

Introduction: What are the Big Questions

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**Obesity and Pregnancy
World Obesity Federation
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London, UK**

Conflict of Interest

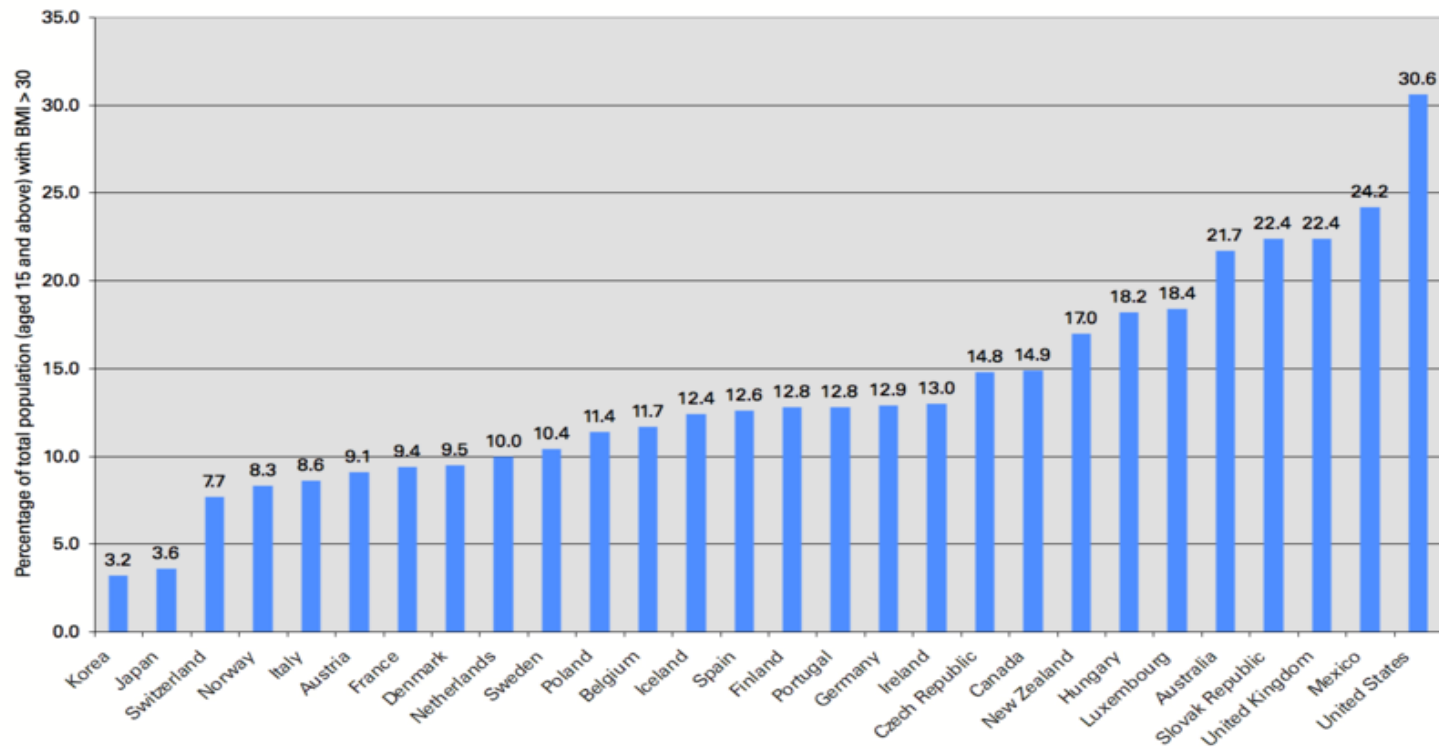
**I have no conflicts of interests relating to
this presentation**

Maternal

Prevalence of Obesity by Race/Ethnicity in Women of Reproductive Age

	All Race/ Ethnicity Groups	Non- Hispanic White	Non- Hispanic Black	Hispanic	Mexican American
Body Mass Index ≥ 30					
20-39y	31.9 (28.6-35.5)	26.9 (23.0-31.3)	56.2 (44.3-67.5)	34.4 (30.9-38.2)	37.8 (33.2-42.7)
Body Mass Index ≥ 25					
20-39y	55.8 (49.6-61.9)	50.7 (43.1-58.2)	74.2 (65.9-81.1)	65.4 (59.9-70.5)	68.8 (62.1-74.8)

Worldwide Prevalence of Obesity

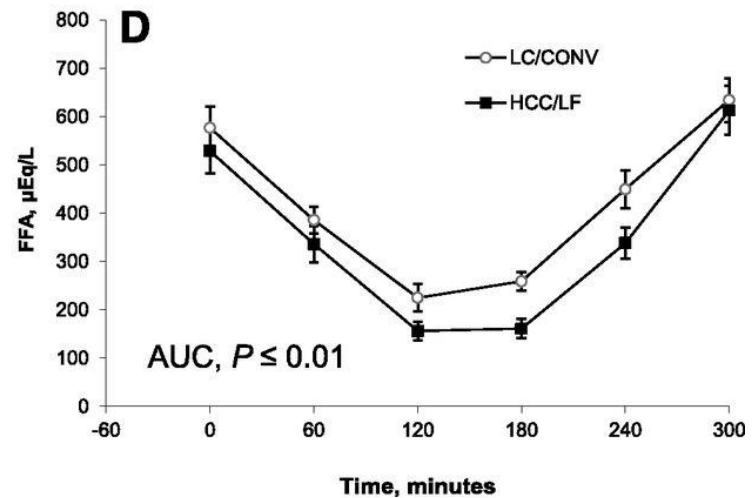
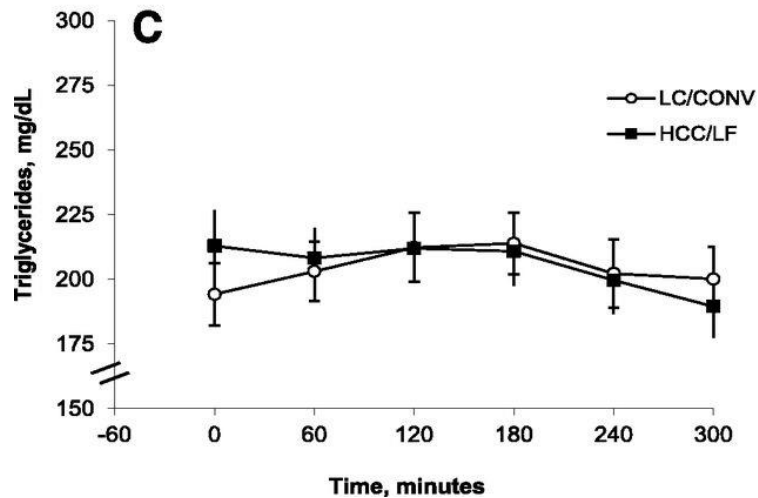
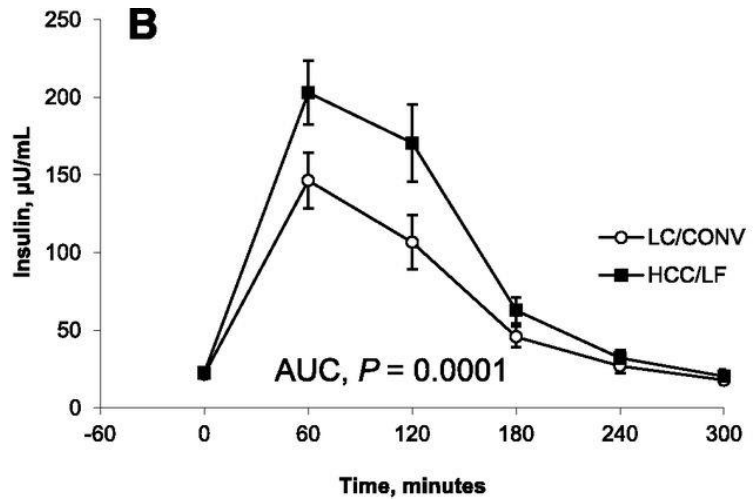
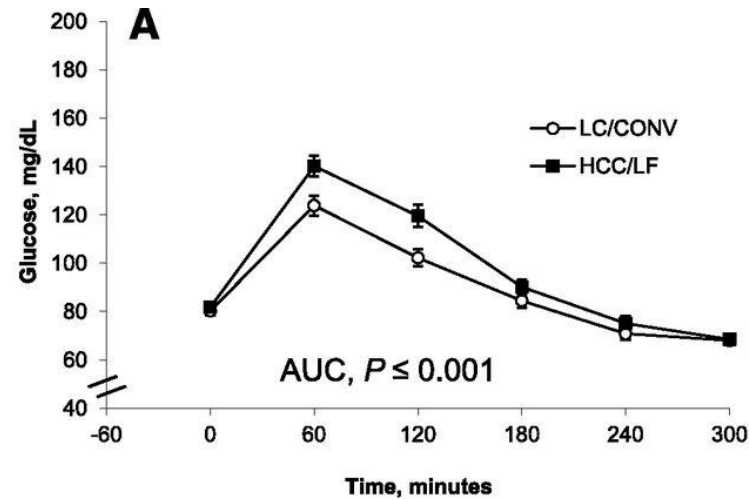


**Is There a Best Nutritional
Recommendation/Gestational Weight
Gain in Pregnancy for Obese Women ?**

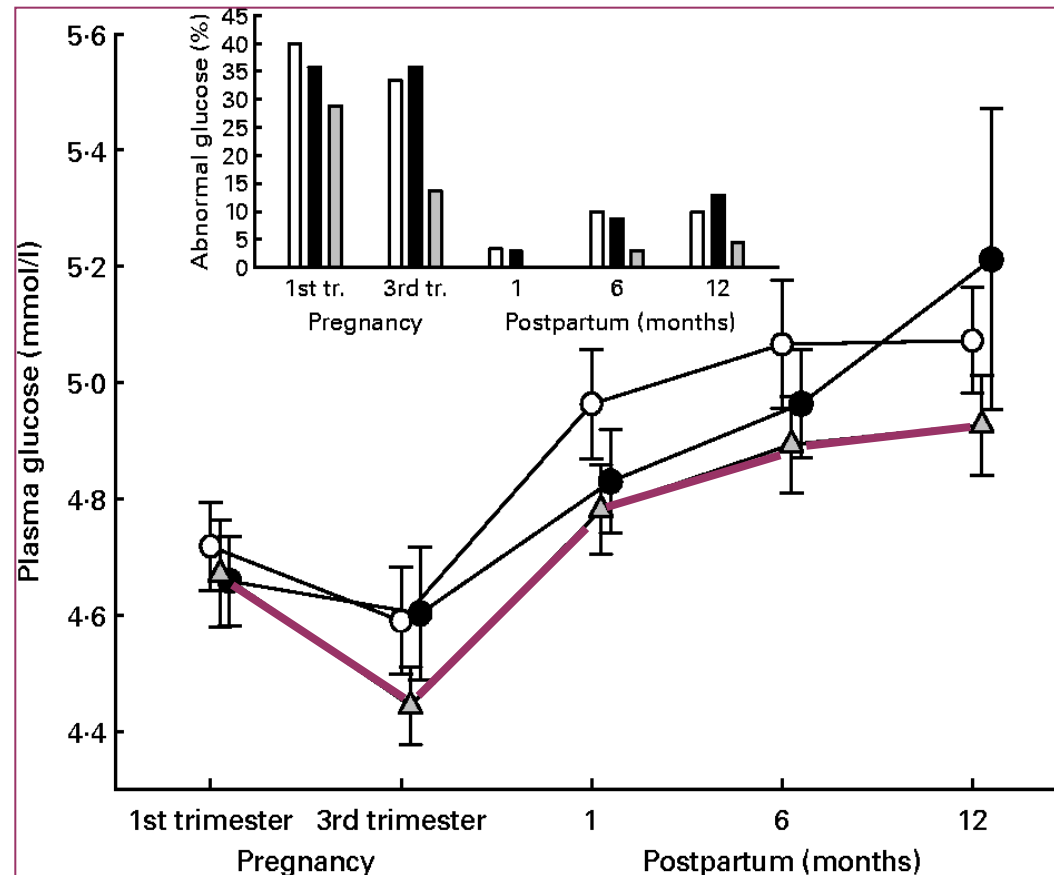
ROLO Study

Outcome	Intervention group (n=372)	Control group (n=387)	P value
Birth weight (g)	4034 (510)	4006 (497)	0.449
Birth weight centile	70.5 (25.6)	72.8 (25.6)	0.409
No (%) birth weight > 4000g	189 (51)	199 (51)	0.88
Length at birth (cm)	52.9 (2.7)	52.6 (2.1)	0.189
Head circumference at birth (cm)	35.8 (1.3)	35.7 (1.5)	0.985
Ponderal index at birth	2.76 (3.8)	2.75 (0.33)	0.95
Birthweight difference from first pregnancy (g)	-214.2 (541)	-250.8 (512)	0.507

