Nutrition Recommendations for Pregnancy and Lactation

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Which of these countries/territories has the lowest infant mortality rate # /1000 live births?

- US
- United Kingdom
- Sweden
- Czech Republic
- Japan
- Singapore

United Nations data, 2013

Which of these countries has the highest infant mortality rate # /1000 live births?

- Congo
- Afghanistan
- Iraq
- Vietnam
- Somalia

United Nations data, 2011

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By

Michelle Castillo /

CBS News/ May 7, 2013, 12:49 PM

U.S. has highest first-day infant mortality out of industrialized world, group reports

This July 25, 2006 handout photo provided by the March of Dimes Foundation shows a baby in the Neonatal Intensive Care Unit (NICU) at the Albany Medical Center in Albany, N.Y. / March of Dimes Foundation,AP Photo/Jennifer Coate

Critical periods

Embryo at 4 weeks

- A deficiency (or toxicity) of a nutrient during a critical period may cause a birth defect

Programming

- An undernourished fetus adapts to a limited supply of nutrients and oxygen by slowing growth
- Growth of muscle is sacrificed but brain may be spared

Fetus at 4 months

Diabetes during pregnancy and high birthweight (macrosomia)

Stress and preterm delivery

- Infections, stress, and possibly iron deficiency may trigger hormonal changes resulting in preterm delivery

Fetus at 18 weeks

Special issues in teenage pregnancy

- Small size of pelvis
- Insulin resistance
- Competition between growing teen and her baby for nutrients

Child Brides

National Geographic. Too Young to Wed. June 2011

Academy of Nutrition and Dietetics

Practice Paper of the Academy of Nutrition and Dietetics:

Nutrition and Lifestyle for a Healthy Pregnancy Outcome

Objectives:

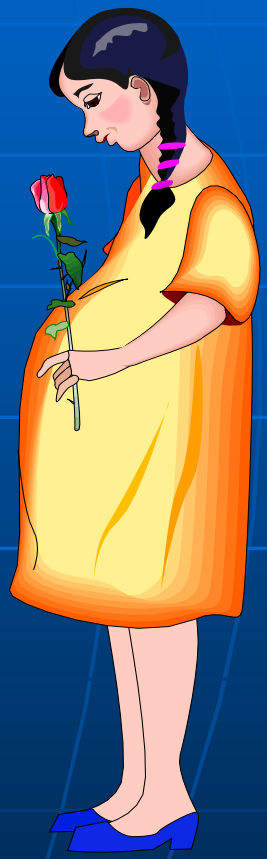
Apply the DRIs to determine energy & nutrient needs for pregnant & lactating women

Identify key recommendations for a healthy lifestyle during pregnancy

Academy of Nutrition and Dietetics, Sept 2014

Key point: #1 Weight Gain

- Prenatal weight gain within 2009 Institute of Medicine recommended ranges associated with better outcomes



Birthweight

Low Birthweight:
Less than 2500 gm (5 lb 8 oz)

High Birthweight: More than 4000 gm (8 lb 12.8 oz)

Adverse Maternal Outcome

- Pregnancy-induced hypertension (PIH)
- Pre-eclampsia
- Gestational diabetes
- Post-partum weight retention

Maternal Obesity

- Infertility
- Hypertension & pre-eclampsia
- Gestational and type 2 diabetes
- Cesarean-section delivery
- Postpartum hemorrhage
- Excessive prenatal weight gain & retention of weight at 12 mo
- Infants: preterm, macrosomia, birth defects

J Academy of Nutrition & Dietetics, April 2016

Institute of Medicine (IOM) Guidelines on Weight Gain during Pregnancy

Institute of Medicine, 2009

- Underweight (BMI <18.5): 28-40 lb
- Normal weight (18.5-24.9): 25-35 lb
  - Twins (34-54lb)
- Overweight (>25.0-29.9): 15-25 lb
  - Twins (31-50 lb)
- Obese (>29.0): 11-20 lb
  - Twins (25-42 lb)

www.nap.edu/catalog.php?record_id=12584

Other IOM Recommendations

- Women should enter pregnancy in the normal weight (BMI) category

Exercise can be safe during pregnancy and postpartum

- Moderate-intensity exercise beneficial
- Does not increase risk of low birth wt or preterm birth (strong evidence)

- Improves cardiac fitness
- May reduce risk of some PN complications (but not conclusive)
- Does not have adverse effect on breast milk volume, composition, or infant growth

