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Oregon Nutrition Update 2019

Nutrition Therapy within and Beyond Gestational Diabetes

Early Life Exposures Program

Colorado Clinical and Translational Sciences Institute (CCTSI)
UNIVERSITY OF COLORADO DENVER | ANSCHUTZ MEDICAL CAMPUS

Endocrinology, Metabolism and Diabetes
UNIVERSITY OF COLORADO ANSCHUTZ MEDICAL CAMPUS
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Teri L. Hernandez

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- No Conflicts of Interest

Investigations in the Gestational Origins of Lifelong Development
Learning Objectives

1. Describe the powerful influence of nutrition in pregnancy on glucose, [lipids], and infant adiposity
2. Understand some metabolic similarities across pregnancy phenotypes
   - Lessons from GDM can apply to all pregnancy
3. Summarize recommendations for nutrition in pregnancy and GDM based on current evidence
Nutrition in Pregnancy: A Powerful Influence

“Implications of maternal fuels...go far beyond diabetes in pregnancy...”

- Dr. Norbert Freinkel
Banting Lecture, 1980
Metabolic Exposures begin long before Pregnancy...

Birth
- Metabolic Syndrome
- Insulin Resistance
- Obesity
- Sedentarity

Childhood
- Infancy/Toddlerhood
- Formula Feeding
- Poor Diet Quality
- Sleep Disordered Breathing

Adolescence
- HTN
- Adolescence

Pregnancy
- Gestational Weight Gain
- ↑ Insulin Resistance
- ↓ Physical Activity
- GDM
- IGT
- NGT
- Postpartum Weight Retention
- Type 2 Diabetes
- Fat mass is ‘set’...Onwards to the next pregnancy....

Farabi SS & Hernandez TL, 2016
Poorer Diet Quality before Pregnancy:
↑ GDM Risk Independent of BMI

Nurses Health Study II
Western Diet pattern: more red meat, processed meats, 
refined grains, sweets, french fries, pizza
vs
Prudent Diet Pattern: more fruit, green leafy vegetables, 
poultry, fish
• ↑ red meat
  • ≥ 6 servings/week → 1.74 fold (95% CI 1.35, 2.26) 
    increased risk of GDM vs. <1.5 servings/week
  • Per 1 serving increase per day → 1.61 (95% CI 1.25, 2.07) increased risk of GDM
• ↑ glycemic load (global insulin demand)
  • Combined high glycemic load/low cereal-fiber diet → 2.15 fold (95% CI 1.04, 4.29) increased risk of GDM
• ↓ fiber
  • 10g/day increase in total fiber → 26% GDM risk 
    reduction (95% CI 9.0, 49)

*Adjusted for age, parity, pre-pregnancy BMI, 
diet factors (total calories), smoking, race 
family history

Simmons D, 2015, Diab Obes Metabol 17(9):824
Zhang C, 2006, Diabetes Care, 29(10):2223
Balanced Nutrition is Key: Pitfalls with Restriction of One Macronutrient Category

Pre-Pregnancy Carbohydrate Restriction Predicted Neural Tube Defects

- Pre-pregnancy carbohydrate restriction was associated with higher odds for NTD (aOR = 1.30, 95% CI 1.02-1.67)\(^1\)
  - n=1740 with birth defect/stillborn vs. n=9545 controls
    - Inadequate folic acid intake?
- Extremes in protein intake linked with low birth weight\(^2\)
  - Both restrictive, excessive intake
- Increased maternal ketones ∼ offspring neurological development\(^3\)

\(^1\)Desrosiers TA, 2018, Birth Defects Res; 1-9
\(^2\)Barker DJ, 2013, Clin Obstet Gynecol, 56(3):511
\(^3\)Discussed in Hernandez TL, 2018, Diab Res Clin Pract, 145:39
**Nutrition in Pregnancy: Overall Goals**

RDA = Recommended daily allowance

<table>
<thead>
<tr>
<th></th>
<th>Carbohydrate</th>
<th>Fiber</th>
<th>Total Fat</th>
<th>Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnant</td>
<td>175g</td>
<td>28g</td>
<td>‘Not Determined’</td>
<td>71g</td>
</tr>
<tr>
<td>Non-Pregnant</td>
<td>130g</td>
<td>25g</td>
<td>‘Not Determined’</td>
<td>45g</td>
</tr>
</tbody>
</table>

% of total calories | 45-65% | 20-35% | 10-35%

**Energy Intake Adjustments for Pregnancy**

*175g/day of carbohydrate does not account for placental glucose consumption*

Infant GOLD

Otten JJ, Institute of Medicine, 2006, http://www.nap.edu
Intrauterine environment: “Incubation medium” at the end of a nutritional supply line

Mother

Placenta

Fetus

Overnutrition
Insulin Resistance
Insulin Deficiency

↑↑ Glucose
↑↑ Fat
↑↑ Protein

Pedersen, 1952
Freinkel, 1980, Diabetes, 29(12):1023
Bloomfield F, 2017, Perinatal Research Society
Goal for Glucose Management: “Good” Glycemic Control by mimicking Normoglycemia

- 1-hour: <122 mg/dL
- 2-hour: <110 mg/dL

Should we also target maternal lipids???

