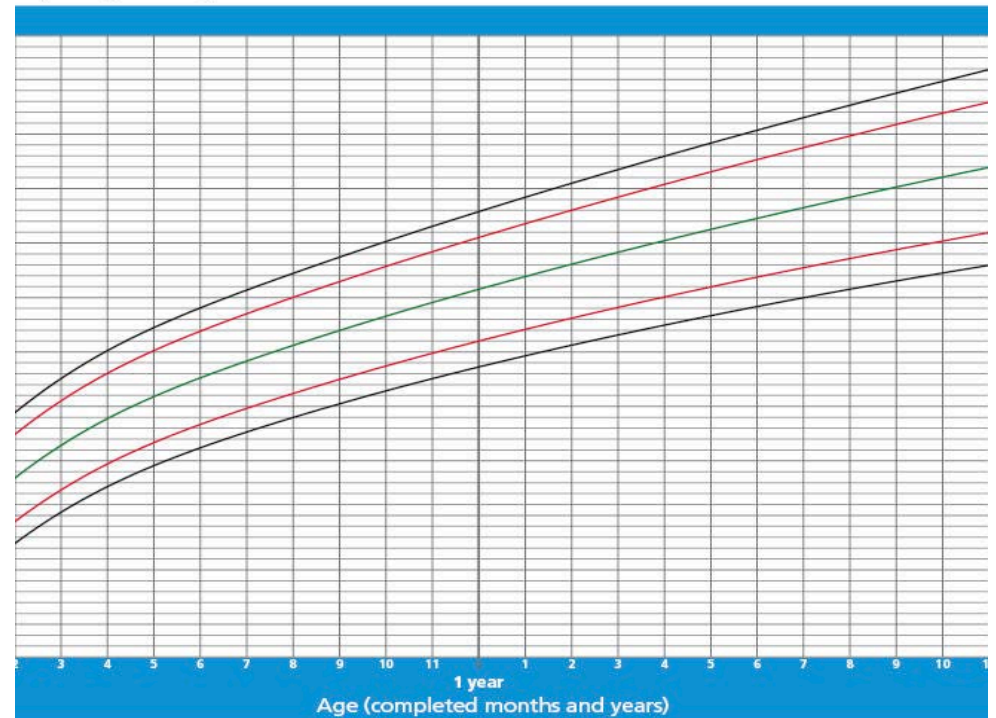


Rapid weight gain

- **GUI data suggests that accelerated postnatal weight gain most important predictor of early childhood obesity**
 - This suggest trajectories are important
 - Link with rapid growth in utero?
 - Can infant feeding choices modulate later obesity risk?
 - Exclusive breast feeding
 - Late introduction of solids and sugary drinks
 - Some evidence suggest that feeding formula with reduced protein content normalizes early growth (Koletzko et al (2009))

gth-for-age BOYS

2 years (z-scores)





Major limitation of comparing data

Differences in the definitions used, diagnostic cut-off points and screening strategies

- **Childhood obesity** (WHO, IOTF and national reference standards)
 - IOTF: 24% prevalence; WHO: 43.5% prevalence
- **Macrosomia**
 - Absolute birthweight (> 4 kg; >4.2 kg; >4.5 kg; or >5 kg)
 - Growth centiles for gestational age above the 90th centile, 95th or 97th percentile
- **GDM**
 - WHO: 3% GDM; IADSPG criteria: 12% GDM
 - Until 2008 no national guidelines for screening of GDM in Ireland
 - Differences in pre-analytical sample handling of glucose measurements (Daly et al. (2015))

What can you do?