Five-hour Postprandial Response to Breakfast: Low CHO/Conventional versus High Complex CHO/Low Fat Diet



Maternal Plasma Glucose on Probiotic Diet



**Do the 2009 IOM Gestational Weight
Guidelines Need to be Revised Based on
Current Literature?**

Obligatory Components of Weight Gain

	Water	Protein
• Fetus	2,400	420
• Placenta	500	100
• Amniotic fluid	500	-
• Uterus	800	170
• Breast	300	80
• Maternal blood	1,300	140
• Extracellular fluid	1,500	-
total:	7,000 - 8,000 g	900 - 1,000 g

Variable Components of Weight Gain

CHO	Lipids	Total
NIL	variable 0 – 6,000 g	<u>±</u> 9,000g

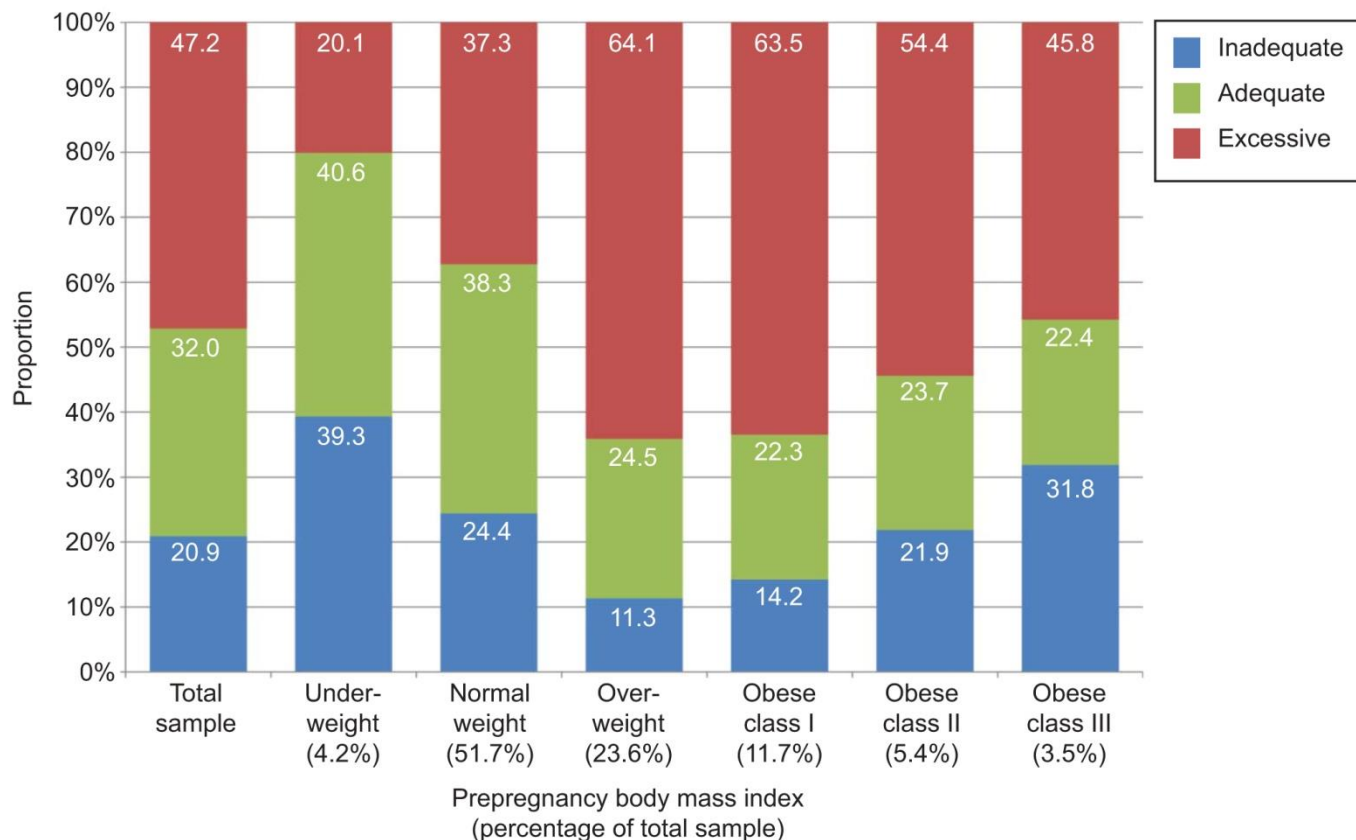
IOM 2009 GWG Recommendations

Pre-pregnancy BMI category	Total weight gain (lb, kg)	Rate of weight gain 2 nd and 3 rd trimester (lb/wk, kg/wk)
Underweight (< 18.5 kg/m ²)	28-40 , 12.5-18	1.0 (1.0-1.3), 0.51 (0.44-0.58)
Normal-weight (18.5-24.9 kg/m ²)	25-35 , 11.5-16	1.0 (0.8-1.0), 0.42 (0.35-0.50)
Overweight (25.0-29.9 kg/m ²)	15-25 , 7-11.5	0.6 (0.5-0.7), 0.28 (0.23-0.33)
Obese** (≥ 30.0 kg/m ²)	11-20 , 5-9	0.5 (0.4-0.6), 0.22 (0.17-0.27)

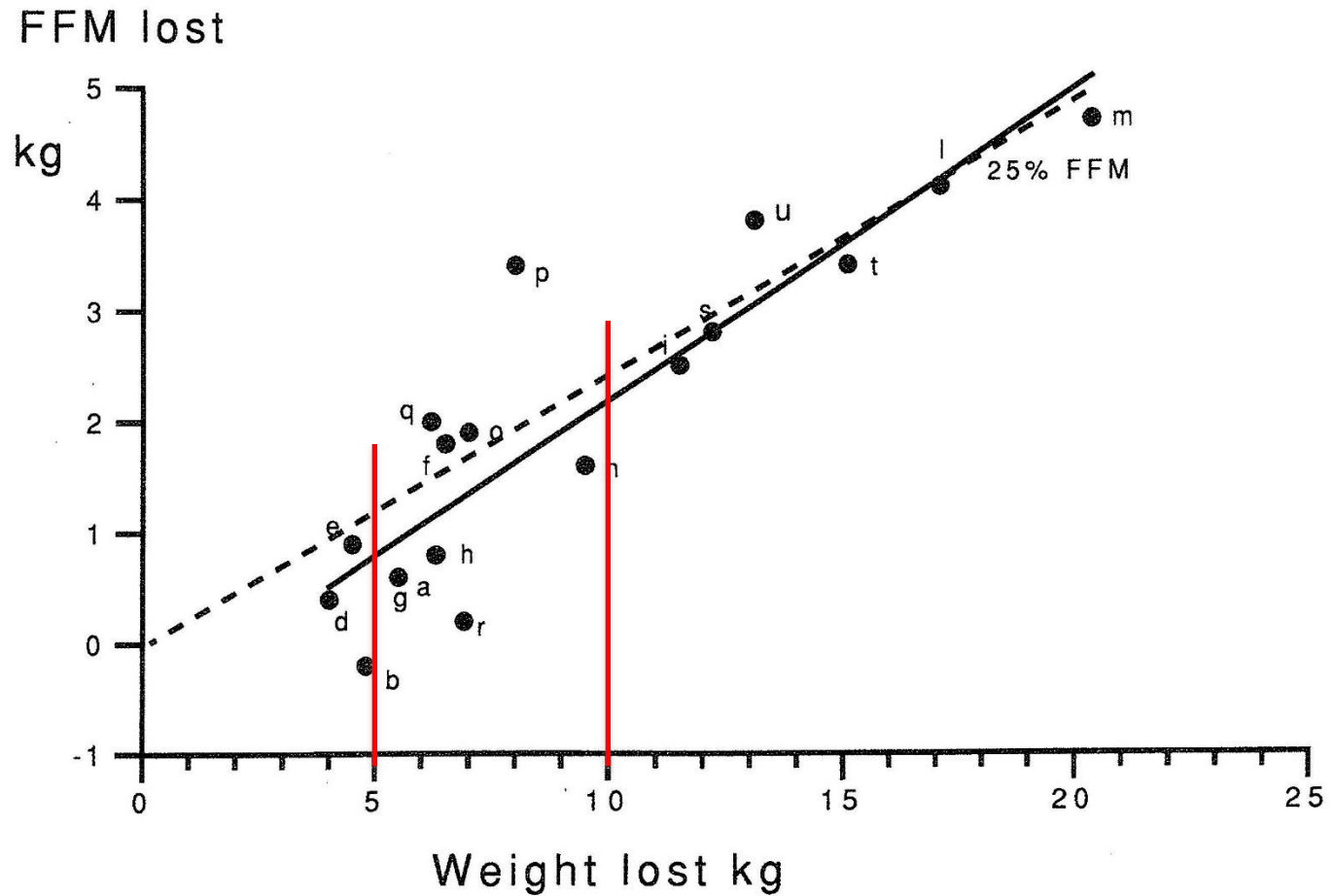
*Calculations assume a first-trimester weight gain of 1.1-4.4 lb (0.5-2.0 kg)

