

Setting The Stage for Future Generations: The Impact of Good Nutrition Throughout the Lifecycle

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Preconception Nutrition: Get Ready for Pregnancy

Pre-pregnancy Planning: Why It Matters

- Most US adults are unaware of how health and lifestyle factors such as obesity affect reproductive health and childbearing
- Nearly 50% of pregnancies in U.S. are unexpected or mistimed

(AAP/ACOG; Brown and Eisenburg, eds. 1995)

Pre-pregnancy Planning: Why It Matters

- Women with unintended pregnancies are less likely to seek early prenatal care
- The embryo and fetus are highly susceptible to birth defects and other problems during the first 8 weeks
 - binge drinking 3 times or more during the first 16 weeks: 56% greater risk for stillbirth than no binge drinking
 - Inadequate folic acid during the first 30 days increases the risk for neural tube defects

(AAP/ACOG; Brown and Eisenburg, eds. 1995; Strandberg-Larsen K, et al. Obstetrics and Gynecology 2008; 111(3):602-609)

Recommendations to Improve Preconception Health and Health Care (2005)

- Details the goals of preconception care for the estimated 62 million American women in their childbearing years (15 to 44 yrs.)

(CDC. A Report of the CDC/ATSDR Preconception Care Work Group and the Select Plan on Preconception Care)

Preconception Care Includes:

- Screening for health risks, such as iron deficiency, diabetes, and overweight
- Health promotion and education
- Interventions that address health risks
- 10 major recommendations meant for use by individuals, communities, public health and clinical practitioners and governments

Healthy Babies: Everyone's Business

- CDC emphasizes the critical role of all health care providers who routinely treat women
- Nutrition and weight control are cited as important areas to discuss with women prior to pregnancy

**Overweight and Obesity
In Women of
Childbearing Age**

Overweight and Obesity in Women, 20-39 years

- Pre-pregnancy overweight is at an all-time high
- About **60%** of women of childbearing age are overweight (BMI \geq 25); **34%** are obese (BMI \geq 30)

[Flegal, et al. JAMA 2010;303(3)]

Pre-pregnancy Body Weight and Fertility

- Infertility affects estimated 7 million couples in the U.S.
- A healthy body weight plays a role in managing Polycystic Ovary Syndrome (PCOS), the primary reason for female infertility
- BMI within the Normal range improves the chances of conception
- Higher BMI may interfere with chances of conceiving with assisted reproduction treatment

(Influence of Pregnancy Weight on Maternal and Child Health. Workshop Report. National Academies Press, 2007; Wang, J. BMJ 321:1320-1321, 2000; Fasano A, et al. Arch of Intern Med. 2003;163(3):268-292)

Girth Control for Dad, too!

- Overweight male partners may lengthen the time to conception for the couple.
- The higher the BMI, the lower the sperm count, and the lower the sperm quality.

(Nguyen,R. Human Reproduction 2007; 22:2488-2493. Jensen T, et al. Fertility and Sterility 2004, 82:863-870)

Excess Maternal Adiposity at Conception

Increases the risk of:

- cesarean delivery
- gestational DM
- HTN, and pre-eclampsia
- greater fat mass in infants at birth; overweight in children
- post-partum weight retention
- hyperglycemia throughout pregnancy

(JADA 2009;109:918-927; Oken, et al. Am J Obstet Gynecol 2007;196:322.e1-322.e8); IOM, 2009)

Hyperglycemia and Pregnancy Outcomes

- 1.85 million women ages 18-44 have DM, mostly type 2
- Increased risk for:
 - birth defects
 - miscarriage
 - infant death
 - macrosomia, cesarean delivery
 - heavier offspring
 - offspring with type 2 DM later in life

(CDC. Diabetes and Pregnancy Frequently Asked Questions)

Pre-diabetes and Pregnancy

- Estimated 57 million Americans are at risk for DM because of pre-diabetes (FBS 100-125 mg/dL)
- The association between obesity and birth defects may be related to undiagnosed DM.
- Pre-diabetes often predicts GDM and post-pregnancy type 2 DM

(ADA. Pre-diabetes; CDC. Diabetes and Pregnancy Frequently Asked Questions; Rasmussen SA and Galuska DA. AJCN 2010;91:1539-40.)