- 2011: In nearly 50 years of research, only n=255 women
  - NW to OW, BMI range 22-28 kg/m²
  - Pre-pregnancy BMI vs. BMI at time of study unclear
  - Only 1 study had characterized glycemia in obese pregnant women (n=15)

FBG from HAPO: 80.9±6.9 mg/dL

Hernandez TL, 2011, Diabetes Care, 34(7): 1660
Freinkel N, 1980, Diabetes, 29(12):1023
Hernandez TL, 2015, Curr Diab Rep, 15: 565
Metabolic similarities across pregnancy phenotypes

Pre-pregnancy BMI is a poor predictor of metabolic milieu
Later Gestation Patterns of Glycemia in Obesity and GDM: Strikingly Similar

Week 28-31
GDM just after diagnosis

Later Gestation Postprandial Lipemia: Strikingly Similar in Obesity and GDM

Week 28-31
GDM just after diagnosis

State of the Science: Nutrition Therapy in GDM

Nutrition therapy will reach all women with the diagnosis independent of diagnostic criteria.
High Potential for Nutrition in GDM and Beyond

- Nutrition therapy: the original and most potent approach to treatment of diabetes (Joslin diet was 2% carbohydrate)\(^1,2\)
- Recognized as the cornerstone to treatment of GDM\(^3\)
- Pioneers in obstetrics and diabetes recognized that in-utero environmental conditions are shaped by maternal nutrition\(^4\)
- Diet therapy has the potential to effectively treat GDM without medication and ↑fetal surveillance\(^5\)
- Nutrition therapy is the single treatment component that will reach every woman with the diagnosis independent of diagnostic criteria and GDM phenotype\(^6\)

4. Freinkel, 1980, Diabetes, 29(12):1023
Challenging the Dogma: Nutrition in GDM

- **Choosing Healthy Options In Carbohydrate Energy = CHOICE™**
  - High Complex Carb/Low-Fat (HCC/LF)
  - 60% carb, mostly complex
  - 25% fat
  - 15% protein
- ‘Conventional Diet’
  - Low-Carb/Conventional (LC/CONV)
  - 40% carb
  - 45% fat
  - 15% protein
- Both diets
  - SFA- 35-45%; MUFA- 35-45%; PUFA- 15-20%
  - **Simple Sugars: fixed at 70±5g in both diets**
  - Carbs are ‘complex,’ low-moderate glycemic index
  - Fiber is similar (~24g/day in LC, ~29g/day in CHOICE)

Similar 24-hour Glycemia

- Similar patterns
- No difference in nocturnal or FBG
- No difference in mean glucose

Higher Insulin Excursion on CHOICE™

*post-breakfast plasma data

Higher FFA on the Conventional Diet

*post-breakfast plasma data

What does FFA response to the Atkin’s Diet look like?

Atkin’s diet (20g carb/day) vs. 55% Carb after 6 weeks of weight loss

Hernandez TL, 2010, AJCN, 91(3):578

**Non-pregnant humans**

Also: Hernandez, TL, 2016, Diabetes Spectr, 29(2), 82
Lower Fasting Glucose on CHOICE™ after 6-7 weeks

Weight Gain over 6-7 wks: 2.6kg 2.3kg

Also:
Lower fasting Insulin, HOMA-IR on CHOICE after 6-7 wks

Hernandez, TL, 2016, Diabetes Care, 39(1), 39
Greater insulin-suppression of Lipolysis on CHOICE™ after 6-7 weeks

Week 37 Adipose tissue biopsies

% Suppression, Isoproterenol + Insulin

- CHOICE: 56% (p=0.005)
- LC/CONV: 30%

Hernandez, TL, 2016, Diabetes Care, 39(1), 39
### Lower Infant Adiposity with CHOICE Exposure

<table>
<thead>
<tr>
<th></th>
<th>LC/CONV</th>
<th>CHOICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>C-section</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>2/4</td>
<td>3/3</td>
</tr>
<tr>
<td>Gest Age, weeks</td>
<td>39.2±0.4</td>
<td>40.5±0.5</td>
</tr>
<tr>
<td>Birth Weight, g</td>
<td>3421±186</td>
<td>3273±104</td>
</tr>
<tr>
<td>Adiposity, PeaPod, 2wks</td>
<td>12.6±2.0</td>
<td>10.1±1.4</td>
</tr>
</tbody>
</table>

*Mean±SEM*

Hernandez, TL, 2016, Diabetes Care, 39(1), 39

\[ p > 0.05 \]
Different types of dietary advice for women with gestational diabetes mellitus (Review)

Han S, Middleton P, Shepherd E, Van Ryswyk E, Crowther CA

Evidence from 19 trials of different types of dietary advice for women with GDM suggests no clear differences in outcomes and secondary outcomes assessed using GRADE, except for a possible reduction in caesarean section for women receiving a DASH diet compared with a control diet. Few differences were observed for secondary outcomes.