** 1990 IOM Recommendation: for obese women (BMI>29), weight gain at least 6.8 kg (15 lb)

Prevalence of GWG Adequacy by Pre-Pregnancy BMI



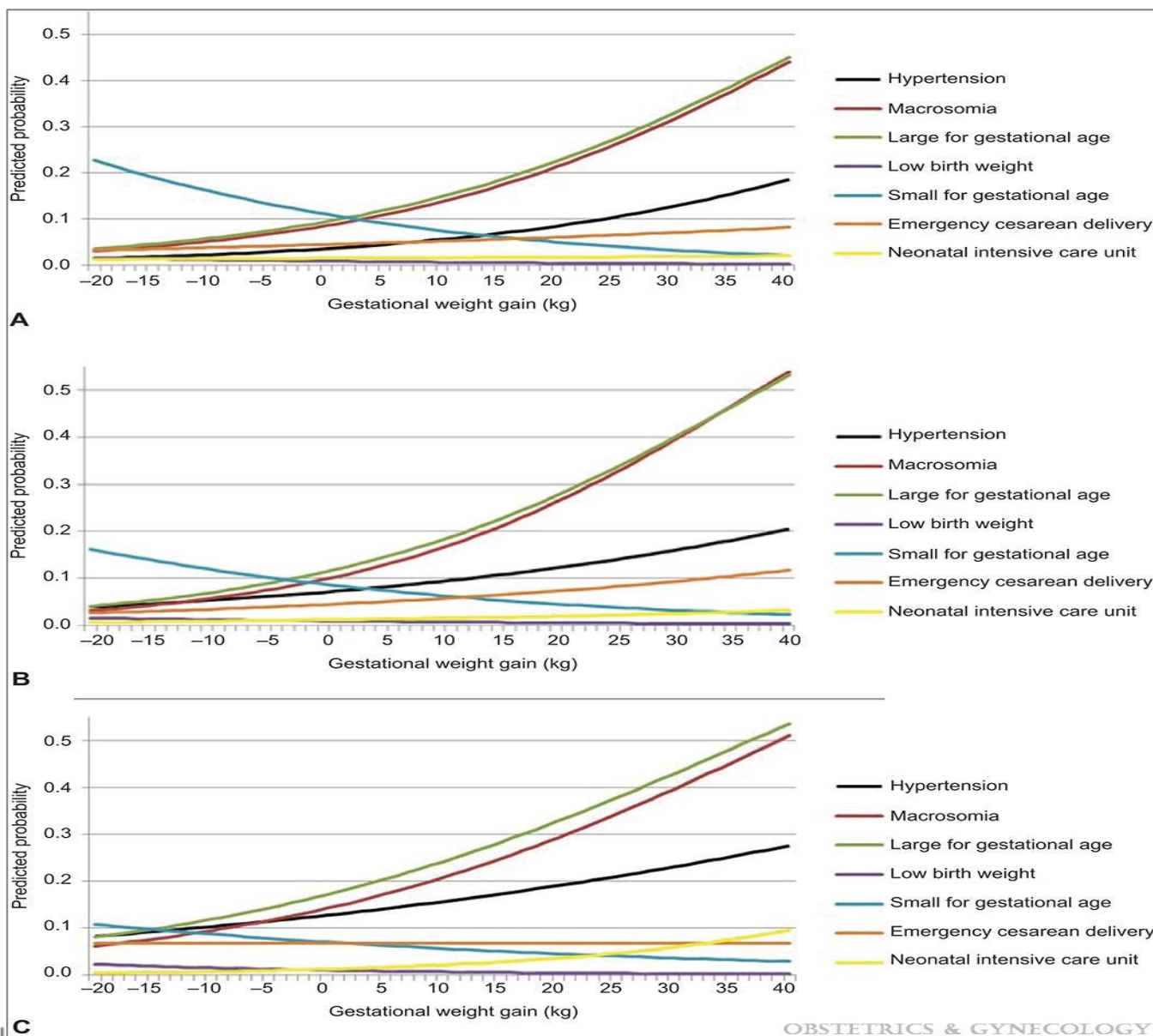
Effect of Weight Loss on Fat Free Mass



Neonatal Measures

	Gestational weight gain > 5 kg (n=1053)	Gestational weight gain ≤ 5 kg (n=188)	p-value
Gestational age (weeks)	38.9 ± 1.4	38.8 ± 1.4	0.28
Gender (%)			0.32
Male	540 (51.3)	89 (47.3)	
Female	513 (48.7)	99 (52.7)	
Birth weight (g)	3466.8 ± 491.5	3258.4 ± 442.7	< 0.0001
Length (cm)	50.0 ± 2.8	49.3 ± 2.3	0.001
Head circumference (cm)	34.5 ± 1.7	34.2 ± 1.7	0.02
Lean mass (g)	2995.4 ± 346.9	2855.1 ± 321.0	< 0.0001
Fat mass (g)	471.4 ± 192.7	403.4 ± 175.3	< 0.0001
Body fat (%)	13.2 ± 4.3	12.0 ± 4.2	0.0006
LGA	139 (13.2%)	14 (7.5%)	0.03
SGA	51 (4.9%)	18 (9.6%)	0.009

Weight Loss in Obese Pregnant Women: Risk for Adverse Pregnancy Outcomes



RESEARCH ARTICLE

Weight Loss Instead of Weight Gain within the Guidelines in Obese Women during Pregnancy: A Systematic Review and Meta-Analyses of Maternal and Infant Outcomes

Mufiza Zia Kapadia^{1‡}, Christina K. Park^{2‡}, Joseph Beyene², Lucy Giglia³, Cindy Maxwell⁴, Sarah D. McDonald^{2,5,6*}

Conclusion

Despite decreased odds of LGA, increased odds of SGA and a lack of information on pre-term birth indicate that GWL should not be advocated in general for obese women.

Lifestyle Interventions in Pregnancy, What are the Benefits?

Antenatal lifestyle advice for women who are overweight or obese: LIMIT randomised trial



OPEN ACCESS

Jodie M Dodd *professor of obstetrics and gynaecology; maternal fetal medicine specialist*^{1,2}, Deborah Turnbull *professor of psychology*³, Andrew J McPhee *director of neonatal medicine*⁴, Andrea R Deussen *senior clinical trials coordinator*¹, Rosalie M Grivell *senior lecturer in obstetrics and gynaecology; maternal fetal medicine specialist*^{1,2}, Lisa N Yelland *senior statistician*¹, Caroline A Crowther *professor of obstetrics and gynaecology*¹, Gary Wittert *professor medicine*⁵, Julie A Owens *head of school paediatrics and reproductive health; associate dean, research*¹, Jeffrey S Robinson *professor of obstetrics and gynaecology*¹, for the LIMIT Randomised Trial Group

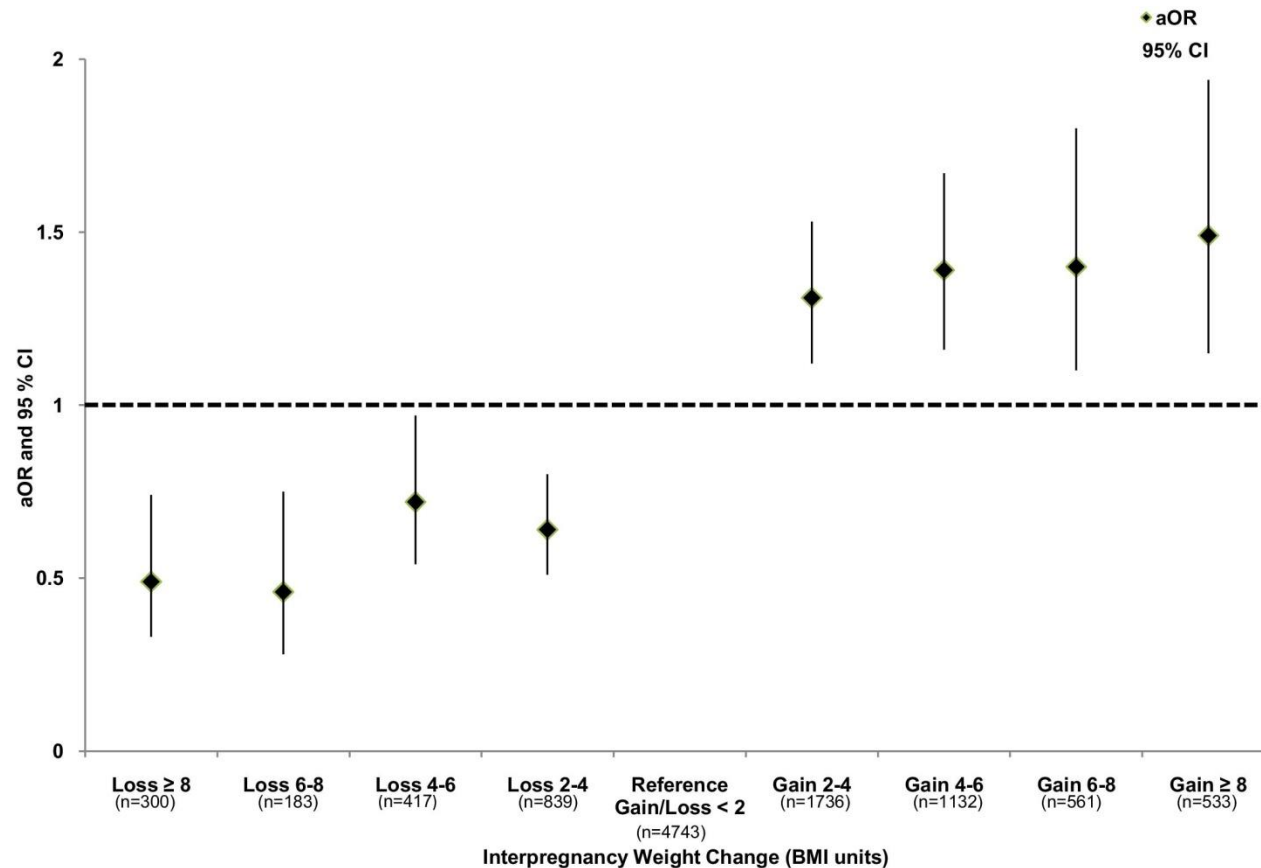
For women who were overweight or obese, the antenatal lifestyle advice used in this study did not reduce the risk delivering a baby weighing above the 90th centile for gestational age and sex or improve maternal pregnancy and birth outcomes.

Effect of a behavioural intervention in obese pregnant women (the UPBEAT study): a multicentre, randomised controlled trial

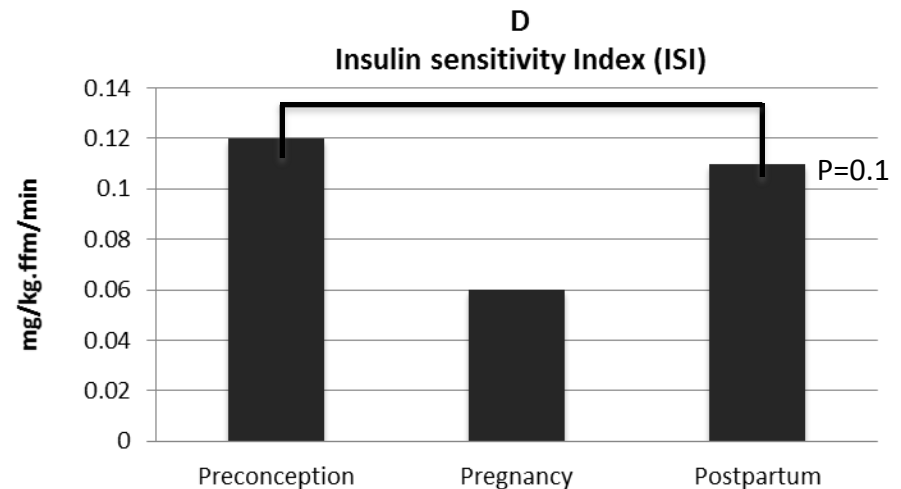
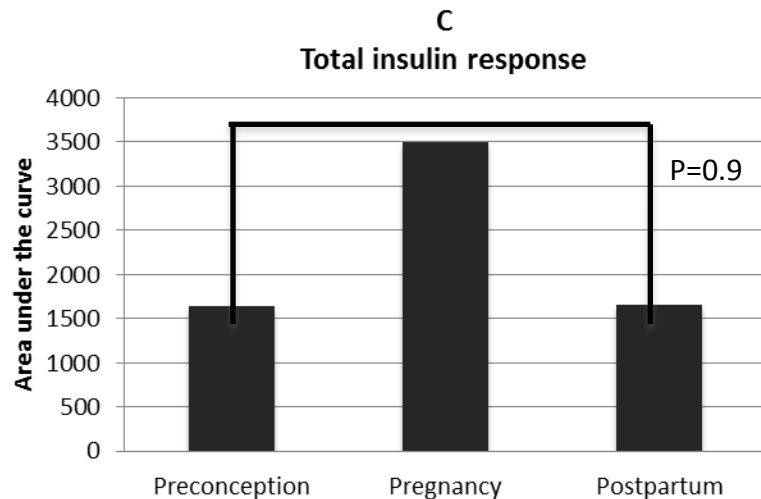
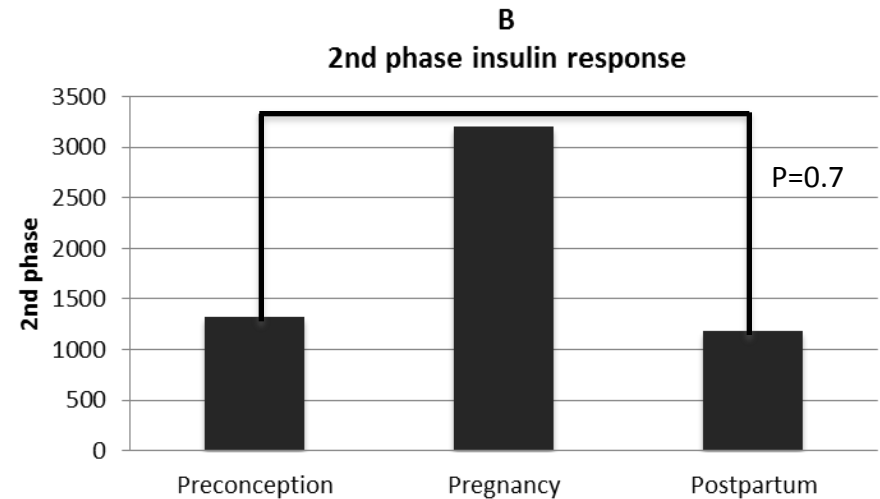
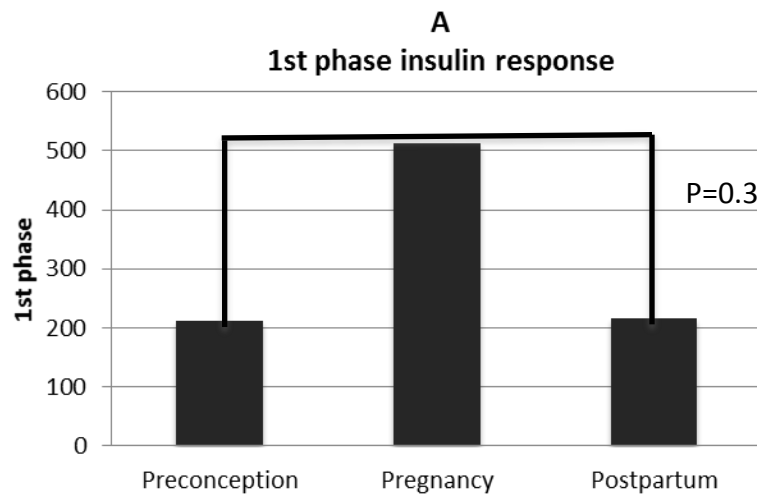
*Lucilla Poston, Ruth Bell, Helen Croker, Angela C Flynn, Keith M Godfrey, Louise Goff, Louise Hayes, Nina Khazaezadeh, Scott M Nelson, Eugene Oteng-Ntim, Dharmintra Pasupathy, Nashita Patel, Stephen C Robson, Jane Sandall, Thomas A B Sanders, Naveed Sattar, Paul T Seed, Jane Wardle, Melissa K Whitworth, Annette L Briley, on behalf of The UPBEAT Trial Consortium**

Interpretation: A behavioural intervention addressing diet and physical activity in women with obesity during pregnancy is not adequate to prevent gestational diabetes, or to reduce the incidence of large-for-gestational-age infants.