Obesity at Conception Increases Birth Defect Risk

- BMI \geq 30: Increased risk of structural defects, including NTD, hypospadias, limb reduction defects
- Congenital heart defects (CHD) are the most common birth defect; account for 1/3 of infant mortality due to birth defects
- Mills et al: Maternal obesity means an additional 1,500 CHD yearly

(Rasmussen, et al. Am J Obstet Gynecol 2008;198:611-19; Waller, et al. Arch Pediatr Adolesc Med 2007;161:745-50; Mills, et al. AJCN 2010;1543-9.)

Excess Adiposity at Conception and Feeding Choices

- Pre-pregnancy BMI ≥ 30 : decreases the chances of breastfeeding as a feeding choice.
- Obese women breastfeed for less time than normal weight women (BMI of 18.5 - 25); less likely to maintain BF at 1 and 3 month

(Mok, et al. Pediatrics 2008;121:e1319-e24; Viswanathan et al. AHRQ Publication No. 08 E009. Rockville, MD, May 2008)

Weight Gain During Pregnancy:

**Reexamining the Guidelines
Institute of Medicine, 2009**

Why New Guidelines?

- Rising obesity rates in women of CB age since last edition (1990)
- Large proportion of women with excessive gestational weight gain (GWG)
- Strength of the evidence linking GWG to pregnancy outcomes

(IOM, 2009)

How Do They Differ from the 1990 recommendations?

- Use World Health Organization (WHO) standards to categorize pre-pregnancy BMI
- Specify fairly narrow range of recommended weight gain for obese women (BMI \geq 30) : 11-20 lbs. vs at least 15 lbs. in the 1990 version

(IOM, 2009)

Special Considerations

- Women of short stature: gain in the lower end of the ranges
- Adolescents: gain as adults
- Women pregnant with multiple fetuses: recommendations have changed
- BMI of 35 and above: gain in the lower end of the ranges

(IOM, 2009)

Criteria for Classifications of Pre-pregnancy Weight

Body Mass Index (kg/m²)

Underweight	<18.5
Normal	18.5-24.9
Overweight	25.0-29.9
Obese	≥30

(IOM, 2009)

Recommended Weight Gain for Pregnant Women (in pounds)

Prepregnancy BMI (kg/m ²)	Recommended Weight Gain (singleton)	Recommended Weight Gain (twins)
<18.5	28 to 40	N/A*
18.5-24.9	25 to 35	37 to 54
25.0-29.9	15 to 25	31 to 50
≥30	11 to 20	25 to 42

* No guidelines were established based on lack of sufficient data.

(IOM, 2009)

Calorie Needs of Pregnancy

- First trimester: 0 calories
- Second trimester: 340 calories/day
- Third trimester: 450 calories/day

(IOM, DRI)

Cesarean Delivery

- Highest rate ever recorded: 31.8% in 2007 (up 50% in last decade)
- Maternal obesity is a risk factor for cesarean delivery

(IOM, 2009; Heron, et al. Pediatrics, 2010;125;1:4-15)

Gain More, Retain More

- Less than 50% of women gain within the recommended range for their pre-pregnancy BMI (1990 IOM ranges)
- Regardless of pre-pregnancy BMI, gaining above the recommended ranges is associated with excess maternal weight retention at 1 year post-partum

(IOM, 2009)

Consequences of GWG for Child

- SGA (<10% weight for gestational age)
- LGA (>90% weight for gestational age)
- Pre-term birth (very low, or high, maternal BMI)
- Childhood obesity

(IOM 2009)

Healthy Pre-pregnancy Body Weight: Goals

- Conceive at a healthy weight and gain accordingly, which will require (pre-pregnancy) weight loss for many women.
- Provide dietary assessment early in pregnancy with a referral to an RD, if needed.

