

Pregnancy Nutrition Update



Produced by the Alabama Department of Public Health
Video Communications and Distance Learning Division

Faculty

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What is Developmental Origins of Health and Disease (DOHAD) or Fetal Programming?

As an adaptation to undernutrition in fetal life, permanent metabolic and endocrine changes occur which would be beneficial if nutrition remained scarce after birth.

If nutrition becomes plentiful, however, these changes predispose to obesity and impaired glucose tolerance.

(Hales and Barker, *Diabetologia*, 1992)

What Affects Fetal Programming?

- Weight
- Weight Gain
- Nutrients
- Stress
- Environmental chemicals

Overnourished Environment: Weight

- Pre - Pregnancy Weight: Overweight
- Pregnancy: Excessive Weight Gain
- Risk factors for:
 - Gestational Diabetes
 - Pre - eclampsia
 - C - Section Delivery
 - Insulin resistance

Overnourished Environment: Weight

- Subclinical inflammation
- Children with more body fat in early childhood



Undernourished Environment: Weight

- Pre - Pregnancy: Underweight
- Pregnancy: Inadequate weight gain for growth
- Risk factors for
 - Premature birth
 - Intrauterine Growth Retardation (IUGR)



Undernourished Environment: Weight

- Low birth weight
- Altered programming of architecture and function of the liver
- Reduced number of nephrons, which can lead to hypertension

Overnourished Environment: Diet

- Elevated blood glucose
- Gestational diabetes
- Imbalance of one or more macronutrients
- Diet with a high glycemic index

Possible Outcomes

- C - Section Delivery
- Insulin resistance
- Subclinical inflammation
- Children with more body fat in early childhood

Points to Ponder

- Type 2 Diabetes is under diagnosed; 40% of those who have it do not know it
- New screening guidelines for GDM from ADA: 18% of pregnancies could be complicated with diabetes
- Most women start their pregnancies overweight
- OOPS - Many pregnancies are unplanned

Overnourished or Undernourished: Similar Consequences in Child

- Higher risk of
 - Diabetes
 - Heart Disease
 - Hypertension
 - Metabolic Syndrome
 - Overweight



Fetal Programming: Nutrition

- Nutrient deficits before and in early pregnancy affect risk of high risk pregnancy in 2nd and 3rd trimester of pregnancy:
 - Iron deficiency
 - Protein deficiency
 - Vitamin D insufficiency / deficiency
 - Vitamin C deficiency

Fetal Programming: Nutrition

- Folate deficiency
- Sedentary lifestyle
- Alcohol / Drugs



Fetal Programming: Nutrition

- Folate, B6 and B12: low serum level associated with inflammation and pre - eclampsia
- Magnesium, Calcium, Vitamin D, Zinc: deficit associated with preeclampsia, reduced bone density



Iodine

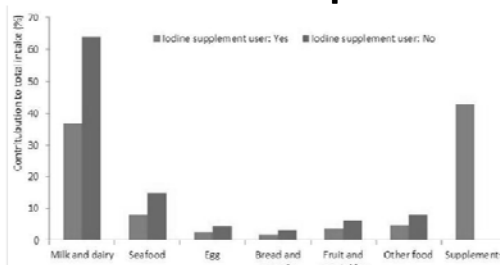
- Mild iodine deficiency linked with reduced educational outcomes at age 9
- Severe iodine deficiency is linked to miscarriage, stillbirth, preterm delivery and birth defects
- Children of iodine deficient moms have mental retardation and problems with growth, hearing and speech

Iodine

- Iodized salt is a good source; sea salt varies
- Salt in processed foods is generally NOT iodized

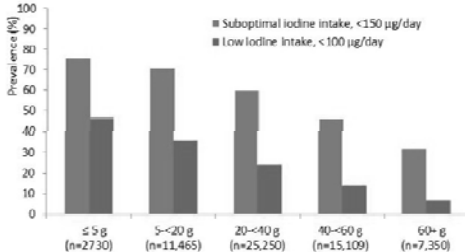


Iodine Intake from Food Groups



<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3635203/>
(Brantsaeter, *Nutrients*, 2013)