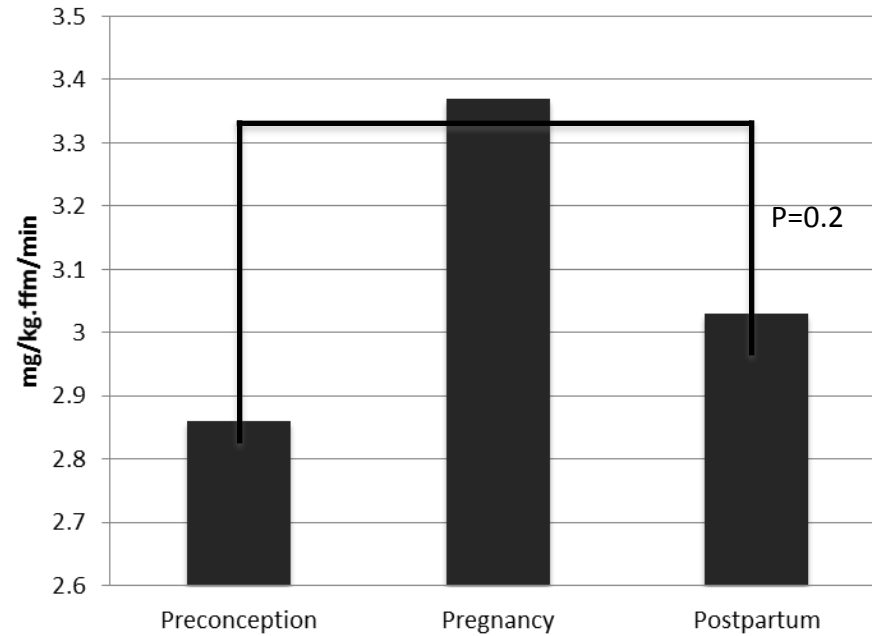
Impact of Inter-Pregnancy Weight Change on LGA Infants



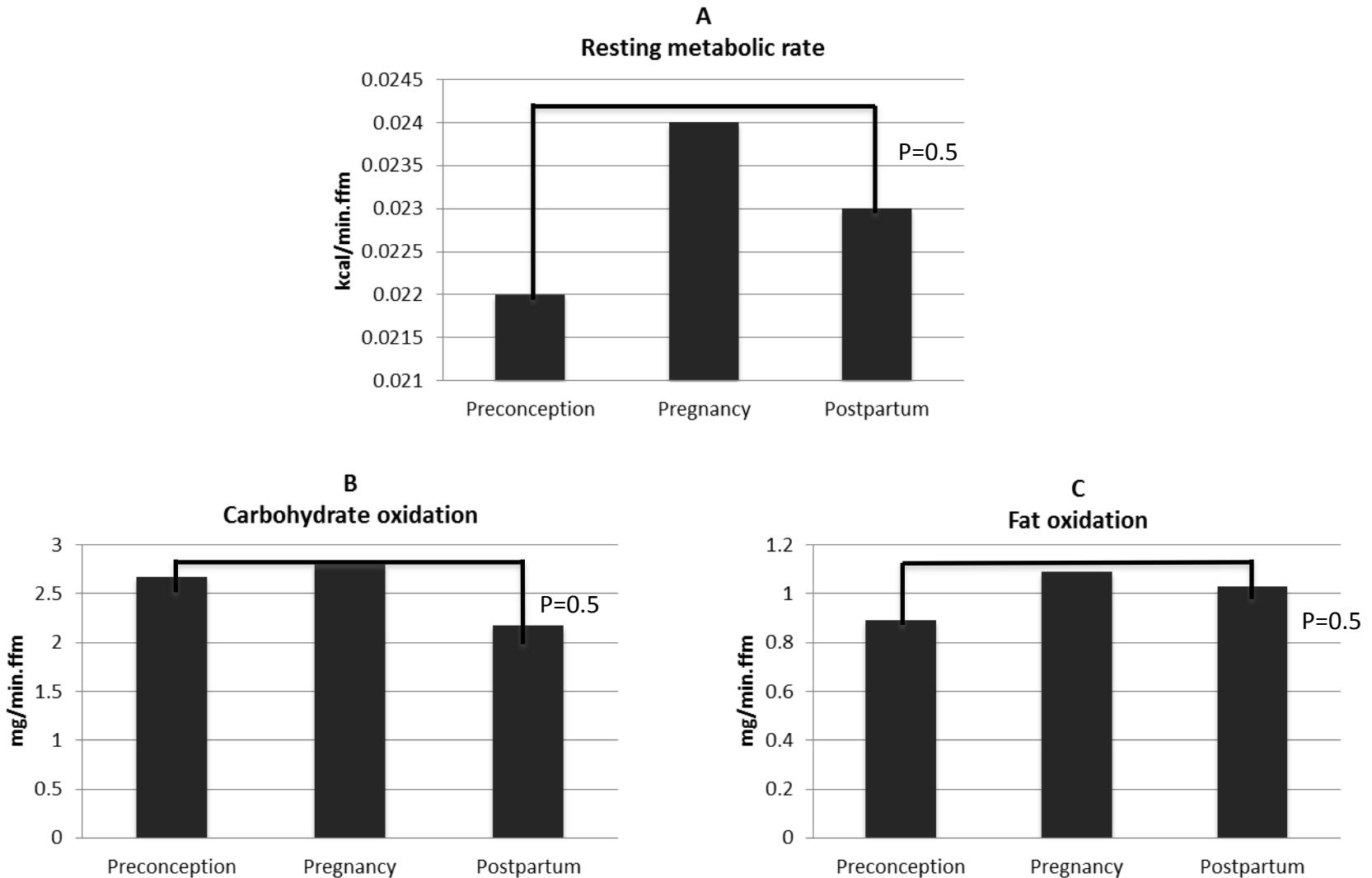
Insulin Response and Sensitivity Preconception, Pregnancy, and Postpartum



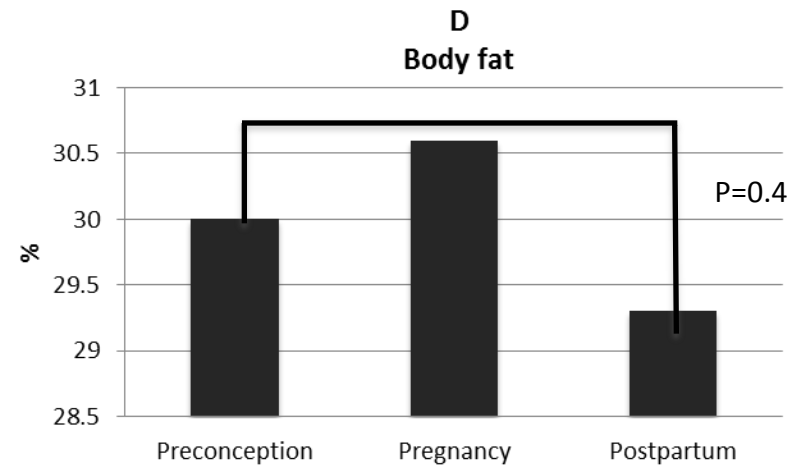
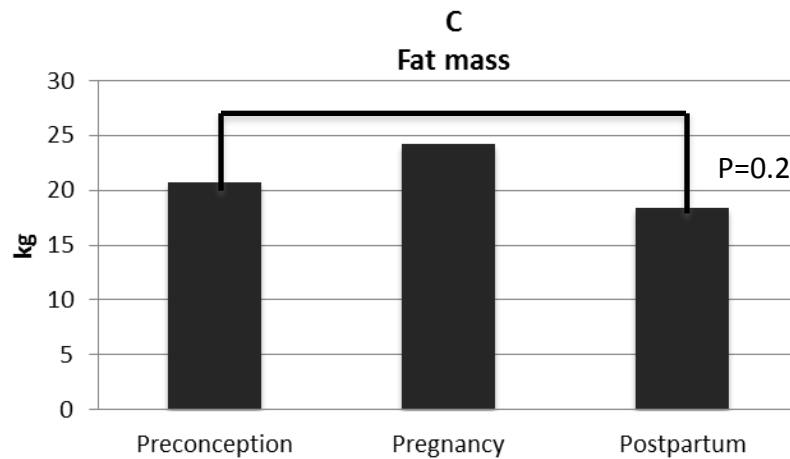
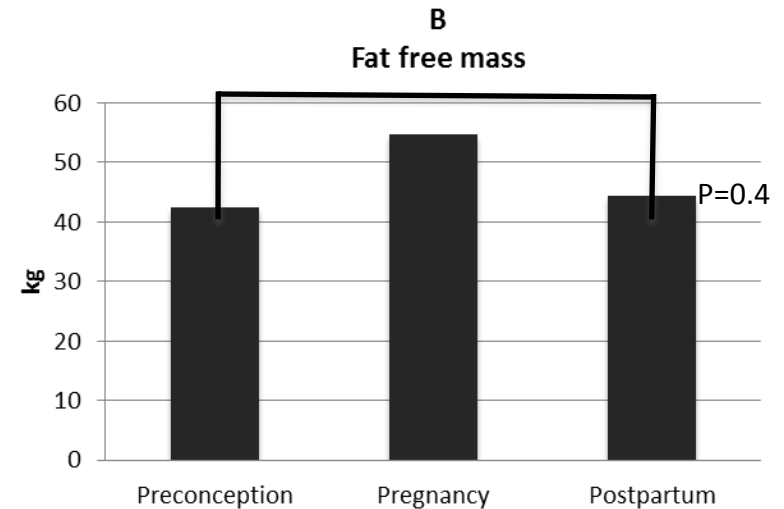
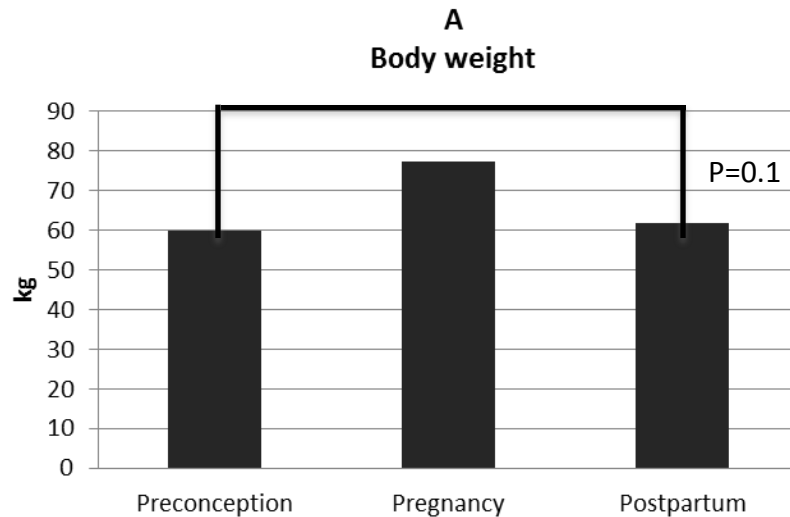
Basal Endogenous Glucose Production Preconception, Pregnancy, and Postpartum



