First Steps Nutrition Modules

Module 2 – Nutrition and Normal Pregnancy

Introduction

Nutritional status plays an important role in pregnancy outcome. Intakes of specific nutrients, for example iron and folate, affect pregnancy outcome (e.g., birthweight, maternal and infant anemia, maternal hypertension). Energy intake, and thus, the amount of weight a woman gains during pregnancy has a direct effect on pregnancy outcome (for example, low gestational weight gain can increase the risk of having an infant with a low birth weight) and on the long-term health of the mother (for example, excessive weight gain can increase the risk of obesity in the mother).

Especially for weight gain, there is wide variation in the "normal" range, and the nutrition assessment should include an evaluation of factors that are specific to the individual.

This module reviews some of the roles that food and nutritional status play in typical pregnancies, and highlights a few specific factors that can affect nutrient needs.

Estimated time to complete this module: 60 minutes.

Learning objectives

Participants will be able to:

- Describe basic nutrient needs during normal pregnancy
- Identify general risk factors during pregnancy and describe the potential complications and nutritional implications associated with each

Outline

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General

Pre-pregnancy nutritional status

Pre-pregnancy nutritional status has effects on pregnancy outcomes.

Weight
One of the most obvious indicators of nutritional status is weight. Pre-pregnancy weight affects the amount and rate of recommended weight gain during pregnancy. Pre-pregnancy weight-related risk factors include the following:

Underweight pre-pregnancy increases the risk of:
- low birthweight
- premature delivery

  Both of these can raise other risks for the infant, including long-term growth and cognitive deficits, pulmonary disease, diabetes, and heart disease.

Overweight pre-pregnancy increases the risk of:
- gestational diabetes
- pregnancy-induced hypertension
- congenital defects
- abnormal labor (induced labor, need for caesarian section)
- macrosomia, which can lead to lower Apgar scores, and places the infant at an increased risk for childhood obesity
- long-term maternal obesity

Nutritional Status
Pre-pregnancy nutritional status can also affect a pregnancy and birth outcome. Pre- and peri-conceptional folate status has a critical role in the prevention of neural tube defects such as spina bifida and anencephaly. Since the fortification of many grains in the US with folic acid, the incidence of neural tube defects has decreased 20-30%. (Grosse, 2005) However, recent data indicate that the goal of 50% of women of childbearing age consuming at least 400 µg/d has not been met. (Bentley et al, 2006).

Other issues related to nutritional status prior to or early in pregnancy include recommendations around alcohol, drugs, caffeine, tobacco, and vitamin A. These are covered later in this module.

Read more: "Developmental origins of adult disease" hypothesis.

The "developmental origins of adult disease" model (also called "fetal origins of adult disease" hypothesis) postulates links between fetal growth and the development of other diseases in adult life, including hypertension, type 2 diabetes, obesity, osteoporosis, and

cancer. According to this hypothesis, stressors (including malnutrition) at critical periods of development lead to "fetal programming," or permanent metabolic and structural changes.

One hypothesis that does not support this model asserts that fetal growth and the risk for cardiovascular and other diseases share an underlying genetic basis, and that it is an association, but not causative.

A recent review of this field states that, "The increasing consensus is that early life environmental factors must be incorporated into our understanding of the genesis of later health and disease." (Gluckman et al, 2005)

Read more: Avoidance diets for prevention of allergy

The literature around avoidance diets during pregnancy to prevent allergy is controversial. If there is a strong family history of atopic disease, then some suggest that it may be advisable to avoid peanuts or foods containing peanuts during pregnancy. Avoidance of other foods (especially entire food groups, for example milk) is controversial, since this may have a significant impact on a woman's nutritional status.

A recent Cochrane Review found that the evidence does not support the use of avoidance diets. In fact, in one study, women who avoided milk, eggs, and other foods gained less weight than other women. (Kramer and Kakuma, 2006)

Physiologic Changes During Pregnancy

Maternal weight gain during pregnancy varies depending, in part, on the individual's pre-pregnancy weight and nutritional status. The average weight gain during normal pregnancy is estimated to be 25-35 pounds (11-16 kg).The components of this weight gain include increases in fluid volume, maternal fat stores and breast tissue, placenta, and fetus. (See Figure below)