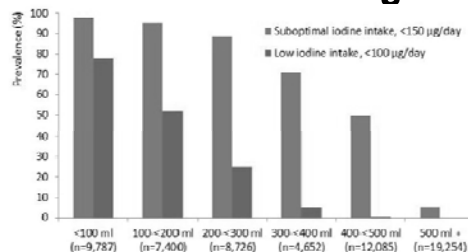
Achieving Adequate Iodine Intake with Seafood



<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3635203/>

The prevalence of suboptimal (<150 µg/day) and low (<100 µg/day) iodine intake by increasing consumption of seafood in 42,329 non-iodine supplement users. (Brantsaeter, *Nutrients*, 2013)

Achieving Adequate Iodine Intake with Milk / Yogurt

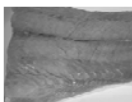


<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3635203/>

The prevalence of suboptimal (<150 micrograms/d) and low (<100 micrograms per day) iodine intake by increasing consumption of milk and/or yogurt in 43,000 non-iodine supplement users. (Brantsaeter, *Nutrients*, 2013)

Fats

- Imbalance of Omega 6: Omega 3
- Not enough dietary DHA
 - Most common sources of omega-6: safflower oil, sunflower oil, corn oil, soybean oil
 - Processed foods contain more omega - 6 fats
 - Women are not eating enough seafood



Environmental Chemicals



According to a WHO / UN Report:

“Close to 800 chemicals are known or suspected to be capable of interfering with hormone receptors, hormone synthesis or hormone conversion. However, only a small fraction of these chemicals have been investigated in tests capable of identifying overt endocrine effects in intact organisms.”

State of the Science of Endocrine Disrupting Chemicals, WHO and United Nations Environment Programme, 2012

- Endocrine related diseases and disorders are on the rise:
 - Up to 40% of young men in some countries have low semen quality
 - Genital malformations in baby boys has increased over time or stayed at high rates

State of the Science of Endocrine Disrupting Chemicals, WHO and United Nations Environment Programme, 2012

- Adverse pregnancy outcomes like preterm birth and low birth weight have increased in many countries
- Neurobehavioral disorders associated with thyroid disruption affect many children and incidence has increased

State of the Science of Endocrine Disrupting Chemicals, WHO and United Nations Environment Programme, 2012

- Global rates of endocrine - related cancers (breast, endometrial, ovarian, prostate, testicular and thyroid) have been increasing over the last 40 - 50 years
- Prevalence of obesity and type 2 diabetes and dramatically increased worldwide

Other Environmental Chemicals

- Heavy Metals

- Mercury (fish)
- Lead (paint, pipes, some ceramics)
- Arsenic (some brown rice and juice)
- Cadmium (tobacco, batteries, fertilizers)



Other Environmental Chemicals

- Phthalates

- Scented body products: lotion, cosmetics, deodorant, air fresheners, candles, anything with “fragrance”
- PVC, vinyl shower curtains, medical tubing



Other Environmental Chemicals

- PCBs
 - Found in soil, water and the air
 - In food supply; especially fish and other high fat animal products

Pesticides / Insecticides

- Widespread use
 - Commercial buildings and homes
 - Landscaping
 - Crops: food and textile
- 45% of pesticide poisonings are in children
- In a multiethnic study of pregnant women, 70% had been exposed to indoor pesticides (Berkowitz GS, Env Hlth Persp, 2003)

Pesticides / Insecticides

Pesticides are associated with decreased fertility, birth defects, low birth weight, Attention Deficit / Hyperactivity Disorder.