Resting Metabolic Rate, CHO and Fat Oxidation Preconception, Pregnancy, and Postpartum

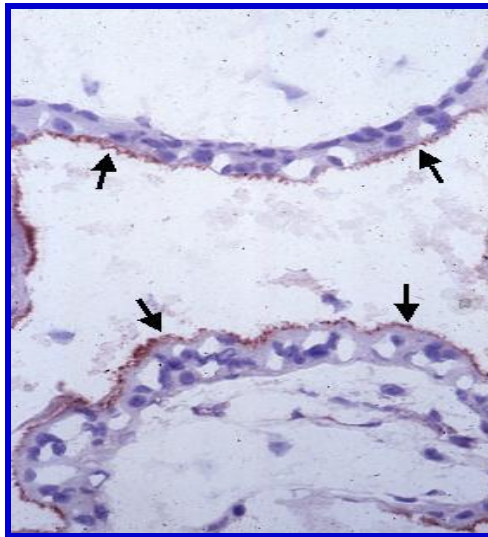


Body composition Preconception, Pregnancy, and Postpartum



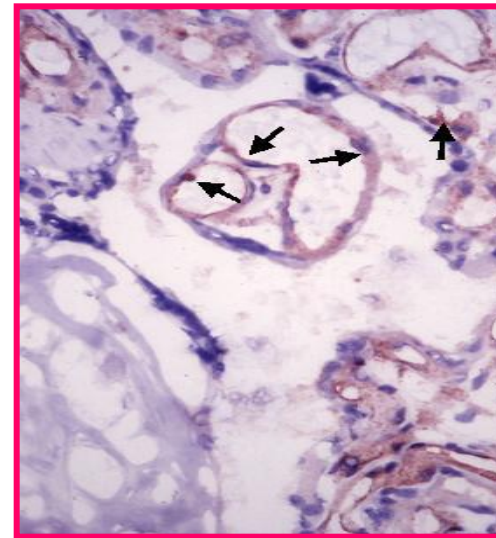
Placental Developmental Changes in Insulin Receptor Location

First trimester



Maternal side:
trophoblast cells

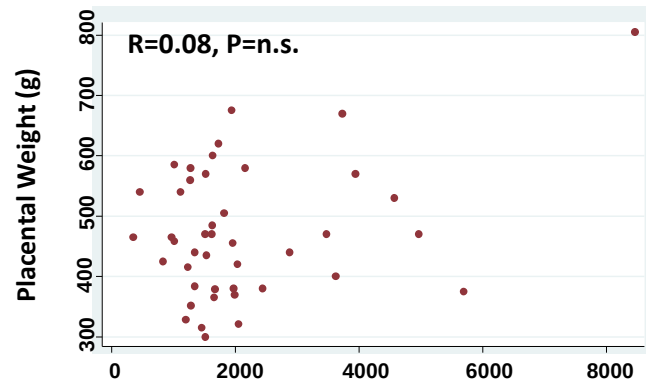
Third trimester



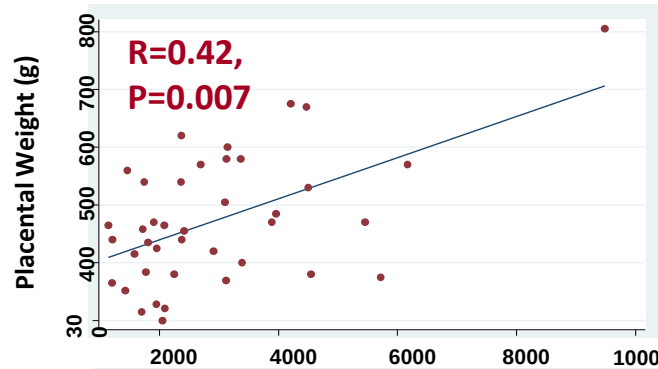
Fetal side :
vascular endothelium



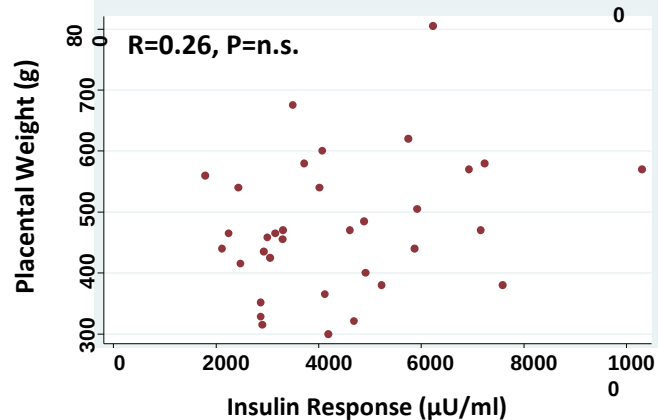
Insulin Response (IVGTT) and Placental Weight



Pre-pregnancy

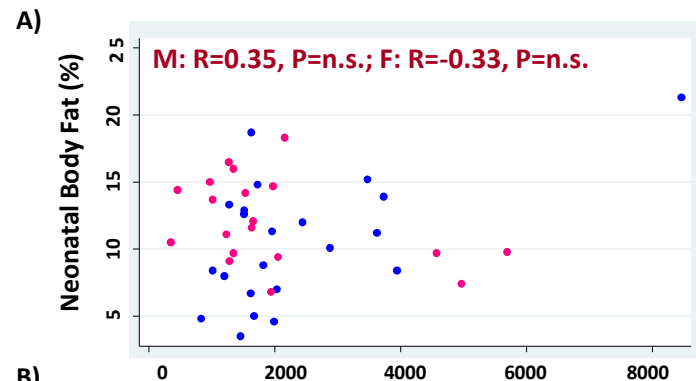


Early pregnancy 12-14 weeks

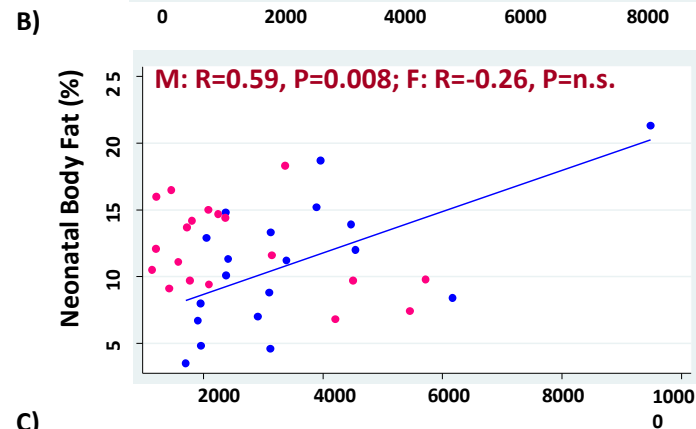


Late Pregnancy 34-36 weeks

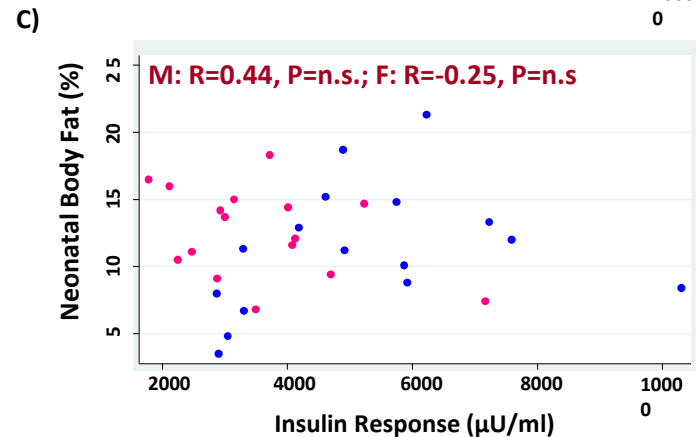
Insulin Response (IVGTT) and Neonatal Adiposity