Nutrients of Concern In the Childbearing Years

- Helping Women to Close
Nutrient Gaps**

Dietary Patterns of Women in the US

Often Deficient In:

- Calcium
- Fiber
- Magnesium
- Vitamin E
- Carotenoids
- Potassium

(USDA, USDHHS. Dietary Guidelines for Americans, 2005)

Other Nutrients of Concern:

- Folic acid
- Iron

(USDA, USDHHS. Dietary Guidelines for Americans, 2005)

- Docosahexaeneoic Acid (DHA)
- Vitamin D
- Choline
- Phytonutrients

Iron

- Hemoglobin production
- Oxygen transport, fetal immunity, energy production, CNS development
- Estimated 8 million women of CB age have iron-deficiency anemia
- Iron stores at conception are a strong indicator for iron-deficiency anemia later in pregnancy

(CDC. A Report of the CDC/ATSDR Preconception Care Work Group and the Select Plan on Preconception Care; Scholl, T. AJCN, 2005, 81:1218S-1222S)

Iron

- Nonpregnant: 18 mg/day
- Pregnant: 27 mg/day
- Lactation: 9 mg/day

- Iron-deficiency during pregnancy may increase pre-term delivery, LBW, perinatal mortality
- CDC: 30 mg elemental iron/day to prevent anemia and 60 to 120 mg to treat
- Serum ferritin best reflects iron stores

(Scholl, T. AJCN, 2005, 81:1218S-1222S)

Folic Acid

- Women in the CB years capable of becoming pregnant: 400 - 800 ug/day of folic acid
- Helps prevent NTD during first month of pregnancy
- Adequate levels associated with lower risk of preterm birth, LBW, fetal growth restriction
- Previous pregnancy affected by a NTD: 4000 ug/day
- Women carrying multiples; those with DM; and those with epilepsy may need more, too

(U.S.Preventive Health Services Task Force. Ann Intern Med 2009;150:626-631;
Berry, R, et al. NEJM 1999;341:1485-1490)

Choline

- Essential nutrient, B-like vitamin
- Associated with a lower risk for NTD, independent of folic acid status
- Necessary for CNS development (particularly the hippocampus); acetylcholine production; muscle control; liver function

(Jensen, HH, et al. Experimental Biology, 2007; Shaw G, et al. Amer J of Epid, 2004;160:102-109)

Choline

- Women: 425 mg/day
- Pregnant: 450 mg/day
- Nursing: 550 mg/day
- Just 10% of women, pregnant women, and lactating women consume adequate choline

(DRI, IOM, 2006)

Common Choline Sources

- Egg yolk, large: 125 mg
- Cooked ground beef, 3 ounces: 95 mg
- Cooked chicken, 3 ounces: 70 mg
- Cooked salmon, 3 ounces: 65 mg
- Cooked broccoli or cauliflower, 1 cup: 50 mg
- Navy beans, 1/2 cup: 30 mg

(USDA)

Docosahexaenoic Acid (DHA)

- Dominant fatty acid in brain cells
- Comprises up to 50% of the total FA in phospholipids of the retina
- Pregnant and nursing women: at least 200 mg/day of DHA

(Koletzko, et al. Br J Nutr 2007;198:873-877; Koletzko, et al. J. Perinatal Med 2008;36:5-14)

DHA

- Many women do not consume adequate DHA
- ALA is converted to DHA, but rate is considered poor (about 1%)
- ALA supplementation has no appreciable affect on infant DHA levels and breast milk levels of DHA

(Innis, SM. Brain Res 2008;1237:35-42; Groot de RH, et al. Am J Clin Nutr 2004;79:251-260)

DHA

- Fish and shellfish are rich sources of preformed DHA
- Preformed DHA gets preferential transport across the placenta and is available in breast milk
- Higher maternal DHA intakes during pregnancy and lactation linked to improved vision and cognition

(Helland, et al. Ped 2003;111(1):e39-e44; Hoffman, et al. PLEFA 2009;81:151-158)

Selected Sources of DHA (mg)

- Salmon, coho, farmed, 3 oz cooked: 740
- Expecta Lipil supplements (algal oil), 1 pill: 200
- Blue crab, 3 oz, cooked: 196
- Tuna, light, canned, drained, 3 oz: 190
- Chicken, roasted, dark meat, 1 cup: 70
- Fortified eggs, 1 large: 50 - 150
- Fortified cheese, 1 oz: 32
- Fortified soy beverages, milk, yogurt, 8 oz: 32

Vitamin D

- Living in the northern part of the US increases the risk for vitamin D deficiency
- Overweight women are at greater risk for vitamin D deficiency

Vitamin D and MS prevention

- Vitamin D is important in the genesis of multiple sclerosis (MS).
- Nurses' Mothers' Study/35,794 pairs/16 yrs.
- Moms who reported the highest intake of vitamin D during pregnancy were 45% less likely to have a daughter who went on to develop MS than those who consumed the least.