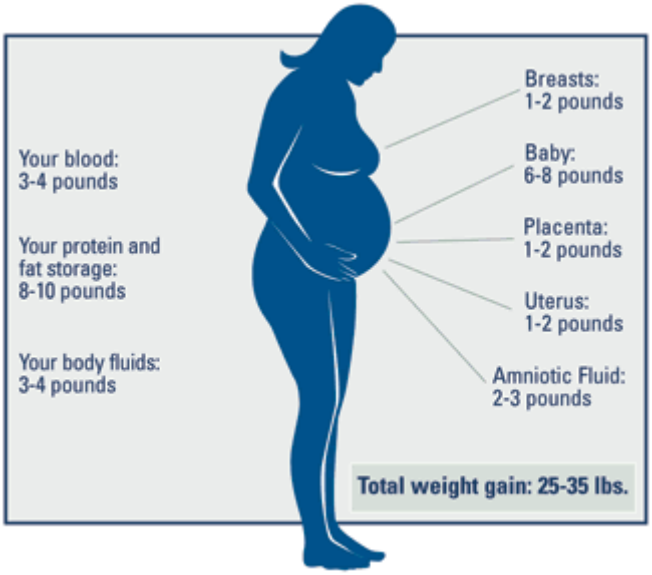

Figure 2-1: Components of weight gain during pregnancy

Nutrient metabolism is affected by hormonal changes. Changes in carbohydrate, fat, and protein metabolism make glucose constantly available to the fetus, while preserving maternal lean body mass. Absorption of calcium and iron increases, and excretion of other nutrients (e.g., riboflavin and taurine) decreases.

Every system is affected by pregnancy. Two systems with direct nutrition-related implications are discussed briefly below:

Vascular

Increase in:

- Plasma volume – up to 50% starting early in pregnancy
- Red cell mass and capacity for oxygen transport
- Concentrations of some fat-soluble vitamins, carrier protein, and lipid fractions (triglycerides, cholesterol, free fatty acids) because of enhanced hepatic triglyceride synthesis and decreased catabolism of adipose tissue (Petraglia, 2005)

Decrease in:

- Amino acids, minerals, water soluble vitamins because of the increased plasma volume, concentrations of hemoglobin, albumin. This is a normal physiologic change, and generally not indicative of altered nutritional status. (Petraglia, 2005)

Gastrointestinal

Increased progesterone levels decrease GI motility and increase reabsorption of water; this contributes to problems with constipation. Relaxation of the lower esophageal sphincter occurs; combined with pressure on the stomach from the growing uterus, reflux can be a result.

Birth Outcomes, Birthweight and Maternal Weight Gain

The World Health Organization (WHO) Collaborative Study on Maternal Anthropometry and Pregnancy Outcomes examined data from more than 100,000 births from 20 countries to identify factors that were associated with poor outcomes (low birth weight, macrosomia, prematurity, and pre-eclampsia). Birthweights between 6.8 and 8 lbs (3.1 and 3.6 kg) were associated with optimal outcomes for mother and baby. The maternal weight gain associated with this birthweight was 22-30 lb (14-15 kg). (WHO, 1995)

This amount of weight gain is consistent with the Institute of Medicine's 1990 recommendations, which include the influence of pre-pregnancy body weight. These recommendations are discussed in more detail in Module 3, Nutrition Assessment.

- Infants with low birthweights (less than 5.5 lb or 2.5 kg) are at increased risk for morbidity/mortality in the neonatal period, deficits in later growth and cognitive development, pulmonary disease, diabetes, and heart disease.

- Macrosomia (birthweight greater than 10 lb or 4.5 kg) has been associated with obstetric complications, birth trauma, and higher rates of neonatal morbidity/mortality.

Nutrient Needs During Pregnancy

During pregnancy, nutrient utilization and absorption is more efficient. Thus, for some nutrients (e.g., calcium), increased intake is not necessary. Even so, some nutrients are needed in higher amounts and supplementation is encouraged by most physicians, either separately (e.g., folate and iron) or as a prenatal multiplevitamin with minerals. (Mardis and Anand, 2000; Wright, et al, 2003)

Guidelines for intake, based on Institute of Medicine recommendations and the Dietary Reference Intakes (DRI) are reviewed below and summarized in a table at the end of this module.

Practical guidelines for overall intake (including recommended portion sizes and number of servings) are included in a table.