Pre-pregnancy

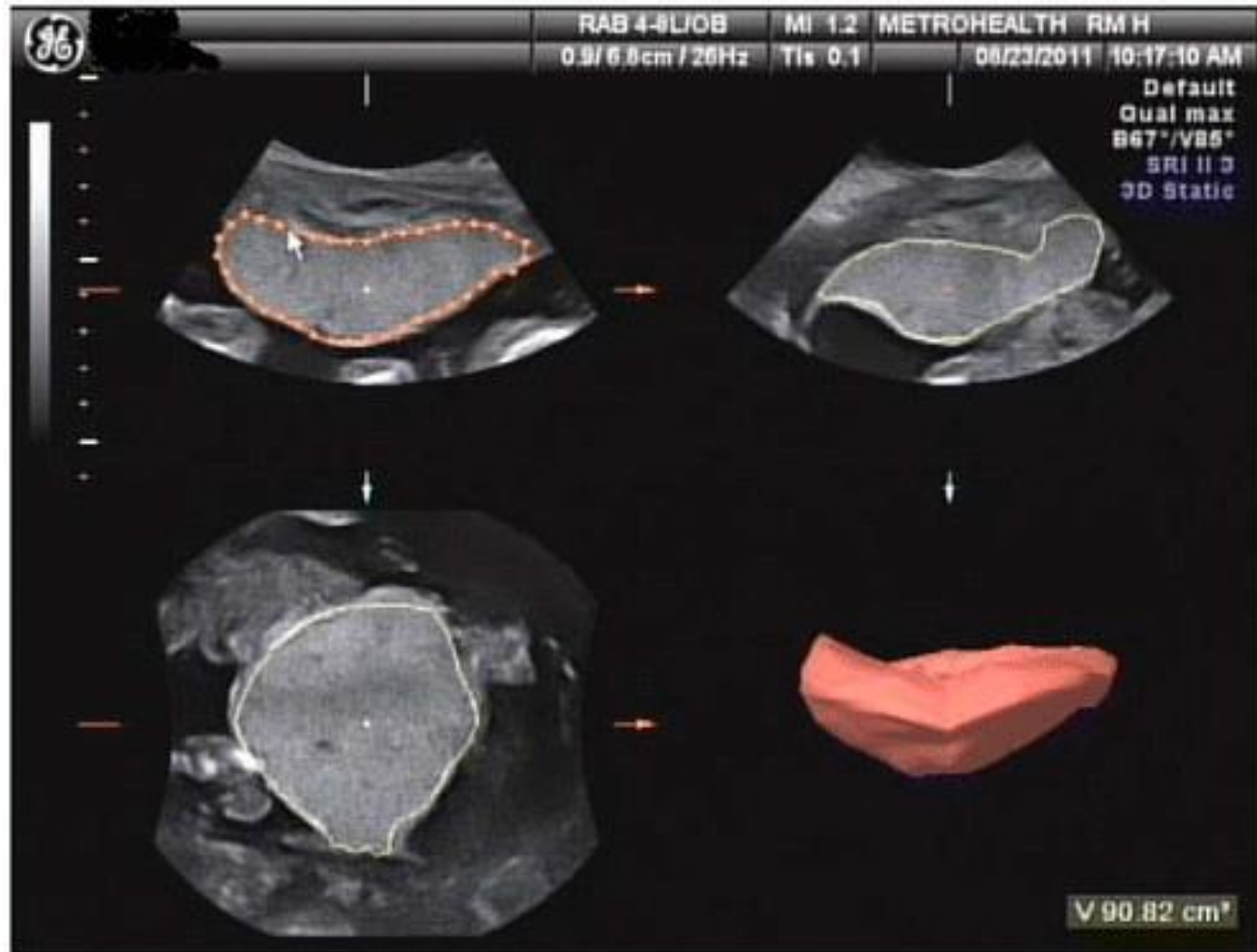


Early pregnancy 12-14 weeks

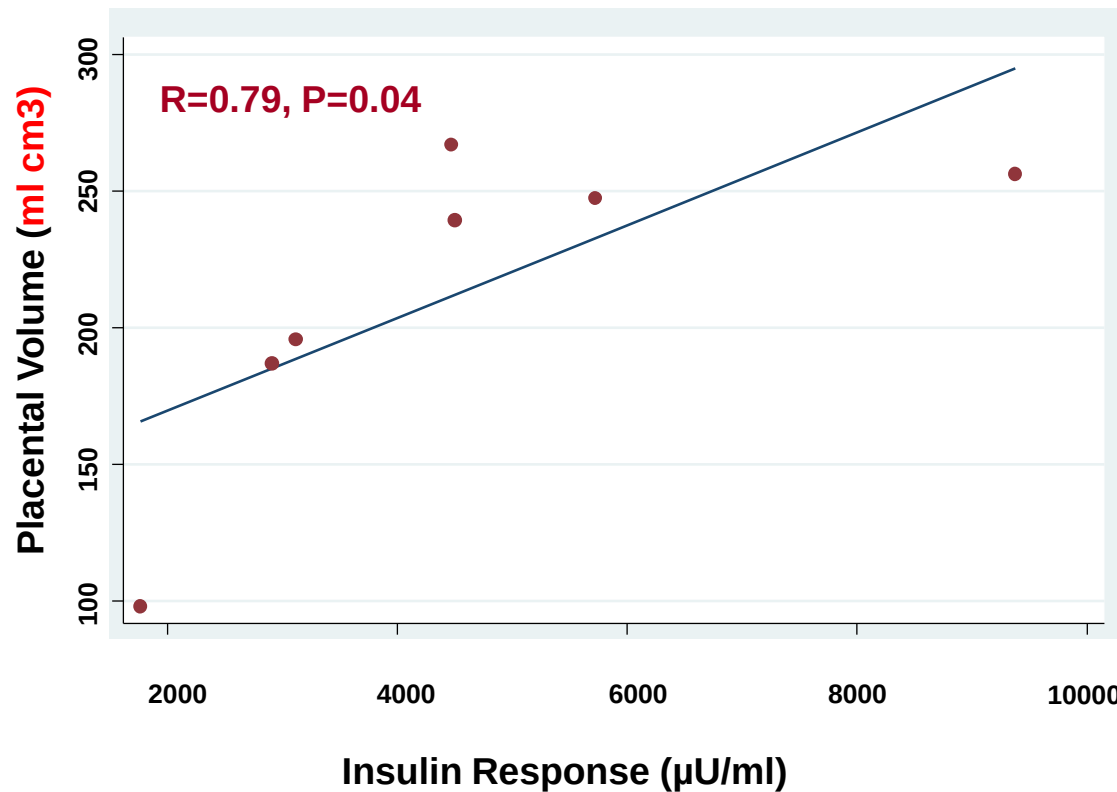


Late Pregnancy 34-36 weeks

Ultrasound Estimates of Placental Volume



At 20 Weeks Insulin Response Correlates with Ultrasound Estimates of Placental Volume



Identification of early transcriptome signatures in placenta exposed to insulin and obesity

Luciana Lassance, PhD; Maricela Haghiac, PhD; Patrick Leahy, PhD; Subhabrata Basu; Judi Minium; Joanna Zhou, BS; Mitchell Reider, MD; Patrick M. Catalano, MD; Sylvie Hauguel-de Mouzon, PhD

Obesity-induced downregulation of the mitochondrial translocator protein (TSPO) impairs placental steroid production

Luciana Lassance, Maricela Haghiac, Judi Minium, Patrick Catalano, and Sylvie Hauguel-de Mouzon

Department of Reproductive Biology, Center for Reproductive Health, MetroHealth Medical Center, 2500 MetroHealth Dr, Cleveland, OH 44109–1998

Conclusion:

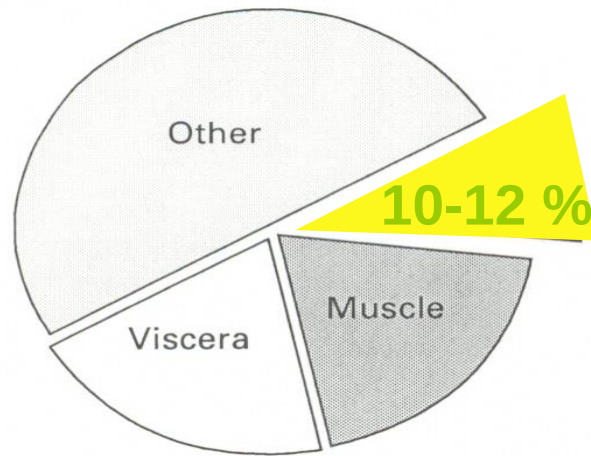
Obesity in pregnancy impairs mitochondrial steroidogenic function through negative regulation of mitochondrial TSPO.

What is the Role of Energy Expenditure

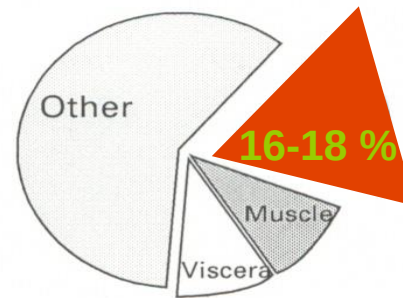
Neonatal

**Characterizing is Fetal Growth is Birth
Weight Sufficient?**

The Thin-Fat Indian Baby



**Caucasian
neonate, 3500 g**



**Indian
neonate, 2700 g**

Yajnik, The Pune Maternal Nutrition Study
International Journal of Obesity; 2003

Body Composition in LGA Infants

Measurement	GDM (n = 50)	CTL (n = 52)	P value
Gestational age at delivery (wk)*	38.0 $\pm$ 1.2	39.2 $\pm$ 1.1	0.0001
Male (n)	31 (62%)	26 (50%)	0.22
Birth weight (g)*	4058 $\pm$ 380	4119 $\pm$ 352	0.13
LBM (g)*	3400 $\pm$ 314	3557 $\pm$ 310	0.0009
Fat mass (g)*	662 $\pm$ 163	563 $\pm$ 206	0.02
Body fat (%)	16.24 $\pm$ 3.27	13.54 $\pm$ 4.54	0.002

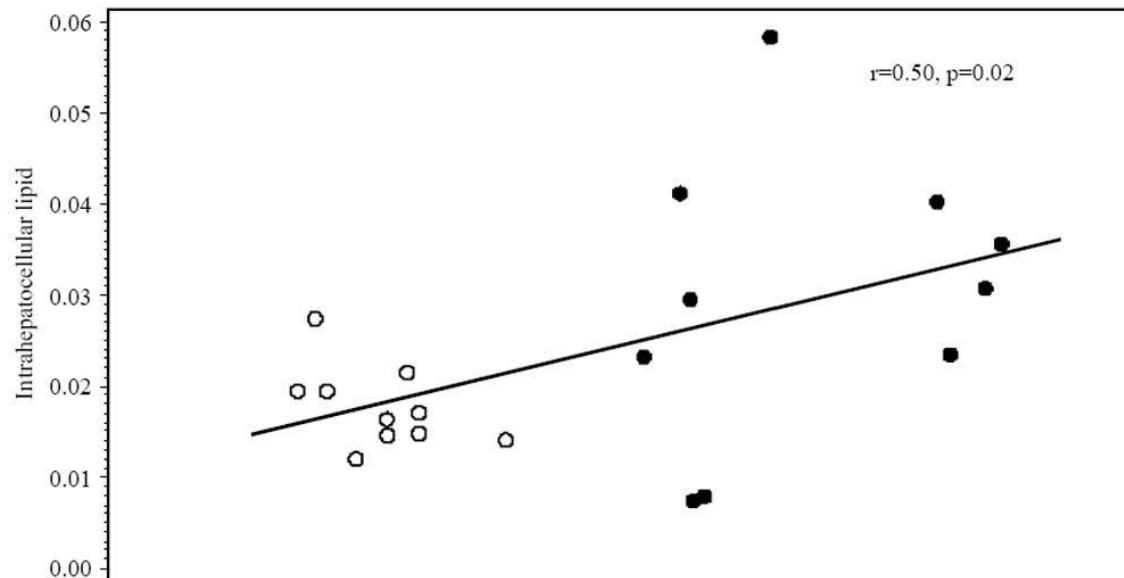
*Data are given as Mean $\pm$ SD

Gender Differences in Neonatal Body Composition

Characteristics	Male			Female		
	n	Mean $\pm$ SD	Minimum-maximum	n	Mean $\pm$ SD	Minimum-maximum
Gestational age, wk	191	38.8 $\pm$ 0.7	36.0-41.0	164	38.8 $\pm$ 0.6	36.0-40.0
Birth weight, kg	194	3.4 $\pm$ 0.5	1.9-5.0	165	3.2 $\pm$ 0.4*	2.1-4.8
Length, cm	192	49.3 $\pm$ 2.1	39.8-54.4	164	48.5 $\pm$ 2.0*	42.4-57.1
Fat mass, kg	184	0.44 $\pm$ 0.19	0.02-1.12	156	0.40 $\pm$ 0.15*	0.07-0.87
Lean mass, kg	184	2.9 $\pm$ 0.3	1.9-3.9	156	2.8 $\pm$ 0.3*	2.1-3.9
Body fat, %	184	12.5 $\pm$ 3.7	1.1-23.8	156	12.2 $\pm$ 3.3	2.9-21.0
Placental weight, g	188	685.8 $\pm$ 172.7	294.3-1316.5	155	648.5 $\pm$ 148.9*	298.0-1189.5

*p<0.05 vs. male infants

Relationship Between Maternal Pre-Pregnancy BMI and Intracellular Lipid



**Does Breastfeeding in Obese Women have
Similar Benefits for the Offspring as
Breastfeeding in Normal Weight Women**

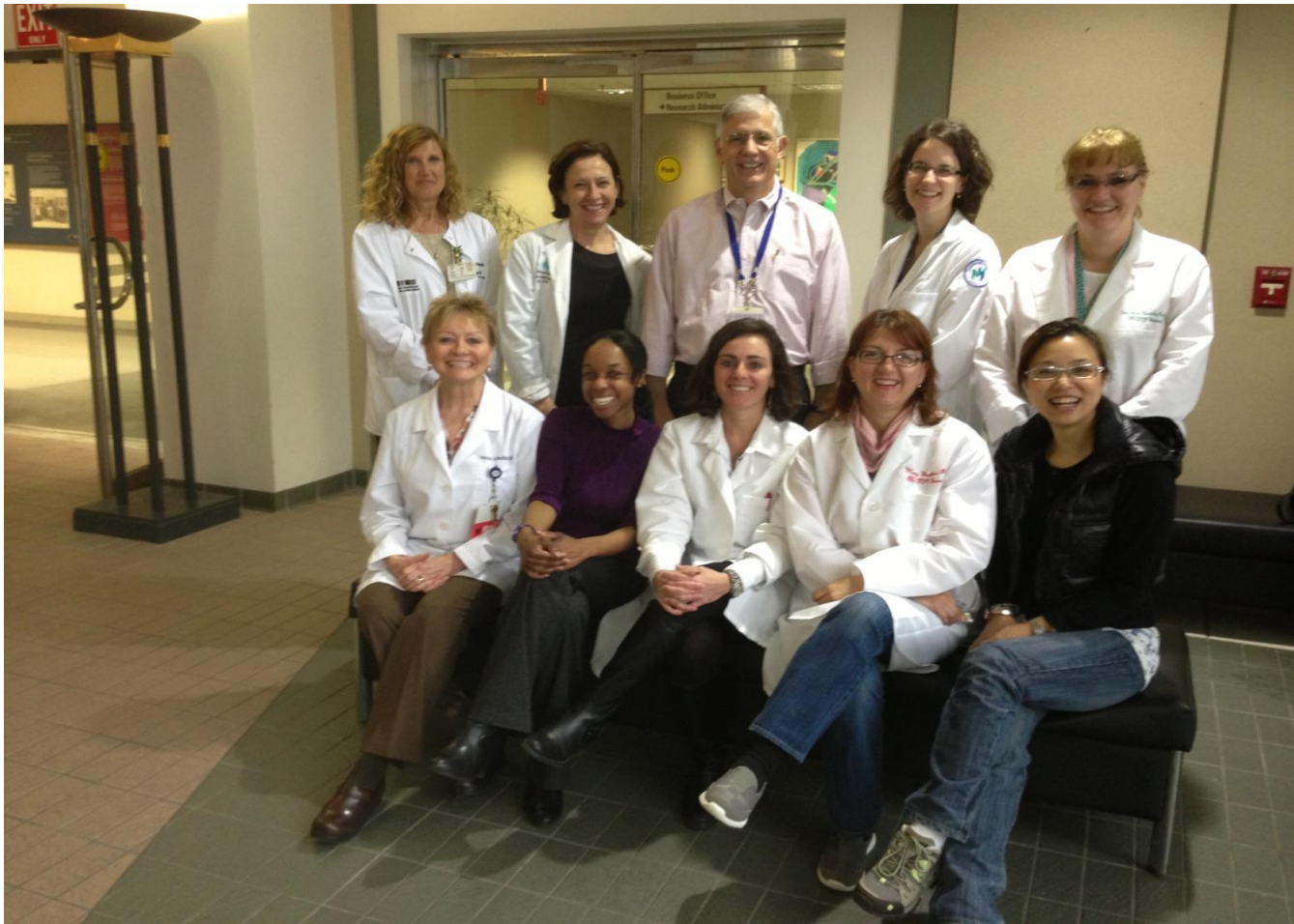
What are the Basic and Translational Research Studies which Need to be Performed to Better Understand the Pathophysiology of Pregnancy?