US Dept HHS 2008
www.health.gov/paguidelines/chapter7.aspx

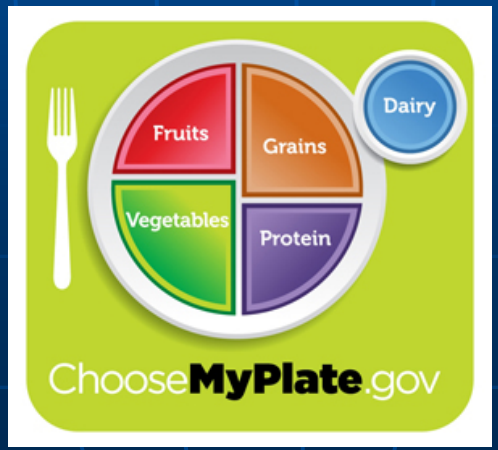
2008 Physical Activity Guidelines for Americans

US Dept HHS, 2008

- Healthy women (pg & pp) should get at least 150 min of moderate-intensity, aerobic activity, preferably throughout the week
- Women who are highly active or engage in vigorous activity may continue PA during pg & pp if they remain healthy and discuss w/ health provider

Key Point # 2:

- Select a balanced diet to meet individual needs, based on age, activity, prenatal weight gain, trimester of pregnancy, and other considerations



DRI Approach for Pregnancy

- Generally use a factorial model
  - Basal needs (for NPNL woman)
  - Increased need for other tissues that expand during pregnancy (e.g. blood volume)
  - Amount deposited in fetus and related tissues
- Needs vary by trimester
  - first trimester: little change over NPNL state
  - second and third trimesters: needs increase

Energy Needs During Pregnancy

EER = Pre-pregnant EER + increase in TEE due to pregnancy + energy deposition

1st trimester = prepreg EER + 0 kcal

2nd trimester = prepreg EER + 160 kcal[a] + 180 kcal

3rd trimester = prepreg EER + 272 kcal[b] + 180 kcal

[a] 8 kcal/wk gestation x 20 wk

[b] 8 kcal/wk gestation x 34 wk

IOM, DRIs for Energy, 2002

Example #1

"Jackie" is 25 yrs old,
Height= 64 in (1.63 m)
Pre-pg wt= 125 lb (56.8 kg)
BMI=21.4
20 weeks gestation
Low active (PAL=1.12)
What is her target wt gain?
What is her EER?

Institute of Medicine (IOM) Guidelines on Weight Gain during Pregnancy

Institute of Medicine, 2009

- Underweight (BMI <18.5): 28-40 lb
- Normal weight (18.5-24.9): 25-35 lb
- Overweight (>25.0-29.9): 15-25 lb
- Very overweight (>29.0): 11-20 lb

www.nap.edu/catalog.php?record_id=12584

Calculating Jackie's EER

- 1) NPNL (EER)=354- (6.91 X age) +PAL X [(9.36 X wt in kg) + (726 X ht in m)] =
- 2) Change in TEE=
  - 2nd 8 X 20=160
  - 3rd 8 X 34=272
- 3) Energy deposition in fetus= 180

EER=

Energy Needs during Pregnancy

- Varies between ~ 2200 to 2900 calories (2400-2500 for many pregnant teens) Dietary Reference Intakes, 2002
- Prenatal weight gain and mother's appetite best indicators of adequate energy intake
- For multiple pregnancies (normal wt) 40-45 kcal/kg (pre-pg wt), 30-35 for overwt women

Balance of Macronutrients Important

- CHO—to meet provide enough glucose to the fetal brain, **RDA= 175 g/day** (vs 100 for non-pg women) AMDR: 45-65% for all adults
- PRO—to add to maternal tissues/blood and to support fetal growth, **RDA=71gm, (includes+ 25 gm/da in 2nd and 3rd trimesters** AMDR: 10-35% for adults
- Fat—AMDR (19 yrs +) 20-35%; Saturated fat < 10% of food energy (Same as for non-pregnant women)

IOM, DRIS, 2002

Breastfeeding recommendations

American Academy of Pediatrics 2012; 129 (3)
Academy of Nutrition and Dietetics 2015; 115: 444

- Exclusive breastfeeding for 6 months
- Complementary feeding and continued breastfeeding for 1 year or longer

DRI Approach for Lactation

Basal needs (for NPNL woman)

Amount secreted in milk (assumed milk output of 0.78 L/d at 0-6 mo and 0.60 L/d at 7-12 mo)