Macrosomia and GDM are modifiable risk factors for childhood obesity:

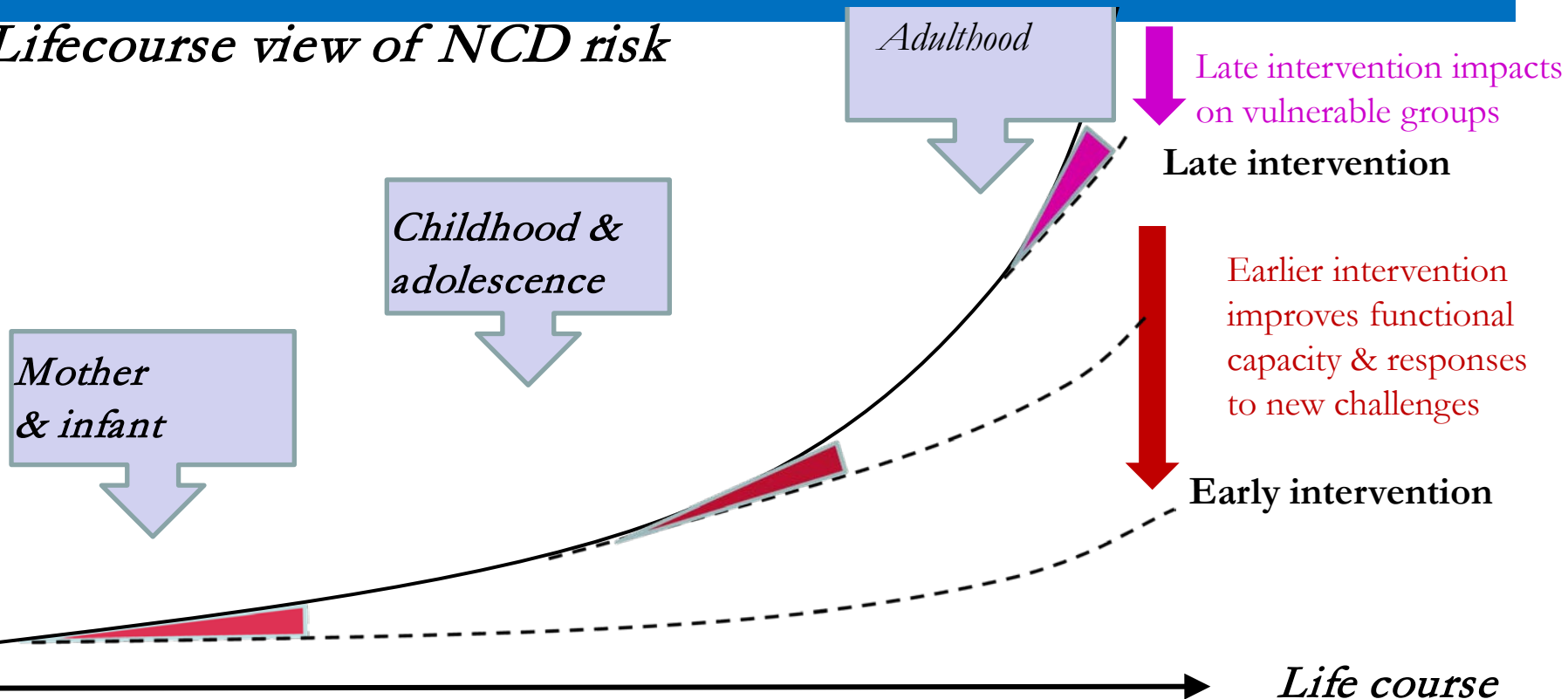
1. **Pre-conception** BMI and lifestyle of prospective parents
2. **Pregnancy:** early prediction of macrosomia and screening of GDM
3. Watch out for **accelerated postnatal growth**
4. **Interpregnancy phase:** promote postpartum weight loss





Early intervention can have a lifelong impact

Lifecourse view of NCD risk



Plasticity

Inadequate response to new challenges



Conclusion

- **Macrosomia is an independent risk factor of early childhood obesity**
- Public health strategies **early in life** are key to prevent early childhood obesity
- The high prevalence of macrosomia may be indicative of **undiagnosed GDM in Ireland**
 - 2010 consensus WHO/IADPSG guidelines for GDM and selective screening in Ireland

Acknowledgements



- Growing up In Ireland study team, in particular the Economic & Social Research Institute (ESRI) and Trinity College Dublin (TCD)
- Prof Michael Turner (UCD/ Coombe Women and Infants Hospital)