(Mirzaei F. AAN 2010)

Vitamin D

- Pregnant, lactating, nonpregnant: 200 IU/day
- Upper Limit: 2,000 IU/day
- Maternal vitamin D status (determined by measuring 25-OH-D) largely determines vitamin D status of the fetus and newborn

(Wagner,CL, Greer, FR. Ped 2998;122:1142-1152)

Multivitamins

- Low-risk, relatively low-cost, with big rewards
- Taking MV qd prior to conception reduces the risk of pre-term birth
- Meta-analysis of 41 studies suggests a link between MV and reduced NTD, heart and limb defects and cleft palate

(Vahratian, A, et al. Jour Epidem 2004;160:886-892; Goh, Y, et al, Jour Obstet and Gyn of Canada Aug 2006; 680-689.)

Supplement savvy

- Look for:
 - About 100% of the Daily Value (DV), including folic acid, iron, and vitamin D
 - Less than 3,000 International Units (IU) of vitamin A; majority as beta-carotene
 - Other vitamins and minerals in Belly Bars, Omama! Bars, other fortified foods
 - Consider calcium, vitamin D, DHA

Exercise Guidelines

**What's New for Women in the
Childbearing Years?**

2008 Physical Activity Guidelines for Americans

- Healthy women: At least 150 minutes (2 hours and 30 minutes) per week (ex. five 30-minute walks) of moderate-intensity aerobic activity, such as brisk walking, **during and after** their pregnancy, spread throughout the week.
- Healthy women who already do **vigorous-intensity** aerobic activity, such as running, or large amounts of activity **can continue doing so during and after their pregnancy** provided they stay healthy and discuss with their health care provider how and when activity should be adjusted over time.

(www.cdc.gov/physicalactivity/everyone/guidelines/pregnancy.html)

Exercise During Pregnancy

- Improves chances of gaining within the IOM's guidelines
- Improves glucose tolerance
- Helps prevent GDM
- Improves mood and energy level
- Lessens constipation
- Improves sleep

Off Limits During Pregnancy

- Skydiving
- Surfing
- Kickboxing
- Scuba diving
- Downhill skiing or snowboarding
- Waterskiing
- Horseback riding
- Skateboarding
- Roller and ice skating
- Contact sports (football, hockey, etc.)
- Gymnastics
- Mountain climbing

Alcohol, Caffeine, and Other Safety Issues

Seafood Safety

- Methylmercury, dioxins, PCBs (polychlorinated biphenyls)
- Avoid: shark, swordfish, tilefish, king mackerel
- Albacore tuna: 6 oz/week, maximum, as part of the 12 oz/week limit
- Check safety of rivers, lakes, and streams with local state or health departments

Considering Caffeine

- Consuming more than 200 mg/day increased the risk of miscarriage in a group of more than 1,000 pregnant women
- Greater risk attributed to caffeine as risk held for soft drinks, tea, and hot chocolate

(Weng, et al. Amer Journ Obstet Gyn 2008;198: 279.e1-279.e8)

Common Caffeine Sources

- Starbucks coffee, 16 oz: 330 mg
- Einstein Bros coffee, 16 oz: 300 mg
- Foosh Energy Mints, 1: 100 mg
- Red Bull, 8.3 oz: 75 mg
- Mountain Dew, 12 oz: 71mg
- Diet Coke, Coke, 12 oz: ~50 mg
- Tea, 8 oz: 47 mg

Alcohol: No Amount is Safe

- Moderate drinking (1/day) may lengthen time to conception
 - (12 oz regular beer; 5 oz wine; 1 1/2 oz 80-proof distilled spirits)
- No alcohol during pregnancy and when trying for a baby

(March of Dimes. Drinking Alcohol During Pregnancy; NIH. Fetal Alcohol Syndrome)

Alcohol Consumption: The Reality

- 1 in 12 women drink during pregnancy.
- About 1 in 30 binge drink (5 or more drinks) on any one occasion.
- Up to 40,000 babies born with Fetal Alcohol Spectrum Disorders (FASD) each year.

