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# The effect of dietary and lifestyle advice for pregnant women who are overweight or obese on maternal diet and physical activity: The LIMIT randomised trial.

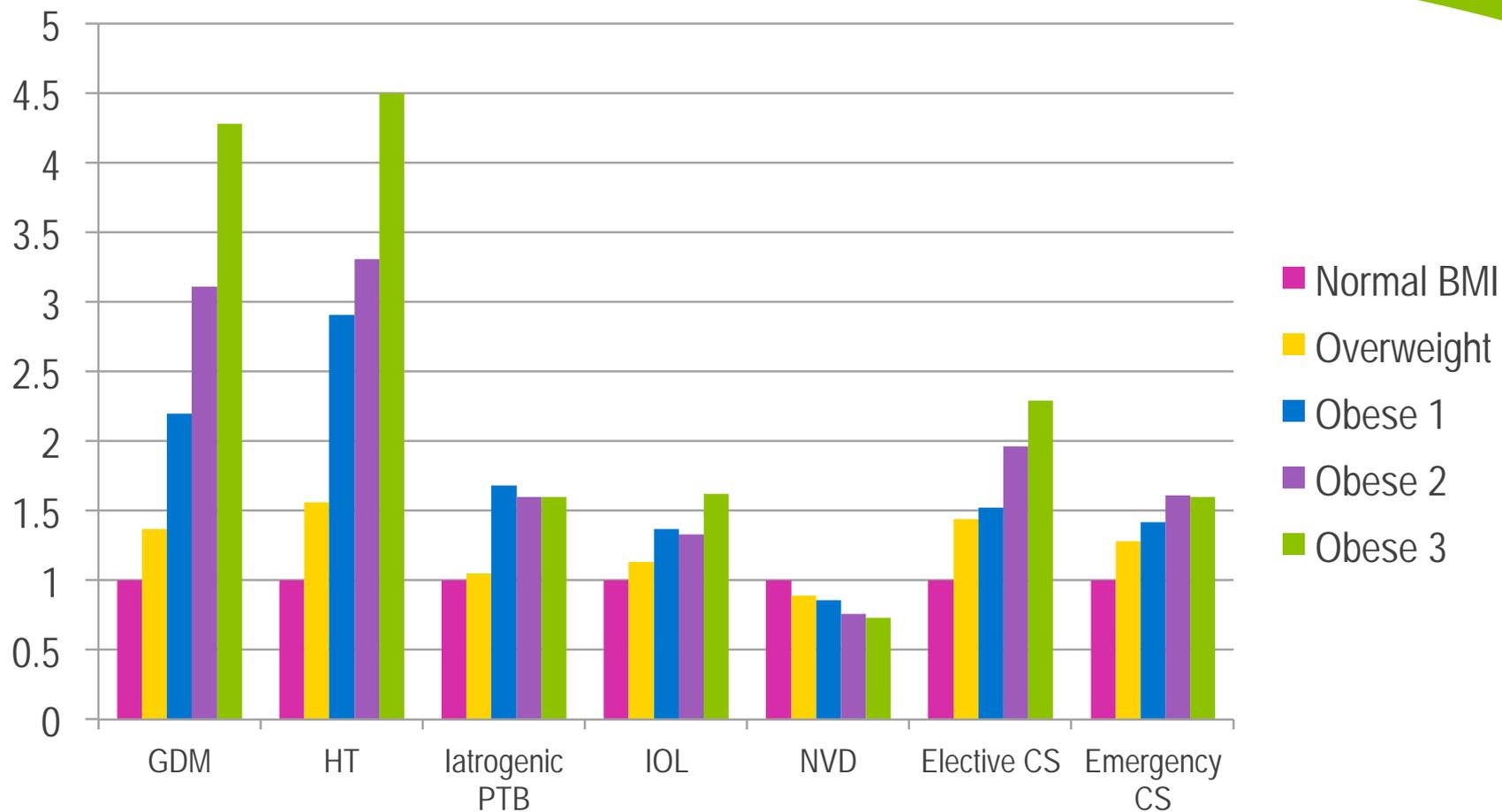


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# Obesity in Pregnancy

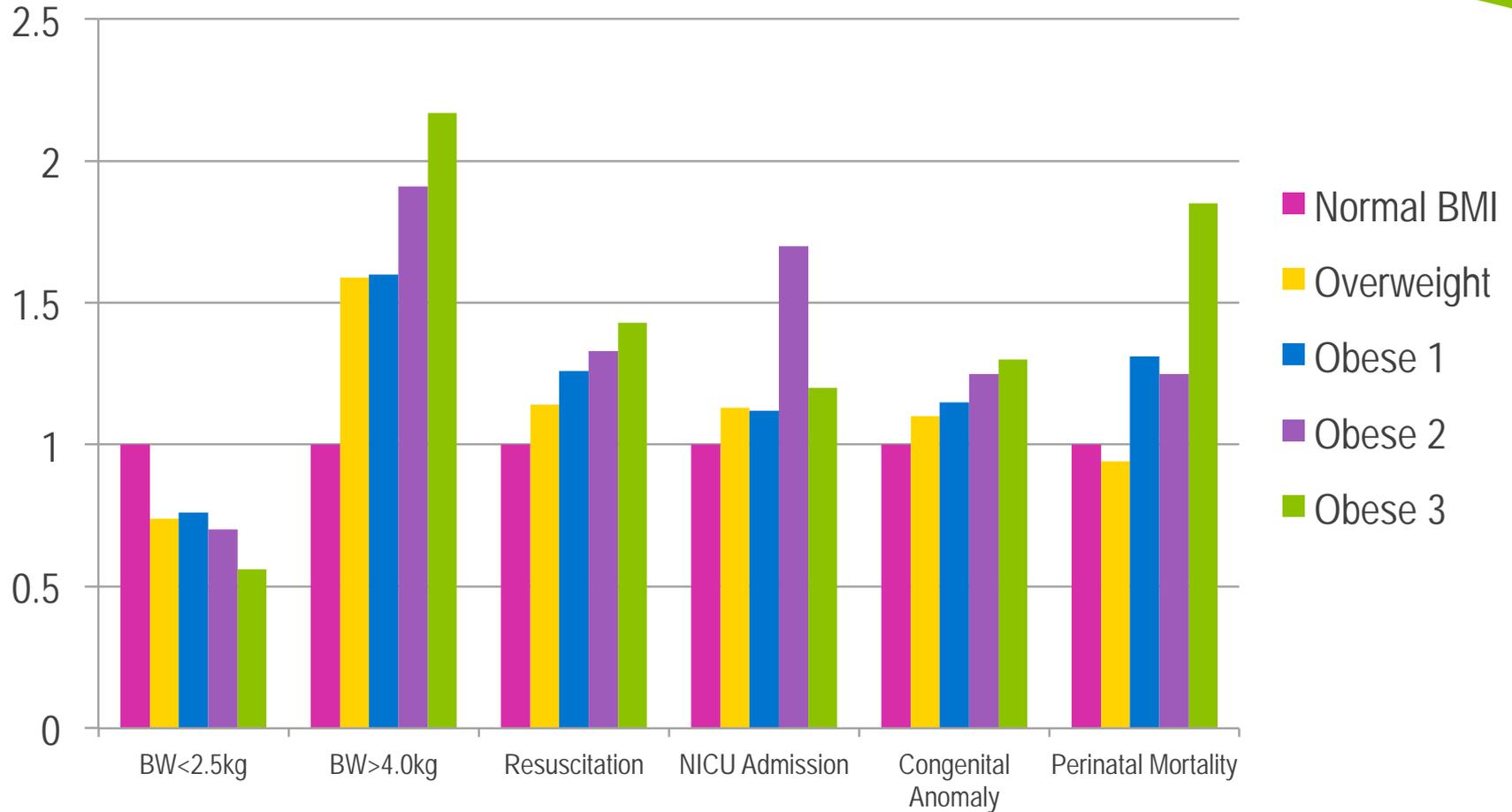
- 35% of women aged 18-45 years are overweight or obese (Cameron 2003)
- Up to 50% of pregnant women in South Australia have a BMI greater than  $25\text{kg}/\text{m}^2$  (Schiel 2012)
- Risk of adverse health outcomes increase with increasing BMI
  - Medical complications
  - Labour & Birth complications
  - Adverse infant health outcomes

# Adverse Maternal Outcomes



Risk of adverse outcomes by BMI category; normal BMI reference range (Dodd 2011)

# Adverse Neonatal Outcomes



Risk of adverse outcomes by BMI category; normal BMI reference range (Dodd 2011)

# Early-life factors and risk of obesity

- Maternal obesity
  - 2- to 6-fold increase in risk of childhood obesity
- Gestational weight gain
  - 2-fold increase in risk of pre-school obesity
- High infant birth weight
  - 2-fold increase in risk of childhood obesity