(Karr JR., Pediatrics, 2012)



Endocrine Disrupting Chemicals (EDCs)

- “Interferes with synthesis, secretion, transport, metabolism, binding action, or elimination of natural hormones that are present in the body and are responsible for homeostasis, reproduction, and developmental processes”

– US Environmental Protection Agency

Endocrine Disrupting Chemicals (EDCs)

- May affect risk of low birth weight, birth defects, reproductive and neuroendocrine disorders (Endocrine Society, 2009)
- May alter fat cells or parts of brain affecting feeding behavior (Thayer et al, Environmental Health Perspectives, 2012) (Ge, Journal of Pediatrics 2009)

Dietary Sources of Endocrine Disruptors

- Foods and beverages containing pesticides
- Plastic storage containers and some water bottles, thermal cash register receipts
 - High fat foods and high temperatures increase leaching of BPA from plastic



Dietary Sources of Endocrine Disruptors

- Large predatory fish and fish from polluted water
 - www.fish4health.net: includes link to EPA advice and apps
 - High fat animal foods: chemicals are stored in body fat
 - Choose lean beef, avoid the skin of chicken / fish, choose skim and low fat dairy

BPA

- Possibly related to oxidative stress and metabolic dysfunction
(Veiga-Lopez, Endocrinology 2015, Ashley-Martin, Environmental health, 2014)
- Low dose BPA exposure during pregnancy associated with decreased lung function at age 5
(Spanier, JAMA Pediatrics, 2014; Donahue Allergy and Clinical Immunology, 2013)
- Some research shows a link between BPA exposure and child behavior
(Rosen, Environmental Research 2015)
- FYI: BPA was banned in US baby bottles and Sippy cups in 2013

Does a Dad's Diet and Lifestyle Count? YES!

- Alcohol, Endocrine Disruptors and Drugs: affect DNA of sperm
- Antioxidants: deficit affects sperm and risk of birth defects
- Dad's type 2 diabetes associated with low birth weight (Tyrrell JS., Int J Epidemiol, 2013)
- Birth history: dad born LBW associated with offspring LBW (Shah, 2010)

Dads and Chemicals

- Bad for fertility:
 - Pesticides, insecticides, heavy metals, solvents
- Environmental chemicals can affect fertility and also affect risk of birth defects



Prenatal Stress and Anxiety: Infant Outcomes

- Temperamental problems and increased fussiness
- Problems with attention, attention regulation, and emotional reactivity
- Lower scores on measures of mental development

Stress and Anxiety: Birth Outcomes

- Increased risk of stillbirth
- Preterm birth
- Lower birth weight

– (Loomans 2013)

So What?

Infants of depressed moms are at risk for fetal growth restriction, and altered neonatal and infant behavior such as disorganized sleep and less responsive to stimulation.

(Etebary Iran J Psychiatry 2010)



So What?

Infants of depressed mothers have difficult temperament, and later in development may have greater risk of attentional, emotional and behavioral problems such as ADHD and antisocial behavior, as well as chronic illnesses in adulthood.

Prenatal Stress and Anxiety: Child Outcomes

- Associated with hyperactivity and inattention in boys
- Emotional problems in girls and boys
- Conduct problems in girls

Pregnant Depressed Mothers are at Risk of:

- Poor weight gain
- Substance abuse
- Failure to obtain adequate prenatal care



Risk Factors for Depression During Pregnancy

- History of depression
- Lack of partner
- Marital difficulties
- Lack of social support, poverty
- Increased life stress
- Substance abuse



Risk Factors for Depression During Pregnancy

- Anxiety about the fetus
- Ambivalence toward the pregnancy
- History of previous abortions
- Family violence
- Unplanned pregnancy

Risk Factors for Postpartum Depression

- Immigration within the last 5 years
- History of depression independent of childbirth
- Recent psychological stress
- Significant physiological stress
- Difficult childbirth experience
- Diagnosis of pregnancy - induced hypertension

Risk Factors for Postpartum Depression

- Vulnerable personality style
- Stressful life events
- Lack of perceived support
- Lack of readiness for hospital discharge
- Dissatisfaction with infant feeding method

What Causes Depression During and After Pregnancy?