Human Physiology

Animal, if so which model(s)

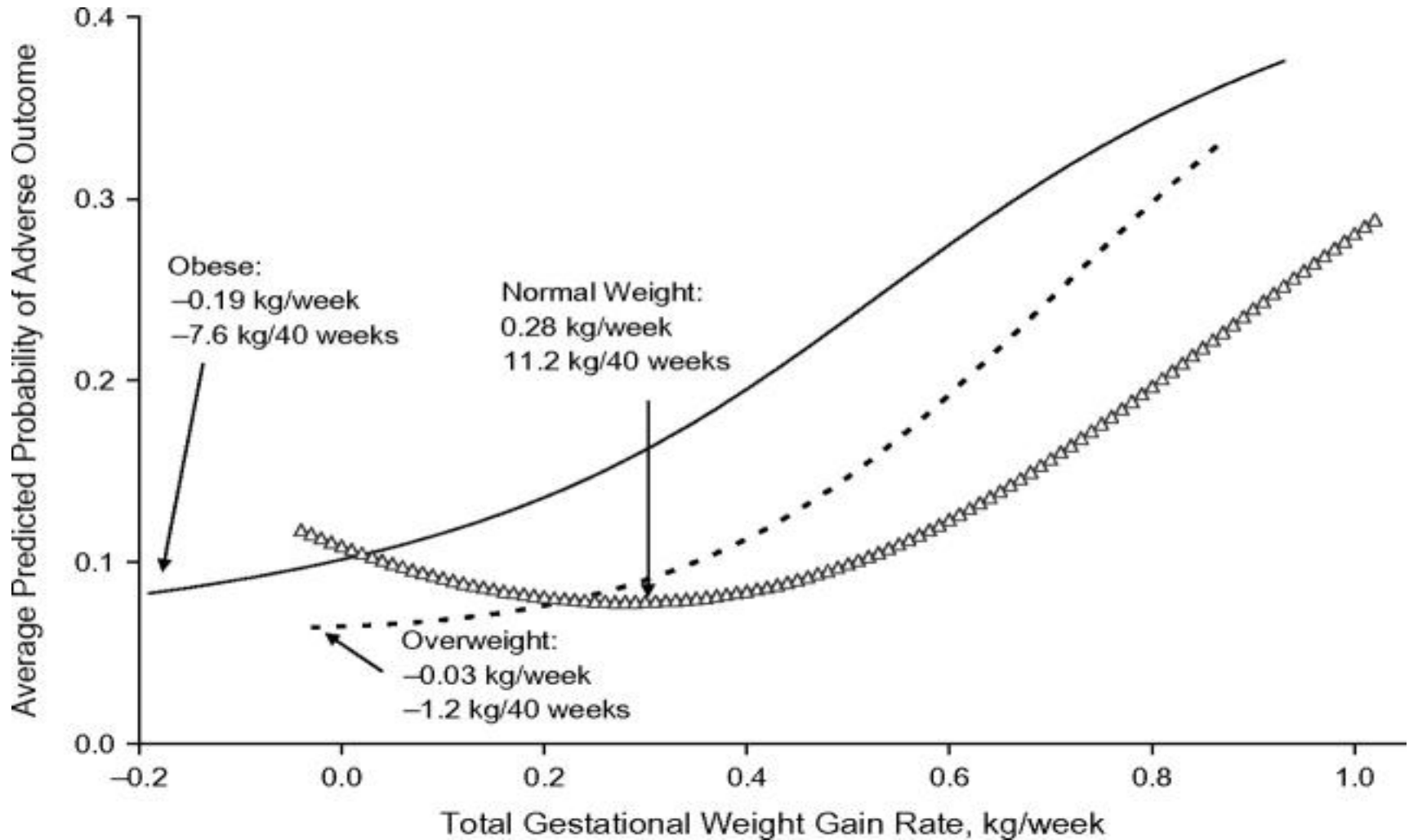
Epigenetics

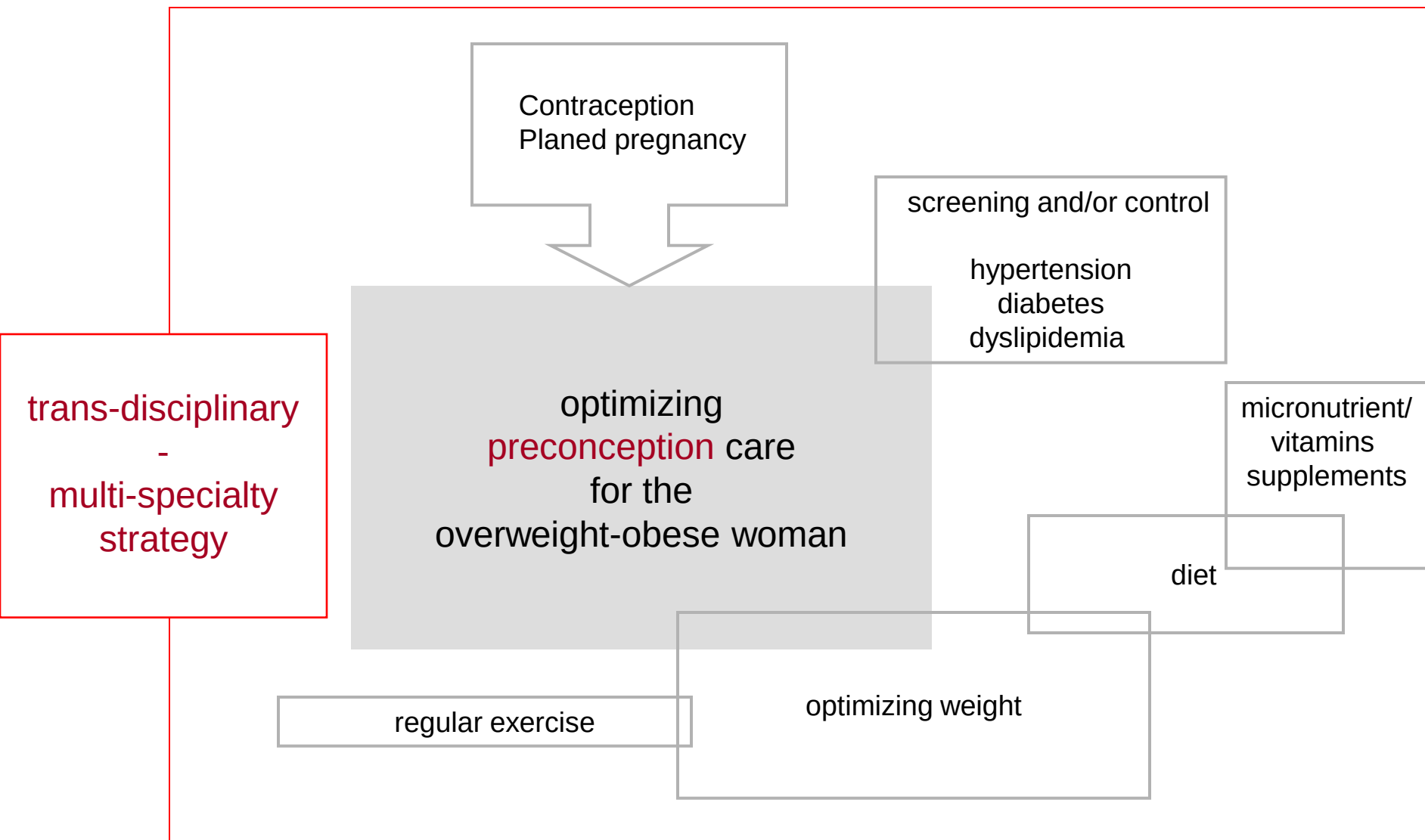
Microbiome/Probiotics



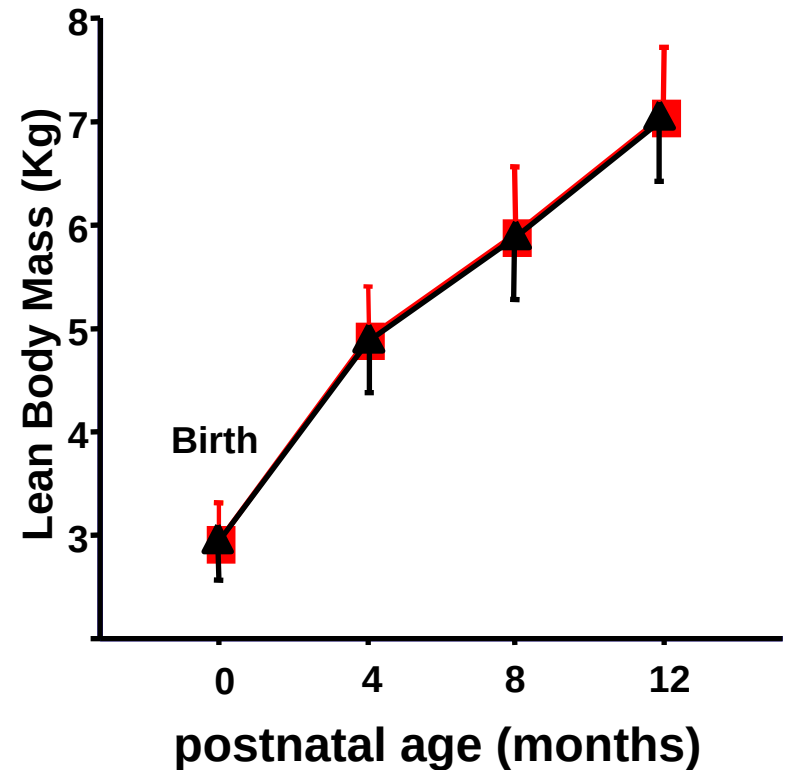
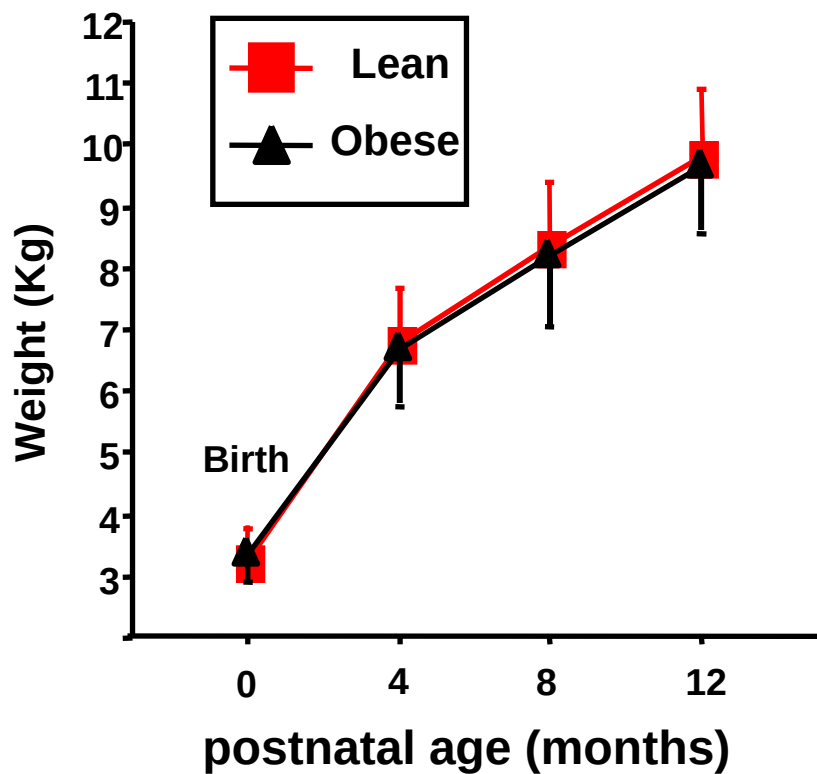
**NICHD HD-22965-19, HD-057236, CTSA-UL-1 RR-024989, ADA
Diabetes Association of Greater Cleveland**