# Assessment of Diet Quality

- Tools:
  - Food frequency questionnaire
  - Food diary
- Components:
  - Energy intake
  - Food groups
  - Macro and micronutrient intake
  - Dietary Quality
    - Healthy Eating Index
  - Glycaemic Index

# Diet quality during pregnancy

- Women who are overweight or obese
  - Poorer diet quality during pregnancy compared with women of normal BMI
  - Effects persistent into the early postpartum period (Moran et al 2012)
  - Reduced intake of grains, fruits & vegetables, iron and folate
  - Increased overall energy intake and percentage energy derived from fats
- Clinical effect of poorer diet quality
  - Increased risk of pregnancy complications
    - Pre-eclampsia
    - Gestational diabetes

# Randomised trials

- Antenatal Dietary Interventions among women who are overweight or obese
  - 9 randomised trials
  - 3,069 women
  - Uncertain benefit in limiting gestational weight gain
  - No differential effect according to intensity of the intervention
  - Specific dietary changes achieved following intervention reported in only 3 small randomised trials

# Assessment of Physical Activity

- Tools:
  - Physical Activity questionnaires
  - Pedometer
  - Accelerometer
- Components:
  - Leisure activity
  - Household activity
  - Commuting activity
  - Work related activity

# Physical activity during pregnancy

- Beneficial effects of physical activity during pregnancy
- Over the course of pregnancy physical activity declines in women of all BMI categories
  - This effect is more pronounced for women who are overweight or obese
  - Importance of assessing household & care-giving activities which may increase to up to 65% of energy expenditure in pregnancy among women who are overweight or obese

# Randomised trials

- Antenatal Exercise Interventions among women who are overweight or obese
  - 6 randomised trials
  - 317 women
  - Modest difference of 0.57kg in gestational weight gain associated with intervention provision
  - Most outcome measures reported relate to cardiovascular fitness
  - Very little information available related to clinical outcomes or changes achieved in physical activity across pregnancy

# Research Question

For pregnant women who are overweight or obese, what is the effect of an antenatal dietary and lifestyle intervention on maternal diet and physical activity?

# Design & Participants

- Multi-centre, randomised, controlled trial
- Public maternity units across metropolitan Adelaide, SA
  - All women had their height & weight measured, & BMI calculated
- Inclusion
  - Singleton pregnancy
  - BMI  $\geq 25\text{kg/m}^2$
  - Gestational age 10<sup>+0</sup> to 20<sup>+0</sup> weeks
- Exclusion
  - Prior diagnosis of type 1 or 2 diabetes

# Lifestyle Advice

## Dietary Advice

Balance carbohydrates,  
protein, fat

Increase consumption  
of fibre

Consume 2 serves fruit,  
5 serves vegetables, &  
3 serves dairy daily

Reduce intake of foods  
high in refined  
carbohydrates &  
saturated fats

## Exercise Advice

Increase physical  
activity

Primarily through  
increasing walking and  
incidental activities

## Goals and Support

Set achievable goals

Self monitor progress

Identify barriers to  
behavioural changes

Identify enablers to  
behavioural changes

# Intervention Sessions

- Detailed dietary & physical activity history
- Individualised information provided
  - Dietary goals
    - 2 serves fruit, 5 serves vegetables, 3 serves dairy daily
  - Meal plans
  - Healthy recipes
  - Simple food substitutions
    - Reducing sugar sweetened beverages and fruit juice
    - Reducing added sugar
    - Reducing foods high in refined carbohydrates & saturated fats
    - Low-fat alternatives
  - Healthy snack & eating out options

## Research Dietitian

Initial face to face planning session  
at trial entry

Follow-up face to face session at 28  
weeks gestation

## Research Assistant

Telephone sessions at 22, 24, and  
32 weeks gestation

Face to face session at 36 weeks  
gestation

# Standard Care

- Ongoing clinical care from health-care providers at their planned hospital of birth
- This care does not currently include the routine provision of dietary and lifestyle information, or advice on gestational weight gain

# Pre-specified Outcomes

- **Primary**
  - Incidence of infants born large for gestational age
- **Secondary**
  - Infant
  - Maternal
  - **Dietary intake**
  - **Physical activity patterns**
  - Psychological well-being and quality of life
  - Costs of health care

# Dietary Questionnaires

- Harvard Semi-quantitative Food Frequency Questionnaire (the Willett Questionnaire)
- Completed at trial entry, 28 & 36 weeks gestation, and 4 months postpartum
- Daily nutrient intake estimated using Australian food composition tables
- Healthy Eating Index
- Glycaemic Index and Load