- Hormones - Estradiol increases significantly
- Low levels of neurotransmitters
- Altered membranes which the neurotransmitters travel through
- Stressful life events often occur before a depressive episode

What's Nutrition Got To Do With It?



Nutrient Requirements are Higher ...but Moms

- May not feel like eating (nausea, heartburn, constipation)
- May not feel like eating the right foods
- May not have the resources to buy or prepare healthy foods

Nutrient Requirements are Higher ...but Moms

- A depressed mom / mom-to-be may not be able to act on good intentions
 - She cannot motivate herself to take healthy actions, even if she knows it is best

Omega - 3s

- Building blocks of brain tissue
- 40% of the polyunsaturated fat in the brain
- 60% of the polyunsaturated fat in the retina
- DHA and EPA found in:
 - Cell membranes of brain
 - Cell membranes of retina
 - In neurotransmitters

B Vitamins

- Vitamin B6, B12 and folate are needed to make neurotransmitters
- Imbalance of neurotransmitters is one cause of depression
- Vitamin B6 has been linked to hormone related depression in women



Eat Folate, Be Happy!

- Not enough folate can lead to high Homocysteine levels which can lead to poor birth outcomes like low birth weight, preeclampsia, miscarriage and placental abruption, which can also lead to depression
- Not enough folate can affect production of neurotransmitters

Eat Folate, Be Happy!

- Folate may have antidepressant properties
- Effectiveness of antidepressants may depend on folate levels



Folate

- Also known as folic acid and folacin
- Folic acid is the form added to supplements and in fortified foods
- Is a coenzyme for making DNA and RNA - necessary for cell division
- A deficiency can cause megaloblastic anemia and neural tube defects
- Needed for conversion of homocysteine to other compounds - excess can be a sign of low folate

How Much Does the Body Absorb?

- At least 85% of folic acid (supplements, fortified foods) is absorbed when taken with food
- Only 50% is absorbed from food sources

Best Food Sources of Folate

- Spinach, cooked ½ cup: 33%
- Black eyed peas, ½ cup: 26%
- Breakfast cereals, fortified with 25% of DV
- White rice, ½ cup: 23%
- Asparagus, 4 spears: 22%
- Spaghetti enriched, ½ cup: 21%



Best Food Sources of Folate

- Brussels sprouts, ½ cup: 20%
- Avocado, ½ cup: 15%
- Broccoli, mustard greens, peas, kidney beans, white bread have 11 - 13% per serving

Folic Acid Fortification

- Added to enriched breads, cereals, flours, cornmeal, pastas, rice and other grain products
- Cereals are important sources of folic acid
- Not added to whole grains or corn masa
- Hispanics continue to have the highest rate of neural tube defects

Who is Not Getting Enough?

- 2003 - 2006 NHANES: 75% of non-pregnant women of childbearing age did not consume enough folic acid
- Folic acid supplement use from 2003 - 2008 was less than 40% in women aged 18 - 45

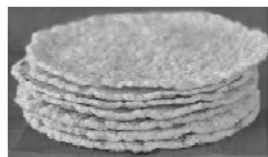


Who is Not Getting Enough?

- Supplement use is the strongest indicator of adequate intake
- Hispanics eat fewer fortified foods and are less likely to take supplements with folic acid

Corn Masa

- Mexico, Chile and other Central American countries fortify corn masa and related products
- The United States does not



Why Do We Need B6?