Adjustment for amount available from body stores, if wt loss occurs

Energy Needs During Lactation

- Little change in basal energy expenditure
- Possibly some change in PAL, but variable
- Milk energy output, based on mean volume and energy density:
  - 0-6 mo: 780 ml/d x 0.67 kcal/g = 523 kcal/d **[~500]**
  - 7-12 mo: 600 ml/d x 0.67 kcal/g = 402 kcal/d **[~400]**
- Energy mobilized from weight loss
  - mean wt loss 0-6 mo ~ 0.8 kg/mo = 170 kcal/d
  - assumed weight stability after 6 mo
- Observed TEE may be about 200 kcal less than predicted at 1 mon

Energy Needs During Lactation

EER = NPNL EER + Milk Energy Output - Weight Loss

0-6 mo: NPNL EER + 500 kcal - 170 kcal

7-12 mo: NPNL EER + 400 kcal - 0 kcal

IOM, DRIs for Energy, 2002

Example

- "Anna" is 33 yrs
- Ht is 67 in (1.70 m); Wt is 180 lb (81.8 kg)
- BMI=28.2
- Exclusively BF infant of 5 mo
- Trying get at least 60 mins/day of activity PAL=1.12

Calculating Anna's EER

- TEE= 448 – (7.95 X age in yrs) + PAL* [11.4 X wt in kg +619 X ht in m]=
- Milk production: + 500 kcal
- Weight loss: - 170 kcal

MyPlate Daily Checklist 2400 kcal

- Grains: 8 ounces
- Vegetables: 3 cups
- Fruit: 2 cups
- Dairy: 3 cups
- Protein: 6.5 ounces
- Oils: 7 tsp

http://www.choosemyplate.gov/MyPlate-Daily-Checklist-input

Nutrient Adequacy

- Nutrient dense choices can meet needs for most nutrients, except iron
- However, many women may choose diets that will fall short in vitamin D, vitamin E, choline
- At calorie intakes < 2600 per day, Mg and K may also be low

AND Practice Paper, 2014

Long-term effects of a high-protein diet during pregnancy

- From 1952-76, Scottish mothers were advised to eat 1 lb. red meat daily and to avoid potatoes, bread, rolls, etc.
- Advice led to increased protein and lower energy intake (24% of energy from pro)
- Mothers had lower PN wt gain; lower BW
- Follow-up of offspring at 27-30 yrs found significant positive effect on systolic BP

Shiell AW, Hypertension 2001; 38: 1282-1288)

Key Point #3:

- Vitamin and mineral supplements may be recommended for vulnerable situations: food insecurity; alcohol, tobacco, other substance dependency; anemia; strict vegetarian diets; poor eating habits

Iron is recommended for all pregnant women

- Iron deficiency anemia increases risk of preterm delivery, low birth
- About 17% of women in developed countries have iron deficiency anemia
- Low dose of iron (27 mg) starting in first trimester, especially for short pregnancy intervals
- Intermittent doses (1-2 times a week) or daily doses can be equally effective in reducing maternal anemia

Setting the EAR for Iron for Pregnancy

- Basal losses
- Fetal and placental iron deposition
- Increase in hemoglobin mass

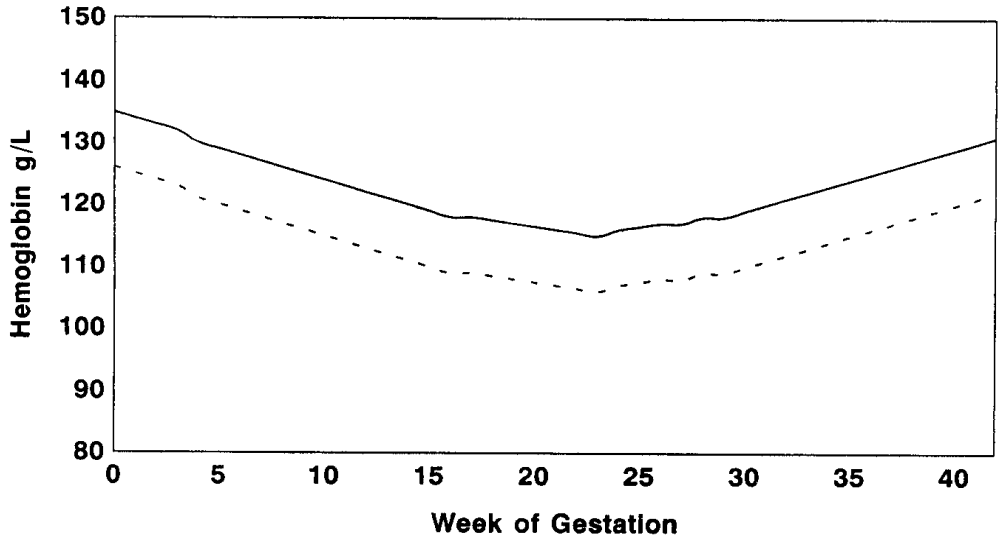


FIGURE 9-1 Hemoglobin concentrations in healthy, iron-supplemented (100–325 mg/day) pregnant women living in industrialized countries. The upper solid line represents the median hemoglobin concentration. The lower dashed curve represents the fifth percentile of hemoglobin concentration.
SOURCE: IOM (1993).