Components	Score	Minimum score	Maximum score
Total fruit (includes 100% juice)	0-5	No fruit	$\geq 0.8$ C equiv/1000 kcal
Whole fruit (not juice)	0-5	No whole fruit	$\geq 0.4$ C equiv/1000 kcal
Total vegetables	0-5	No vegetables	$\geq 1.1$ C equiv/1000 kcal
Dark green/orange vegetables; legumes	0-5	No dark green/orange veg or legumes	$\geq 0.4$ C equiv/1000 kcal
Total grains	0-5	No grains	$\geq 0.8$ C equiv/1000 kcal
Whole grains	0-5	No whole grains	$\geq 85$ g equiv/1000 kcal
Milk	0-10	No milk	$\geq 1.3$ C equiv/1000 kcal
Meat and beans	0-10	No meat or beans	$\geq 70$ g equiv/1000 kcal
Oils (unsaturated)	0-10	No oil	$\geq 12$ g per 1000 kcal
Saturated fat	0-10	$\geq 15\%$ of energy	$\leq 7\%$ of energy
Sodium	0-10	$\geq 2.0$ g per 1000 kcal	$\leq 0.7$ g per 1000 kcal
Calories from SOFAAS	0-20	$\geq 50\%$ of energy	$\leq 20\%$ of energy
<b>TOTAL</b>	<b>100</b>	<b>HEI &gt; 80 = Good; 50-80 = Needs improvement; &lt; 50 = Poor</b>	

# Glycaemic Load and Index

- Analysed from the Food Frequency Questionnaire using Food Works Nutrient Analysis Software
- Incorporation Australian Food Composition tables and published glycaemic index values