Energy

Energy needs increase during pregnancy for a number of reasons:

- Increased basal metabolic rate due to the metabolic contribution of the uterus and fetus, and the increased work of the heart and lungs
- Products of conception, which include the fetus, placenta and amniotic fluid
- Accretion of maternal tissues, including the uterus, breasts, blood, extracellular fluid, and adipose tissue

This increased energy requirement is not evenly distributed throughout pregnancy. The 2002 Dietary Reference Intakes include guidelines for energy intakes for pregnant women by trimester. For well-nourished women ages 19-50 years the energy needs are listed below:

- 1st trimester - no increase in energy needs
- 2nd trimester - additional 340 kcal per day
- 3rd trimester - additional 452 kcal per day

Note: Energy intakes that promote weight gain in the desired range vary widely because of individual differences in energy expenditure and basal metabolic rate.

Protein

Protein needs **increase** during pregnancy. Over the course of a pregnancy, it is estimated that an additional 925 grams of protein (1.1 gm per kg per day) is needed for the fetus, uterus, expanded maternal blood volume, placenta, extracellular fluid, amniotic fluid and to maintain new tissue. (FAO/WHO) More recent studies in developed countries, however, indicate that protein needs may be less than this.

Fat

The essential fatty acids linoleic (18:2 n-6) and alpha-linolenic acid (18:3 n-3) needs **are the same** for women who are pregnant as those who are not pregnant. These fatty acids are important components of cell membranes and essential to the formation of new tissue. Food sources of linoleic and alpha-linolenic acids are primarily vegetable oils, including soybean, safflower, and canola oils.

Read more: What about DHA supplementation?

Supplementation with n-*3 fatty acids during pregnancy (particularly docosahexaenoic acid) has received considerable attention recently.*

To date, there is no general consensus that maternal supplementation with n-*6 and* n-*3 fatty acids has any beneficial effects to the infant. An increase in gestation (about 4 days) has been observed in women who received supplemental* n-*3 fatty acids from fish oil, however there is not enough evidence to determine that* n-*3 fatty acid requirements are increased during pregnancy. Thus, the recommended intake level for essential fatty acids is the same for pregnant women and non-pregnant women. In the US, essential fatty acid deficiency is very rare. (IOM, 2002; Jensen 2006; Szajewska et al, 2006)*

DHA is primarily found in fish and other animal products. It can also be synthesized from alpha linolenic acid; flaxseed, canola, and soybean oils are high in alpha linolenic acid.

Carbohydrate

In the US, recommendations for **carbohydrate** intake during pregnancy were developed in order to assure that glucose is provided to the fetal brain and to prevent the formation of ketoacids by the mother. Thus, the RDA for dietary carbohydrate is **slightly higher** than the RDA for non-pregnant women.

The amount of **fiber** recommended for individuals by the 2002 DRIs is **the same** (28 grams per day) for pregnant and non-pregnant women. It is worth noting, however, while pregnancy does not increase an individual's need for fiber, most people do not consume this amount of fiber, so an individual's intake may need to be increased.

Read more: What does 175 g carbohydrate per day look like?

It's not difficult to fit 175 grams carbohydrate into a food pattern. Take a look:

This food pattern provides approximately 2400 calories, 300 grams carbohydrate, 110 grams protein, 1320 mg calcium, and 20 mg iron

Breakfast	*1 large whole grain bagel*

	2 Tablespoons cream cheese *1 banana* *8 ounces milk*
Snack	*1 ½ ounces cheddar cheese* *10 crackers*
Lunch	*¼ cup chicken salad* *2 cups green salad* *2 Tablespoons Italian salad dressing* *1 roll with 1 Tablespoon butter*
Snack	*1 apple* *8 ounces yogurt*
Dinner	*½ cup rice* *4 ounces lean beef* *1 cup stir-fried vegetables* *½ cup peaches* *½ cup vanilla ice cream*

Minerals

For the most part, requirements for minerals during pregnancy are not different from requirements for non-pregnant women of the same age. However, it is still important to evaluate whether or not an individual's intake meets recommendations. Some common minerals to keep in mind with pregnant women are listed below.

Calcium

Most calcium is laid down during last trimester. Although this amount of calcium is significant (approximately 25-30 grams), it seems that maternal calcium needs **do not increase**. Instead, physiologic changes occur, making intestinal calcium absorption more efficient.

During pregnancy some women may not drink milk due to lactose intolerance, so reviewing calcium sources that are not milk-based is important. Other women may simply not have adequate calcium intakes and may need information about milk- and non-milk-based calcium sources. If a woman is still not able to consume enough calcium from food sources then a supplement may be needed.

Calcium supplementation has been suggested as a treatment for pregnancy-induced hypertension. This is discussed in Module 4.

Magnesium

The RDA for magnesium during pregnancy is set at an **additional** 35 mg per day.