Current evidence is limited by the small number of trials in each comparison, small sample sizes, and variable methodological quality.

Approaches reviewed across trials:
- Glycemic Index (Low, Moderate, Higher) ~ Energy-restricted ~ Dietary Approaches to Stop Hypertension (DASH) ~ Low vs. Higher Carbohydrate ~ High vs Low Unsaturated Fat ~ Higher vs. Standard Fiber ~ Diet recommendations + behavior advice ~ Soy-protein enrichment ~ Ethnic-specific
2018: Nutrition modification to improve intake from baseline in GDM reduces maternal glucose, BW

- 18 RCTs
- 1,151 women
- Fasting glucose ↓4mg/dL
- Postprandial glucose ↓8 mg/dL
- Birth weight ↓171g (9 studies)
- Low quality of evidence

Yamamoto JM, 2018
Diabetes Care, 41:1346
Suggestions of Benefit: The Case for Higher Quality Complex Carbs instead of pure Carb Restriction

**Improved**
- Maternal glucose control, equal to or superior to carbohydrate restriction
- Fasting glucose
- Response to OGTT
- A1C
- Insulin action, insulin resistance index
- Systolic BP

**Decreased**
- Total, LDL cholesterol
- Fasting, postprandial lipemia

**Vascular Benefits**
- ↑ total glutathione/anti-oxidant capacity

Appropriate GWG when calories not in excess
Less C-section delivery
Less macrosomia, lower birth weights

A Less Restrictive Nutrition Approach is Culturally Adaptive

<table>
<thead>
<tr>
<th>Geographical region</th>
<th>Examples of traditional foods that qualify for less restricted GDM Nutrition therapy approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>Whole grain breads, pasta, brown or parboiled rice, oats</td>
</tr>
<tr>
<td></td>
<td>Vegetables, fruits, beans, lentils</td>
</tr>
<tr>
<td></td>
<td>Low-fat dairy, lean poultry and fish</td>
</tr>
<tr>
<td></td>
<td>Occasional meats, cheese and nuts</td>
</tr>
<tr>
<td>Latin America</td>
<td>Whole grains like amaranth, maize, quinoa, brown rice</td>
</tr>
<tr>
<td></td>
<td>Vegetables, fruits, beans</td>
</tr>
<tr>
<td></td>
<td>Lean poultry, fish, low-fat dairy</td>
</tr>
<tr>
<td></td>
<td>Occasional meats, nuts and cheese</td>
</tr>
<tr>
<td>Mediterranean Region</td>
<td>Whole grain bread/pasta, brown rice, couscous</td>
</tr>
<tr>
<td></td>
<td>Vegetables, fruits, beans, lentils</td>
</tr>
<tr>
<td></td>
<td>White fish, lean poultry, low-fat dairy</td>
</tr>
<tr>
<td></td>
<td>Occasional nuts, cheese, meats and shellfish</td>
</tr>
<tr>
<td>Africa</td>
<td>Whole grains like millets, sorghum, teff, parboiled rice</td>
</tr>
<tr>
<td></td>
<td>Vegetables, fruits, roots, tubers, beans</td>
</tr>
<tr>
<td></td>
<td>Fish, eggs, poultry</td>
</tr>
<tr>
<td></td>
<td>Occasional meats and dairy</td>
</tr>
<tr>
<td>South Asia</td>
<td>Whole wheat, millets, barley, rye, buckwheat, parboiled rice, wheat rotis</td>
</tr>
<tr>
<td></td>
<td>Vegetables, roots, tubers, fruits</td>
</tr>
<tr>
<td></td>
<td>Beans, lentils, dals, low-fat dairy, lean poultry, fish</td>
</tr>
<tr>
<td></td>
<td>Occasional meats, nuts and cottage cheese (paneer)</td>
</tr>
<tr>
<td>East Asia</td>
<td>Noodles and brown rice</td>
</tr>
<tr>
<td></td>
<td>Soybeans, fish, seafood, vegetables, wild plants, seaweed, mushrooms</td>
</tr>
<tr>
<td></td>
<td>Occasional lean meats, shellfish, dairy</td>
</tr>
</tbody>
</table>