(Substance Abuse and Mental Health Services Administration, U.S. Department of Health and Human Services. Fetal Alcohol Spectrum Disorders. 2007; CDC Fetal Alcohol Spectrum Disorders.)

Alcohol and Pregnancy Do Not Mix

- Fetal Alcohol Syndrome: leading cause of mental retardation in the US
- Birth defects
- Learning disabilities
- Behavioral problems
- Emotional problems

**Setting the Stage:
How Genes and Nutrition
Interact**

Growing By Leaps and Bounds

- DNA synthesis is rapid
- Genes direct the growth, development and functioning of every system
- When genetic information is faulty, then problems can occur in normal development

Some Known Teratogens

- Alcohol
- Lead
- Toxoplasmosis
- Mercury

Epigenetics

- Epigenetics (literally “on top of genetics”) also influences genetic information and affects growth and development *in utero*

Epigenetic

- Gene expression is altered in response to environmental factors, such as available nutrients, but DNA is not changed (not a mutation)
- Yet, epigenetic changes are heritable, so a child's health may have been influenced by his grandmother as well as his mother

Epigenetics and Pregnancy

- Epigenetic changes are common during embryogenesis
- Mom's nutrition (and other lifestyle habits) influences the environment in the womb influencing the epigenomic "programming" of her child
- Some epigenetic changes can increase the risk of birth defects and chronic conditions

Birth Defects (U.S.)

- Abnormalities in structure, function, or metabolism
- 1 in 33 births; 120,000/yr.
- 70% cannot be explained
- Genetic components
- Environmental factors
- Combination of genes and environment

(www.macrodomes.com/printableArticles/14332_1206.asp)

Neural Tube Defects (NTD)

- General population's risk: .1%
- Chances of NTD with history of one affected pregnancy: **2 - 5%**
- With 2 affected pregnancies: **10%** for the next pregnancy
- One parent with SB: about 4% chance
- Identical twins have NTDs more often than both fraternal twins.

[www.chg.duke.edu/diseases/ntd.html; AGOG Practice Bulletin, 44, July 2003 (reaffirmed 2008)]

Diabetes: Genes Don't Fully Explain Risk

- You must inherit a predisposition
- There must be an environmental trigger
- ID twins and type 1: the other twin has only half the chance of developing it
- ID twins and type 2: other twin has 3 in 4 chance

(www.diabetes.org/diabetes-basics/genetics-of-diabetes/html?print=t)

**Prepare for Pregnancy:
Act Like You're Already
Pregnant**

Future Moms Should:

- Have regular physicals and blood work.
- Achieve a healthy weight before pregnancy and gain the appropriate pounds based on prepregnancy BMI.
- Eat a balanced diet with adequate nutrients, including folic acid, vitamin D, choline, and iron.
- Take a daily multivitamin.

Future Moms Should:

- Cut out noxious substances: alcohol, medications, cigarettes, second-hand smoke, etc.
- Avoid unsafe foods, including certain fish, and raw or undercooked animal foods and unpasteurized juices and dairy products.

The Fourth Trimester

Recovering, Nursing, and
Preparing for the Next Child?

Nutrient Needs of Nursing Moms

- Calories: 330/day for first 6 months; 400/day for 6-12 months
- Fluid: minimum of 13 8-ounce glasses/day
- DHA: 200-300 mg/day throughout
- Continue with daily multivitamin to cover nutrient needs + balanced diet with adequate choline

Vitamin D and the Breastfed Infant

- Nursing infants: Begin 400 IU vitamin D daily within first few days of birth

(Wagner,CL, Greer, FR. Ped 2008;122:1142-1152)

Post-partum Weight Loss

- No severe calorie restriction for at least 6 weeks post-delivery (Nursing moms, no less than 1,800 calories/day.)
- OK to exercise, if exercise is OK per MD
- Give your body time to recover; can take up to a year to return to “normal”