Probability for Adverse Outcomes (SGA, LGA, Preterm Delivery, PP Weight Retention, Childhood Obesity)

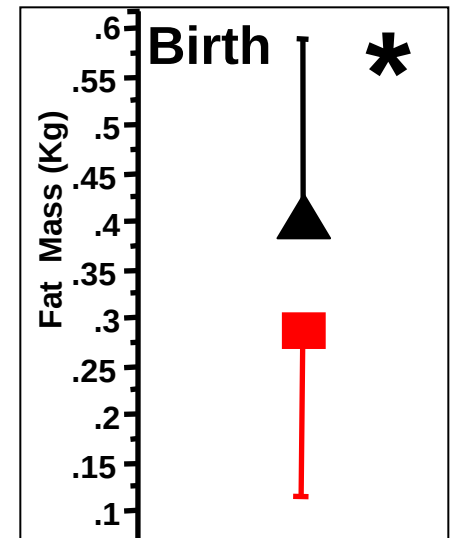
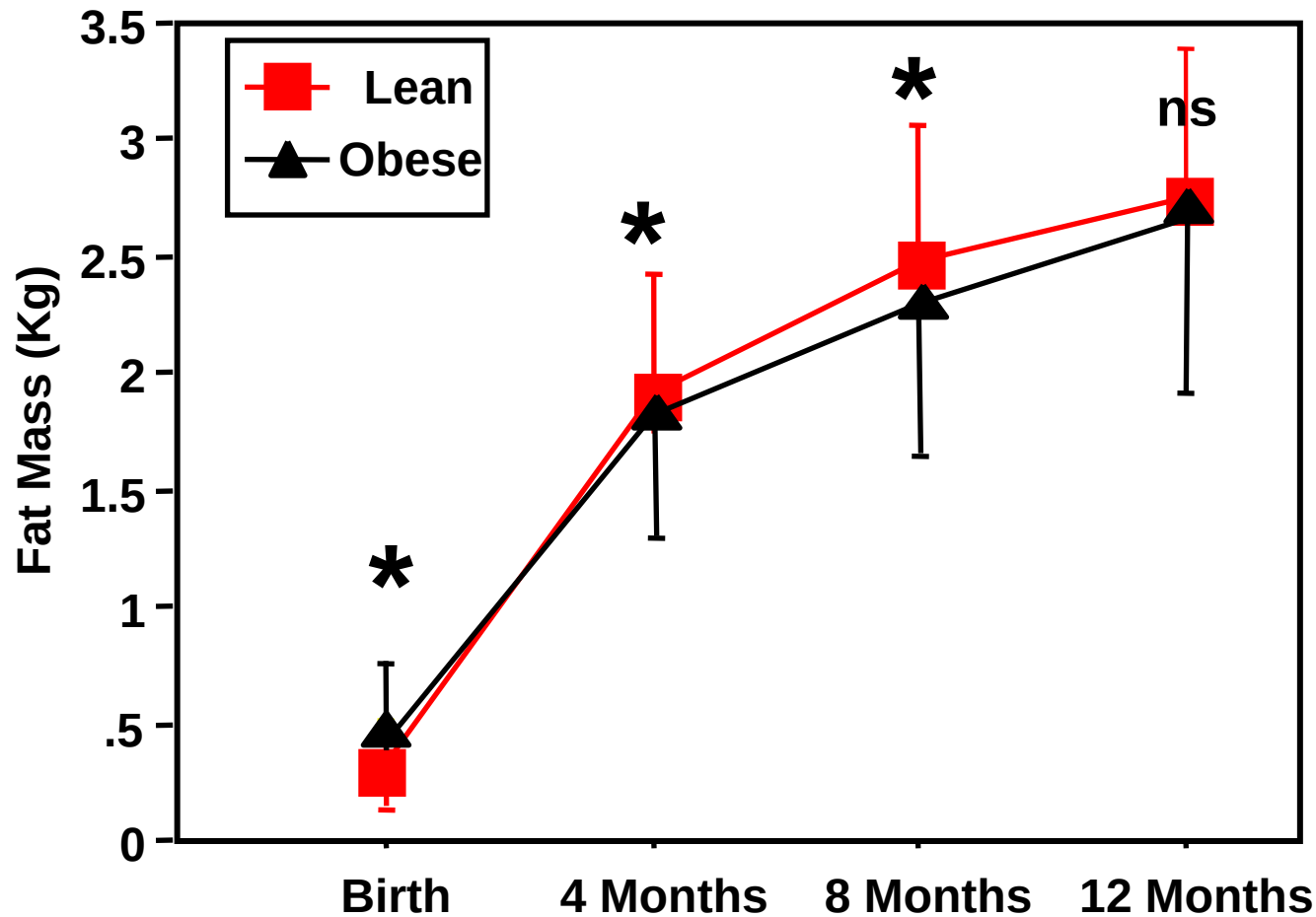




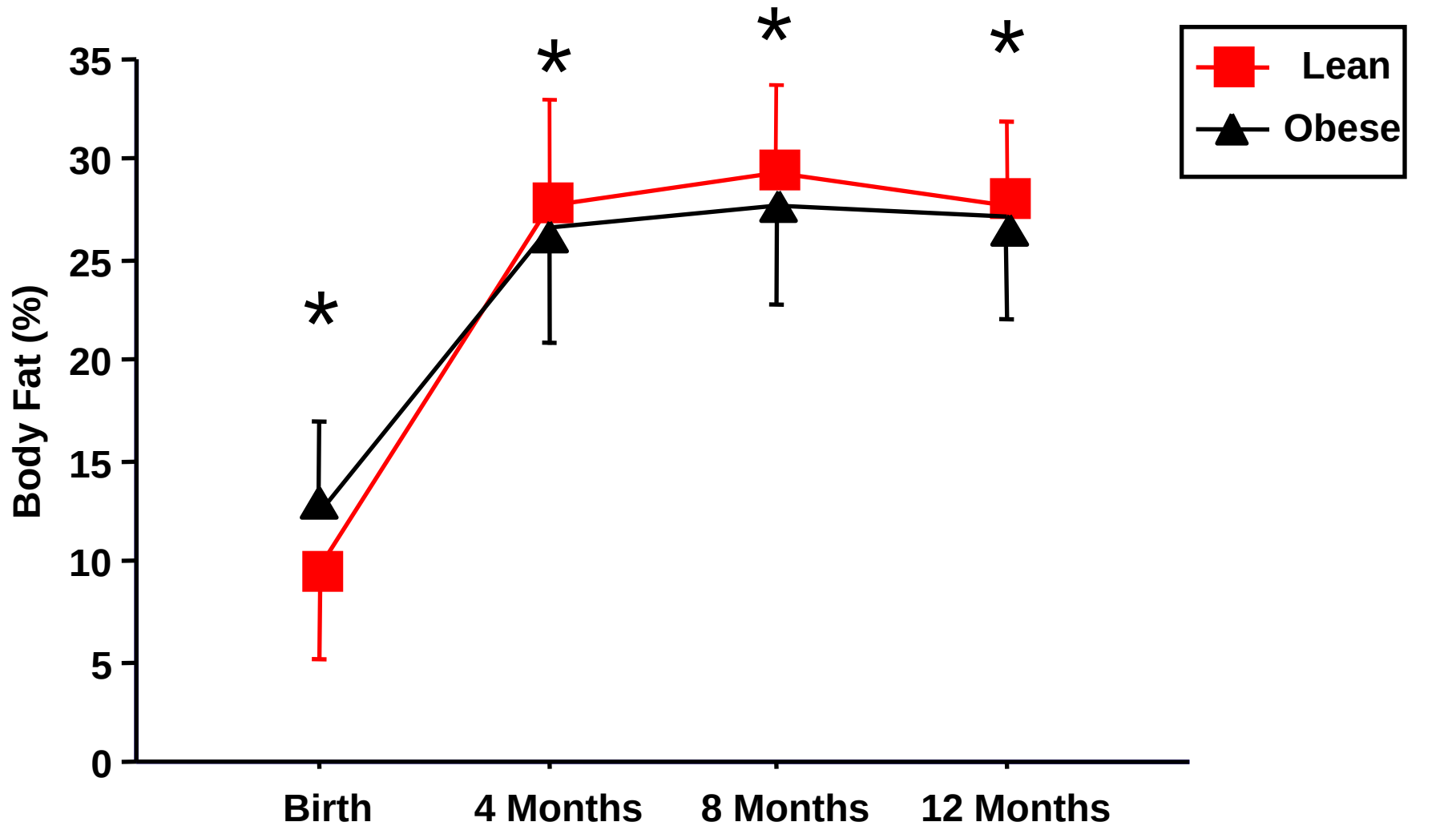
Weight & Lean Body Mass; Birth through 1 Year



Fat Mass; Birth through 1 Year



% Body Fat; Birth through 1 Year



Low glycaemic index diet in pregnancy to prevent macrosomia (ROLO study): randomised control trial



OPEN ACCESS

Jennifer M Walsh *clinical research fellow, specialist registrar in obstetrics and gynaecology*, Ciara A McGowan *research dietician*, Rhona Mahony *consultant obstetrician and gynaecologist*, Michael E Foley *consultant obstetrician and gynaecologist*, Fionnuala M McAuliffe *professor of obstetrics and gynaecology*

Maternal Characteristics

	Gestational weight gain > 5 kg (n=1053)	Gestational weight gain ≤ 5 kg (n=188)	p-value
Age (years)	28.1 ± 5.8	28.2 ± 5.7	0.67
Pre-pregnancy height (cm)	160.1 ± 7.5	159.3 ± 8.2	0.19
Pre-pregnancy weight (kg)	78.2 ± 16.1	87.4 ± 21.9	< 0.0001
Pre-pregnancy BMI (kg/m ²)	30.4 ± 5.2	34.2 ± 7.1	< 0.0001
25.0 - < 30	627 (59.5)	59 (31.4)	
30.0 - ≤ 40	370 (35.1)	97 (51.6)	
>40	56 (5.3)	32 (17.0)	
Tobacco use + (%)	120 (11.4)	29 (15.4)	0.12
Parity (%)			0.09
1	231 (21.9)	30 (16.0)	
2	396 (37.6)	68 (36.2)	
3+	426 (40.5)	90 (47.9)	

Maternal Characteristics

	Gestational weight gain > 5 kg (n=1053)	Gestational weight gain ≤ 5 kg (n=188)	p-value
Race (%)			0.99
White	345 (32.8%)	62 (33.0%)	
AA/Black	220 (20.9%)	38 (20.2%)	
Hispanic	469 (44.5%)	85 (45.2%)	
Other	19 (1.8%)	3 (1.6%)	
Glucose status (%)			0.002
Normal GCT	343 (32.6%)	52 (27.7%)	
Abnormal GCT/NL OGTT	366 (34.8%)	52 (27.7%)	
GDM treated	197 (18.7%)	58 (30.9%)	
GDM untreated	147 (14.0%)	26 (13.8%)	
Weight gain/loss (kg)	14.4 ± 6.2	1.1 ± 4.4	< 0.0001

Original Research

Weight Loss in Obese Pregnant Women and Risk for Adverse Perinatal Outcomes

Annick Bogaerts, PhD, Lieveke Ameye, PhD, Evelyne Martens, MSc, and Roland Devlieger, PhD

Conclusion: Weight loss in obese pregnant women was associated with reduced perinatal risks but not with the rate of low birth weight or small-for-gestational-age neonates in obese women from class III in this affluent region. Stratification of recommended gestational weight gain ranges in obese women should be considered.

Pregnancy and Glycemic Index Outcomes study: effects of low glycemic index compared with conventional dietary advice on selected pregnancy outcomes¹⁻³

Robert G Moses, Shelly A Casey, Eleanor G Quinn, Jane M Cleary, Linda C Tapsell, Marianna Milosavljevic, Peter Petocz, and Jennie C Brand-Miller

A low-intensity dietary intervention with an Low Glycemic Index Diet (LGI) compared with an Healthy Eating (HE) diet in pregnancy did not result in any significant differences in birth weight, fetal percentile, or PI.