Iron
Iron requirements **are increased** during pregnancy, to support the growing fetus and placenta and also to support increased maternal red blood cells. Iron absorption is increased during pregnancy and maternal stores are mobilized. Anemia during pregnancy can increase the risk of low birthweight and of iron deficiency in the infant.

Iron needs increase in the second, and again in the third trimester. The DRIs for iron for pregnant women are based on estimated needs during the third trimester of pregnancy, in order to build iron stores during the first trimester.

Iron intakes in the US are generally below recommendations, so in many cases, supplementation is necessary during pregnancy. There are some compliance issues around iron supplements during pregnancy. Some women have noted constipation and/or nausea when taking supplements. Dietitians should keep this in mind when talking to clients. Usually taking iron with a meal can help decrease the nausea and trying other ways such as walking and increasing fluids to help with the constipation. Other suggestions for women who have difficulty taking vitamins include splitting the supplement (e.g., half in the morning and half in the evening) and using a children's chewable vitamin with iron.

One safety issue to note is that iron supplements contribute to a leading cause of poisoning deaths in US children under 6 years or age; children ingest their mother's iron tablets because they look like candy.

Read more: Anemia

Anemia during pregnancy can increase the risk of hypertension in the mother and poor pregnancy outcome, and low birthweight and of iron deficiency in the infant during the first year of life. Severe maternal iron deficiency compromises fetal iron status. This may affect the infant's development, including socio-emotional behavior, recognition memory, later IQ, and motor skills. (Kaiser, 2002; Georgieff and Innis, 2005; Lozoff et al, 2006) Some suggest that severe iron deficiency can impair mother-infant bonding.

Vitamins

For the most part, requirements for vitamins during pregnancy are **not different** from requirements for non-pregnant women of the same age. It is still important to evaluate whether or not an individual's intake meets recommendations, however. Some key vitamins are discussed below.

Vitamin A
Vitamin A is needed for growth and maintenance of the fetus, fetal stores, maternal tissue

growth. The RDA for vitamin A during pregnancy is **slightly higher** than the RDA for non-pregnant women.

Preformed vitamin A in excessive amounts can be teratogenic. During the first trimester, toxicity is associated with central nervous system abnormalities, craniofacial malformations, and cardiac defects. The 2000 DRIs set an upper limit for preformed vitamin A (including during pregnancy): 2800 µg per day for 14-18 year olds and 3000 µg per day for 19-50 year olds.

Folate
In addition to folate early in pregnancy, related to prevention of some neural tube defects, folate is needed throughout pregnancy to prevent megaloblastic anemia.

A fortification policy implemented by the US Food and Drug Administration in 1998 mandated that enriched grain products be fortified with folic acid. It was expected that this would increase individuals' folic acid intakes by about 100 µg per day, with 50% of women of childbearing age receiving at least 400 µg per day. A recent study indicates that although folic acid intakes of women of childbearing age have increased since 1998, only 22-33% (depending on race/ethnicity) are reaching the 400 µg goal. (Bentley et al, 2006) In addition, the recommended intake level for women was increased to 600 µg per day in 1998. (IOM 1998)

Vitamin B12
Maternal intake of vitamin B12 seems to have more of an influence on fetal B12 concentrations than maternal stores of the vitamin. The RDA for B12 during pregnancy is **increased** above recommendations for women who are not pregnant.

Vitamin D
The recommended intake for vitamin D during pregnancy is **not increased** over that for non-pregnant women. Women who receive regular exposure to sunlight do not need vitamin D supplementation, but those who are at high latitudes during winter months (such as those in Washington State) may be at risk for vitamin D deficiency. The IOM does suggest that an intake of 10 µg (400 IU)/day (the amount supplied by prenatal vitamin supplements), would not be excessive. Primary food sources for vitamin D are eggs, meat, oily fish, and fortified milk and dairy products.

Table: Recommended nutrient intake levels

Intake Recommendations for Selected Nutrients During Pregnancy

Nutrient	*Recommended intake during pregnancy*	*Change from non-pregnancy recommendations?*	*Comments*