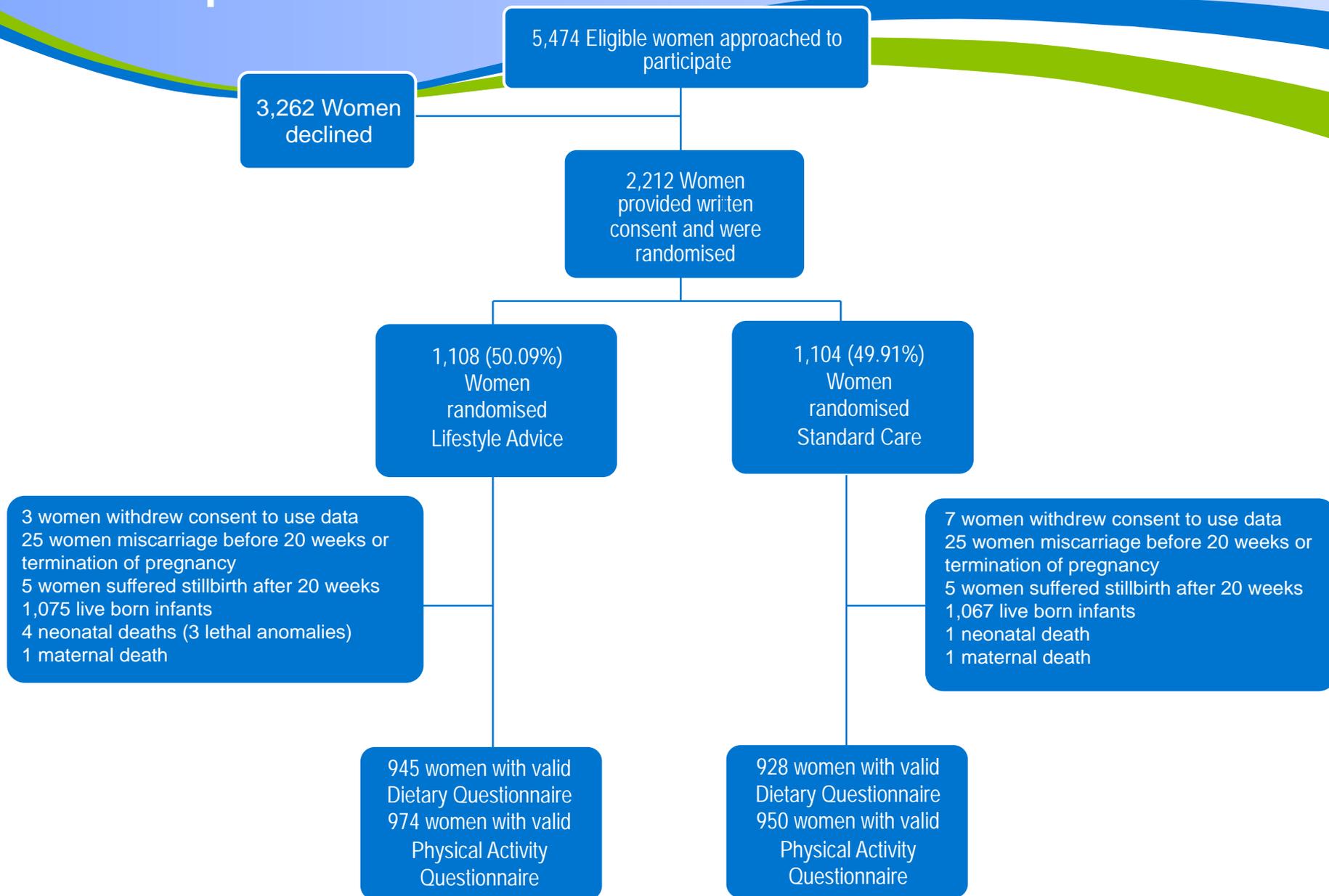
# Physical Activity Questionnaires

- Short Questionnaire to Assess Health-enhancing physical activity (the SQUASH Questionnaire)
- Completed at trial entry, 28 & 36 weeks gestation, and 4 months postpartum
- Evaluates time spent on different types of physical activity
  - Commuting, Leisure, Household, Work Related activities
- Activity assigned Metabolic Equivalent Task unit (METs)
  - Assessed as MET-minutes per week
  - Duration x frequency x MET intensity

# Statistical Analyses

- Intention to treat basis
- Both adjusted and unadjusted analyses performed
- Linear mixed effects model
  - Treatment group, time point assessed and their interaction
  - Where treatment by time interaction significant, post hoc tests to assess the effect of treatment at each point
  - Where interaction was not significant, removed from model and main effect of treatment group estimated

# Participant Flow



# Baseline Characteristics

- Characteristics similar between Lifestyle Group and Standard Care Group for participants contributing data from
  - Dietary Questionnaires
  - Physical Activity Questionnaires

# Healthy Eating Index Scores

Outcome	Adjusted Treatment Effect	Adjusted P-value
<b>Healthy Eating Index</b>		
28 weeks	1.58 (0.89 to 2.27)	<0.0001
36 weeks	1.77 (1.01 to 2.53)	<0.0001
<b>Total Fruit</b>		
28 weeks	0.20 (0.10 to 0.30)	0.0001
36 weeks	0.82 (0.13 to 0.35)	<0.0001
<b>Whole Fruit</b>		
28 weeks	0.19 (0.09 to 0.30)	0.0003
36 weeks	0.24 (0.12 to 0.35)	<0.0001
<b>Dark Green &amp; Orange Vegetables</b>		
28 weeks	0.10 (0.04 to 0.16)	0.0006
36 weeks		
4 months postpartum		

# Food Groups, Macronutrients, Micronutrients & Glycaemic Load

Outcome	Adjusted Treatment Effect	Adjusted P-value
Total Energy (kJ)	178.60 (-26.56 to 383.77)	0.09
Fruit (number serves/day)	0.21 (0.08 to 0.35)	0.002
Vegetables (number serves/day)	0.47 (0.22 to 0.72)	0.0002
Fibre	1.55 (0.55 to 2.56)	0.002
% Energy Saturated Fat	-0.20 (-0.38 to -0.01)	0.04
Glycaemic Load	2.62 (-0.94 to 6.18)	0.15
Glycaemic Index	-0.22 (-0.48 to 0.04)	0.10

Significant increase in consumption of potassium, vitamin A, vitamin C, and folate

# Physical Activity

Outcome	Adjusted Treatment Effect	Adjusted P-value
Commuting Activity	11.83 (-26.75 to 50.42)	0.55
Leisure Activity	79.33 (-2.09 to 160.75)	0.06
<b>Household Activity</b>	<b>265.60 (61.36 to 469.84)</b>	<b>0.01</b>
Work Activity	80.85 (-163.12 to 324.83)	0.40
<b>Total Activity</b>	<b>359.76 (74.87 to 644.65)</b>	<b>0.01</b>

Change in total activity equivalent to 15-20 minutes brisk walking on most days of the week.