IMPLICATIONS FOR PRACTICE
The Academy's EAL EBNPGs promote the application of a consistent approach to qualify clinical practice to achieve positive patient outcomes. Despite the lack of clear evidence for an ideal nutrition prescription for all women with GDM, a number of dietary approaches or combinations of approaches may be considered within the framework of the guideline. For example, no studies evaluated CHO counting, a common tool used by RDNs. However, the guideline recommendations may be facilitated by use of CHO counting, helping to explain and implement the recommendations for the amount, type, and distribution of CHO as part of a strategy to achieved better glycemic control.

treatment goals; physical activity; medication, if any (eg, insulin); and patient needs. The amount and type of CHO at meals and snacks should be individualized and distributed into three meals and two or more snacks per day to reduce postprandial BG elevations. In the case that a patient continues to experience elevated postprandial BG after breakfast, further modification to the amount or the type of CHO at breakfast may be incorporated to achieve BG targets.

Individualization...
At Delivery….our work is not done

Poor postpartum diet quality in GDM

<table>
<thead>
<tr>
<th>2 wks- 4 mos Postpartum</th>
<th>BMI Kg/m²</th>
<th>Protein</th>
<th>Carbohydrate</th>
<th>Fat</th>
<th>Saturated Fat</th>
<th>Added Sugars</th>
<th>Whole Grains</th>
<th>Refined Grains</th>
<th>Glycemic Index</th>
<th>Fiber</th>
</tr>
</thead>
<tbody>
<tr>
<td>NW (n=29)</td>
<td>24±4</td>
<td>17%</td>
<td>48%</td>
<td>34%</td>
<td>12%</td>
<td>21%</td>
<td>30%</td>
<td>70%</td>
<td>83</td>
<td>24g</td>
</tr>
<tr>
<td>Ob (n=11)</td>
<td>32±4</td>
<td>12%</td>
<td>49%</td>
<td>34%</td>
<td>12%</td>
<td>26%</td>
<td>10%</td>
<td>90%</td>
<td>88</td>
<td>20g</td>
</tr>
<tr>
<td>GDM (n=9)</td>
<td>31±4</td>
<td>18%</td>
<td>44%</td>
<td>38%</td>
<td>13%</td>
<td>23%</td>
<td></td>
<td></td>
<td>86</td>
<td>13g</td>
</tr>
<tr>
<td>Intensive GDM (n=14)</td>
<td>30±3</td>
<td>18%</td>
<td>46%</td>
<td>36%</td>
<td>12%</td>
<td>9%</td>
<td>21%</td>
<td>78%</td>
<td>84</td>
<td>20g</td>
</tr>
<tr>
<td>DGA* Guideline</td>
<td></td>
<td></td>
<td>&lt;25%</td>
<td>&lt;10%</td>
<td>&lt;10%</td>
<td>≥50%</td>
<td>&lt;50%</td>
<td>≤55 low 56-69 med</td>
<td>25-28g</td>
<td></td>
</tr>
</tbody>
</table>

*DGA=USDA Dietary Guidelines for Americans, 2015-2020

**Intensive GDM:**
Women were randomized to 1 of 2 high quality diets just after diagnosis; food was provided through delivery

GDM Postpartum: Pattern of ↓Calcium, ↓Potassium, ↓vitamins
Across Women: ↓fiber, ↑sodium, ↑refined grains → *Patterns recently linked with increased worldwide diet-related death/disability*[^4]

1. Friedman, American Diabetes Association
2. Barbour, R01DK78645
3. Hernandez, R01DK101659
4. GBD 2017 Diet Collaborators, April 3, 2019, Lancet
Prevention of GDM starts long before pregnancy
Pre-pregnancy interventions can include:
• Good nutrition focused on ↑ diet quality, healthy eating patterns
• Return to normal body weight before conception
• Attention on psychological factors such as anxiety, depression, and dysfunctional eating patterns

Nutrition Implications for all pregnant women, children and families:
• Focus on increasing diet quality and reinforcing healthy eating patterns: ↑ fruits, vegetables, legumes, whole grains
• Avoidance of simple sugars: contribute to hyperglycemia
• Fats in moderation: high total and increased saturated fats contribute to insulin resistance

It takes a Village...

- Linda A. Barbour, MD, MSPH
- Jacob E. Friedman, PhD
- Rachael E. Van Pelt, PhD
- Nicole Hirsch, MS, CLC
- Sarah Farabi, PhD, RN
- Libby Haugen, BA, Nursing Student
- Emily Dunn, MS, RD, CDE
- Kristy Heiss, BS
- Jayne Martin-Carli, PhD
- Laurie Moss, MS
- Nancy Krebs, MD
- Becky DelaHoussaye, MS
- Robert H. Eckel, MD
- R01 DK 078645
- Judith Regensteiner, PhD
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- CCTSI Adult/Pediatric Nursing Core
- R01 DK 101659
- Gabriele Ronnett, PhD

THANK YOU!