- As a coenzyme, it helps with more than 100 different reactions in the body
- Plays a role in production of neurotransmitters
- Helps make glucose
- Involved in the immune system

Best Sources of B6

- Poultry, fish and organ meats
- Potatoes and other starchy vegetables, which are some of the major sources of vitamin B6 for Americans
- Fruit (except citrus)



Sources of B6

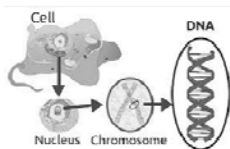
- Chickpeas, canned 1 cup: 55%
- Tuna, fresh, 3 oz.: 45%
- Salmon 3 oz: 30%
- Chicken breast, 3 oz.: 20%
- Potatoes, 1 cup: 20%
- Turkey, 3 oz: 20%
- Banana 1 medium: 20%
- Spaghetti sauce, 1 cup: 20%



Do We Get Enough?

- 24% of people in the United States, and 11% of people who take a vitamin B6 supplement have low concentrations of vitamin B6
- The level was lower in women and blacks, current smokers, underweight, obese and those with malabsorption syndromes
- Teens had the lowest levels, followed by 21 - 44 year olds

Vitamin B12



- Needed for proper red blood cell formation, neurological functions and DNA synthesis
- Important for many chemical reactions that affect the brain

Best Sources of B12

- Fish, beef, milk and other animal products
- 3 oz of trout: 58% DV
- Double cheeseburger: 35%
- 3 oz Top sirloin: 23%
- 1 cup of milk or yogurt: 18%
- Cured ham, 3 oz: 10%
- Chicken breast, 3 oz: 5%



Iron

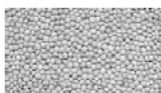
- Needed for neurotransmitter production and function and thyroid hormone metabolism
- Iron deficiency without anemia is associated with higher depressive scores among women taking contraceptives
- Women who were anemic on day 7 postpartum had higher depressive symptoms on day 28 than non - anemic women

Best Sources of Iron

- Fortified cereals and breads, lean meat and seafood, nuts, beans, vegetables
- In the United States, half of dietary iron comes from bread, cereal and other grain products
- White beans, 1 cup: 44%
- Beef liver, 3 oz: 28%

Best Sources of Iron

- Tofu or lentils, ½ cup: 17%
- Dark chocolate, 1 oz: 13%
- Beef bottom round, 3 oz: 11%
- Stewed tomatoes ½ cup: 11%
- Potato, 1 medium: 10%



Iron Bioavailability

- 4 - 18% from mixed diets containing meat, seafood and vitamin C
- 5 - 12% from vegetarian diets
- Vitamin C, meat and seafood can increase absorption of non - heme iron found in vegetables and eggs
- There are enhancers and inhibitors to iron absorption, which in a mixed diet have little total effect

Zinc

- In the brain, zinc is found within neurons at the synapse
- Thought to be involved in nerve signal transmission as well as acts as a neurotransmitter
- Needed for DNA and for cell membranes

Zinc

- Deficiency causes depression of immune system, also common among depressed people
- Blood zinc concentrations linked with depression

Best Sources of Zinc

- Seafood especially shellfish, beef, fortified cereals, beans, nuts
- Oysters 3 oz: 493%
- Chuck roast 3 oz: 47%
- Crab, 3 oz: 43%
- Pork loin, 3 oz: 19%
- Baked beans, ½ cup: 19%



Best Sources of Zinc

- Chicken, dark, 3 oz: 16%
- Yogurt, 8 oz: 11%
- Chickpeas, ½: 9%



Antioxidants

- The brain is a major consumer of oxygen
- This creates reactive oxygen species (free radicals) which can attack and damage neuron cell membranes
- Damaged cell membranes affect neurotransmitter transport

Antioxidants

- Free radicals can cause oxidative stress and vascular changes, which have been observed in depression
- Antioxidants like vitamin C and E could be important in the brain



Selenium

- Plays a critical role in reproduction, thyroid hormone metabolism, DNA production, as an antioxidant, and for immune system
- Thought to play an important role in brain function
- During times of deficiency, the brain retains selenium