# Physical Activity – A nested RCT

- Women within the Lifestyle Advice Group further randomised
  - Access to a supervised walking group + Intervention sessions as previously described
  - Intervention sessions as previously described
- Poor compliance
  - Despite initial consent to participate, only 14% of women attended a walking group session
- No additional benefit of supervised walking group in increasing physical activity during pregnancy

# To summarise our findings...

Provision of an antenatal dietary and lifestyle intervention for women who are overweight or obese was associated with

Increased consumption of fruits, vegetables, and dietary fibre

Reduced percentage energy from saturated fats

Increased consumption of Vitamins A and C, & folate

Increased physical activity equivalent to 15-20 minutes brisk walking on most days

**What does this mean?**

Are our findings of modest dietary changes consistent with the available RCT literature?

# Dietary Changes following Randomised Interventions

- Limited available data reported from randomised interventions in pregnant women who are overweight or obese
- Findings consistent with 3 small randomised trials reporting dietary changes (Guelinckx 2010; Wolff 2008; Rae 2000)
  - Reduced consumption of saturated fat
  - Effects evident in the absence of changes in total energy intake or gestational weight gain (Guelinckx 2010; Rae 2000)

# Dietary Glycaemic Load and Index

- Effect of dietary GI and GL on pregnancy outcomes uncertain
  - Lower gestational weight gain
    - Walsh et al 2012 BMJ; Knudsen 2013 Br J Nutr
  - Infant birth weight



Moses 2006 AJCN



Walsh 2012 BMJ; Knudsen 2013 Br J Nutr; Grant 2011 Diabe Res Clin Pract; Moses 2013 AJCN; Rhodes 2010 AJCN

Could the modest changes observed  
in maternal dietary intake have an  
effect on clinical outcomes?

# Maternal dietary changes and child adiposity

- ROLO Randomised trial (Donnelly 2014 Pediatric Obesity)
  - Low GI diet associated with lower thigh circumference measure in neonates
- Project Viva Cohort (Donahue et al 2011 AJCN)
  - An association between higher maternal dietary polyunsaturated fatty acids and reduced childhood adiposity by skinfold thickness measurements
- Southampton Women's Survey (Moon et al 2013 JCEM)
  - 263 mother-child pairs
  - Maternal dietary polyunsaturated fatty acids associated with childhood adiposity assessed at 4 and 6 years age by DEXA

Are our findings of modest changes  
in physical activity consistent with  
the available RCT literature?

# Physical Activity Changes following Randomised Interventions

- Little available data reported from randomised interventions in pregnant women who are overweight or obese
- Non-randomised cohorts
  - Physical activity declines across pregnancy among women of all BMI categories
  - Particularly evident among women who are overweight or obese  
(Gaston 2011 J Sports Med Sci; Schmidt 2006 J Women's Health)
  - Increased proportion of domestic & caregiving activities
    - 50% activity during pregnancy
    - 65% among pregnant women who are overweight or obese  
(Schmidt 2006 J Women's Health; Chandonnet 2012 PLoS One; McParlin 2010 BMC)

**Are our findings valid?**

# Which tools should be used?

- Self-completed questionnaires
  - 4 time points during pregnancy and the post-partum period
  - Sample size in excess of 2,000 pregnant women
  - More detailed assessment tools were not considered feasible
    - Dietary recall
    - Accelerometer or pedometer
  - Allow between group comparisons rather than “gold-standard” estimates

# Which tools should be used?

- Dietary Assessment
  - Provision of “desirable” answers consistent with the intervention message
  - However, would also have anticipated reported changes in consumption of refined carbohydrates & sugar sweetened beverages, which was not observed
- Physical Activity Assessment
  - Use of pedometers and accelerometers not considered feasible
  - Poor estimation of upper body & stationary exercise
  - Poor estimation of low intensity activity

# Pregnancy: A teachable moment?

(Phelan 2010 Am J Obstet Gynecol)

# Yes, but...

- Being pregnant provides a label
  - Safety in a broader environment where weight and weight gain are stigmatised
- Women more sensitive to barriers to change
  - Pregnancy complications, tiredness
  - Don't like or feel like cooking or exercising
  - Lack of knowledge about healthy eating and physical activity
  - Lack of time
  - Lack of support
  - Higher cost of healthy eating
  - Lack of access to a safe place to exercise

(Sui et al 2013 Aust Medical J)

Our findings are consistent with the wider weight management literature from non-pregnant individuals...

Making lasting and significant change to diet and exercise patterns is hard!

# Conclusions

Our findings provide evidence that  
high infant birth weight can be improved  
in the absence of changes in gestational weight gain

Modest changes in dietary quality and physical activity  
are likely far more achievable  
from a public health perspective than are more restrictive  
approaches to  
limiting gestational weight gain

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