Iron Requirements During Pregnancy

TABLE 9-15 Summary of Absorbed Iron Requirements in Pregnant Adult Women

Stage of Gestation	Basal Losses (mg/d)	Erythrocyte Mass mg/d (mg/trimester)	Fetus and Placenta mg/d (mg/trimester)	Total Absorbed Iron Requirement (mg/d)
First trimester	0.896	—	0.27 (25)	1.2
Second trimester	0.896	2.7 (250)	1.1 (100)	4.7
Third trimester	0.896	2.7 (250)	2.0 (190)	5.6

Dietary Iron Requirement During Pregnancy

TABLE 9-16 Dietary Iron Requirement During Pregnancy

Stage of Gestation	Absorbed Iron Requirement (mg/d)	Absorption (%)[a]	Requirement (mg/d)
First trimester	1.2	18	6.4
Second trimester	4.7	25	18.8
Third trimester	5.6	25	22.4

[a] Absorption efficiency in the first trimester is as estimated for nonpregnant females; in the second and third trimesters, the efficiency is increased to 25 percent by the increased demand for iron as part of the physiological regulation of iron flux.

Iron Requirements During Pregnancy

- EAR = 22 mg/d (based on third trimester)
  - rationale: to build iron stores in early pregnancy
- RDA = 27 mg/d
- 60 mg/d often given to anemic patients

Iron Requirements During Lactation

- Assumes no menstruation 0-6 mo
- Basal iron need = 0.896 mg/d
- Iron secreted in milk
  - 0.78 L/d x 0.35 mg/L = 0.27 mg/d
- Total absorbed iron needed = 1.17 mg/d
- EAR = 1.17 / 0.18 = 6.5 mg/d
- RDA = 9 mg/d

Folate

- RDA for pregnancy is 600 ug
- To prevent birth defects, 400 ug folic acid from supplements and/or fortified foods, needed in addition to food sources
- Upper limit—1000 ug (19 yrs. and older); 800 ug (14-18 yrs)

Calcium and Vitamin D

- Calcium absorption more efficient in pregnancy; RDA= 1000 mg 19-50 and 1300 mg 14-18yr.
- Vitamin D; RDA=600 IU, UL=4000 IU
- Supplements of calcium and vitamin D are needed if no dairy or calcium-fortified food consumed
- Supplements of 1000-2000 IU vitamin D are probably safe for pregnant women
- Recent study (Kansas) found 82% of women deficient in Vit D at birth, with no effect of usual PN supplement levels (334 IU)

IOM, DRIs for Calcium and Vitamin D, 2010; Ozias et al J Am Coll Nutr, 2014

What about omega-3 fatty acids?

- Evidence from fish-eating populations suggests fatty acids may delay spontaneous birth and increase BW
- Marine oils are rich source of omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)
- Potential effects on hypertension in pregnancy through inflammatory and vascular response

Key Point #4: Other guidance

- Pregnant women should not drink alcoholic beverages at all. Especially important to avoid marijuana, cocaine, and other illegal drugs during pregnancy
- Limit caffeine to < 200 mg

AND 2014, 2015-2020 Dietary Guidelines

Key point: # 5 Safe food handling

Pregnant women are at risk for food-borne illness:

- Avoid raw/undercooked meat, poultry, fish, eggs, unpasteurized juices, raw sprouts, raw milk
- Re-heat or cook deli-meats, hot dogs
- Avoid soft cheese, feta, Mexican cheeses
- Avoid intake large fish—king mackerel, swordfish, shark. Limit other fish (12 oz /week)

How well are we doing in preconception health behaviors?

- 29.7% used multivitamin supplement 1 mo before pregnancy
- 51.6% reported recommended levels of physical activity
- 54% used alcohol and 25% smoked in the 3 mo before pregnancy

MMWR 2014; 63(3): 1-62, n=40,388 US women, 18-44 yrs

Internet

- Webpages on prenatal weight gain- only 23% have accurate and complete recommendations
- Most of the inaccurate info is on for-profit websites
- Example of a good site—Mayo clinic

Chang et al. J Med Internet Research 2016; 18(4):e81