Best Sources of Selenium

- Brazil nuts, 1 oz - 6 - 8: 777%
- Tuna - yellow fin, 3 oz: 131%
- Sardines, 3 oz: 64%
- Ham 3 oz: 60%
- Shrimp, 3 oz: 57%
- Macaroni, 1 cup: 53%
- Chicken, 3 oz: 31%
- Ground beef, 3 oz: 26%
- Egg, 1 large: 21%



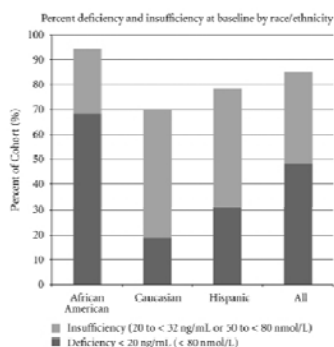
Vitamin D

- Deficiency / Insufficiency is Widespread, even in sunny areas
- Risk Factors:
 - Dark skin, covered skin, sunscreen
 - Body fat
 - Latitude
 - Genetic variation
 - Lack of vitamin D in the diet



Vitamin D

- Light exposure also plays a role in depression, especially Seasonal Affective Disorder (SAD)
- Bright light therapy has been used as a non-medicinal therapy for depression (Crowley J. Journal of Physiological Anthropology, 2012)



(Hamilton SA., Int J Endocrinol, 2010) Pregnant women age 14 - 43, Columbia and Charleston, SC

Vitamin D Insufficiency / Deficiency

- Infertility
- Bacterial vaginosis
- Gestational diabetes / higher blood glucose
- Preeclampsia
- Primary C - section
- Postpartum depression

Vitamin D Insufficiency / Deficiency

- Risk of low blood calcium in newborn
- Risk of rickets in newborn / infant if breastfed
- Decreased bone mass in childhood

– (Grundmann G., Reprod Biol Endocrinol, 2011)



How Dairy, Calcium and Probiotics Affect Birth Outcomes

- Reduced risk of preeclampsia
- Increased placental weight
- As the best source of dietary vitamin D, affects negative outcomes associated with insufficiency

How Dairy, Calcium and Probiotics Affect Birth Outcomes

- Daily probiotic dairy foods associated with decreased risk of preeclampsia (Brantsaeter 2011)
- Dental health



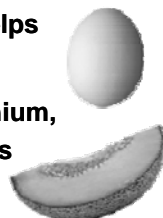
WIC Foods: Champions of Mental Health

- Milk, yogurt, cheese: vitamin D (milk), zinc, vitamin B12, iodine
- Whole grains: iron, zinc, vitamin E, selenium, antioxidants
- WIC cereals: folic acid, zinc, iron, vitamin B6 and B12
- Salmon, tuna: omega-3s, B6, B12, selenium, iodine



WIC Foods: Champions of Mental Health

- Eggs: choline, selenium, vitamin D
- WIC juice: vitamin C helps iron absorption
- Beans: zinc, iron, selenium, vitamin B6, antioxidants
- Potatoes: B6
- Fruits and vegetables: B6, folic acid



Pregnancy on the Dash Diet



What is the DASH Diet?

- Dietary Approaches to Stop Hypertension (DASH) is a flexible and balanced eating plan that is based on research studies sponsored by the National Heart, Lung, and Blood Institute (NHLBI)

What is the DASH Diet?

- These studies showed that DASH lowers high blood pressure and improves levels of blood lipids (fats in the bloodstream), which reduces the risk of developing cardiovascular disease

Appropriate for Pregnancy and Postpartum? YES!

- Recommended by the 2010 Dietary Guidelines for Americans and ChooseMyPlate.gov as one of the best plans people of all ages can follow
- Studied in women with a history of gestational diabetes with favorable results (Tobias DK. Arch Intern Med. 2012)

Appropriate for Pregnancy and Postpartum? YES!



In a Nutshell...

- The DASH eating plan:
 - Emphasizes vegetables, fruits, and fat - free or low - fat dairy products
 - Emphasizes whole grains, fish, poultry, beans, seeds, nuts, and vegetable oils

In a Nutshell...

- Limits sodium, sweets, sugary beverages, and red meats (However the BOLD diet, emphasizing lean beef results in similar cholesterol effects)
- In terms of nutrition content, DASH is:
 - Low in saturated and *trans* fats
 - Rich in potassium, calcium, magnesium, fiber, and protein

In Other Words...

The DASH diet is how we would like all of our clients to eat!

What is the DASH Diet?

Daily Nutrient Goals Used in the DASH Studies (for a 2,000-Calorie Eating Plan)

Total fat	27% of calories
Saturated fat	6% of calories
Protein	18% of calories
Carbohydrate	55% of calories
Cholesterol	150 mg
Sodium	2,300 mg*
Potassium	4,700 mg
Calcium	1,250 mg
Magnesium	500 mg
Fiber	30 g

Possible Benefits of Eating a DASH-like Diet During Pregnancy

- **Healthier weight gain**
 - Increased fruits and vegetables
- **Can lead to better birth outcomes such as decreased risk of gestational diabetes and large for gestational age babies**
- **Better digestive health - can improve appetite**

Possible Benefits of Eating a DASH-like Diet During Pregnancy

- **Healthy blood pressure**
 - Improved blood flow to fetus improves nutrient delivery
- **Increased serum levels of calcium and magnesium linked to lower risk of preeclampsia**

More Possible Benefits of DASH Diet

- **Lower risk of gestational diabetes**
 - Lower glycemic index
 - Increased fruit, vegetable and cereal fiber linked with lower risk of GDM

Who Would Benefit Most?

- **Women with high blood pressure**
- **Women with previous hypertensive disorder during pregnancy**
- **Overweight women (greater risk of hypertension)**
- **Women with major stress**

DASH for Postpartum Weight Loss

- **DASH diet is the number one rated diet for weight loss**
 - Fruits, vegetables and whole grains help with fullness, possible role of calcium
- **Mediterranean diet similar in focus and has been studied in pregnancy**
(Timmermans Am J Obstet Gynecol. 2011., Br J Nutr. 2012)

WIC Foods for the DASH Diet

- **Calcium:** Milk, yogurt, cheese, vegetables
- **Magnesium:** spinach, peanut butter, beans (especially black and kidney), potato, milk, soymilk, whole grain cereals
- **Potassium:** Fruits and vegetables: potatoes, avocado, tomatoes and sauce, melon, bananas, kiwi
- **Also, WIC cereals may be fortified with any of the above nutrients**

Antioxidants in Whole Grains and Healthy Blood Pressure

In the Women's Health Study of 30,000 women who ate the most whole grains had a 11% lower risk of developing hypertension

• (Wang, AJCN Aug 2007)

Antioxidants in Whole Grains and Healthy Blood Pressure

- Men who ate the most whole grains had a 19% reduced risk of hypertension in the Health Professionals Follow Up Study of 31,000 (Flint, AJCN Aug 2009)
- In a small 12 week study, eating 3 servings of whole grains daily significantly reduced blood pressure (Tighe, AJCN Oct 2010)

Frosted Mini Spooners

- 1 cup with ½ cup milk provides:
 - 100% DV folic acid
 - 90% DV iron
 - 30% DV Zinc
 - 20% DV Magnesium
 - 15% DV for calcium



Cheerios

- 1 cup cereal with ½ cup milk provides:
 - 50% DV folic acid
 - 45% DV iron
 - 25% DV calcium
 - 10% DV magnesium



Summary

- **YOU ARE** making a difference to the health of the next generation!
- Fetal programming is a proven hypothesis and using the evidence can improve prenatal outcomes

Summary

- Prenatal and postpartum mental health cannot be overlooked; nutrition makes a difference
- A whole foods diet, similar to MyPlate, with a bit of "DASH" + a healthier lifestyle results in healthier pregnancy and positive birth outcomes