Energy	*1st trimester - no increase* *2nd trimester - additional 340 kcal per day* *3rd trimester - additional 452 kcal per day*	*Increased during 2nd and 3rd trimesters*	*Example*
Protein	*All age groups: 1.1 g protein per kilogram per day or + 25*	*Increased by 0.27 g per kg body weight*	*Example*
Carbohydrate	*All age groups: 175 g per day*	*Increased slightly*	*Fiber recommendation is not changed during pregnancy (28 g per day)*
Calcium	*14-18 years – 1300 mg per day* *19-30 years – 1000 mg per day* *31-50 years – 1000 mg per day*	*No change*	*Food sources*
Magnesium	*14-18 years – 400 mg per day* *19-30 years – 350 mg per day* *31-50 years – 360 mg per day*	*Increased*	*Food sources*
Iron	*All age groups: 27 mg per day*	*Increased*	*Food sources*
Vitamin A	*14-18 years – 750 µg RAE per day* *19-30 years – 770 µg RAE per day* *31-50 years – 360 µg RAE per day*	*Increased slightly*	*Food sources*
Thiamin	*All age groups: 1.4 mg per day*	*Increased*	
Riboflavin	*1.6 mg per day*	*Increased*	
Folate	*All age groups: 600 µg per day*	*Increased*	*Food sources*
Vitamin B12	*All age groups: 2.6 mg per day*	*Increased*	

Diet- and Food-Related Concerns

Foodborne Illness

Foodborne illness can have more significant implications for pregnant women than for non-pregnant women; in some cases, foodborne illness can lead to miscarriage. Some foodborne illnesses that have been associated with risks during pregnancy are reviewed below, along with recommendations for prevention.

Listeriosis, caused by the bacteria *Listeria monocytogenes* can cause miscarriage, stillbirth, or severe illness in the newborn. Pregnant women are advised to avoid foods which have been found to have the bacteria. These foods include pate; soft, mold-ripened cheese (e.g., Brie, Camembert, queso blanco, fresco); unpasteurized milk products, and processed meats such as deli and lunch meats and hot dogs.

The bacteria are heat-sensitive, so guidelines call for reheating meats and cheeses (especially hot dogs, luncheon meats, refrigerated smoked seafood, cheeses, and deli meats) until they are steaming hot and washing raw vegetables and fruits well. (USDA, 2001)

Salmonellosis may cause miscarriage or premature labor. The bacteria that cause salmonellosis, salmonella, are most often found in raw eggs and undercooked poultry. Prevention guidelines include thorough cooking of foods, especially those with eggs and poultry, and avoidance of foods which contain raw eggs (e.g., raw cookie dough and homemade mayonnaise). (USDA, 2006)

Toxoplasmosis is caused by *Toxoplasma gongii*. The most common foods that contain Toxoplasma gongii are raw/undercooked meat and unpasteurized milk (especially goat's milk). Pregnant women should also avoid contact with soil or cat litter trays, which often contain the bacteria.

Campylobacter has been associated with premature birth, spontaneous abortion, and stillbirths. It is sometimes found in poultry, untreated water, domestic pets, soil, and unpasteurized milk.

Women from some cultures are at higher risk for foodborne illness because they use unpasteurized milk, make their own soft cheeses, etc. (e.g., women from Latino or other Hispanic cultures)

Overall:

- No unpasteurized milk
- No soft cheese (unless made with pasteurized milk)
- Cook all meats and eggs thoroughly
- Cook any deli and lunch meats/hot dogs
- Wash hands

Resources related to foodborne illness:

- http://www.ext.colostate.edu/PUBS/FOODNUT/09372.html
- http://www.ific.org/publications/brochures/listeriosisbroch.cfm
- http://www.fsis.usda.gov/Fact_Sheets/Listeriosis_and_Pregnancy_What_is_Your_Risk/index.asp
- http://www.cdc.gov/ncidod/dpd/parasites/toxoplasmosis/ToxoWomen.pdf

Special Recommendations Around Fish

To prevent problems associated with methylmercury, the FDA and USDA advise pregnant women to

- avoid shark, swordfish, king mackerel, and tilefish
- limit consumption of tuna, shrimp, catfish, pollock to 12 ounces a week
- limit albacore tuna to 6 ounces a week (included in the 12 ounce limit)
- check local advisories about the safety of fish caught in local rivers, lakes and coastal areas

Some recommendations also call for pregnant women to limit intake of oil-rich fish to 2 portions per week, to avoid pollutants such as dioxins and PCBs. (Williamson, 2006)

Resources:

- http://www.epa.gov/waterscience/fish/MethylmercuryBrochure.pdf
- http://www.fda.gov/bbs/topics/NEWS/2006/NEW01382.html
- http://www.doh.wa.gov/fish/Fishadvmercury.htm - Washington State Fish Advisory for Mercury
- http://www3.doh.wa.gov/here/materials/CRA_Detail.aspx?ID=287 - Fish Facts for Good Health

Vitamin A: Liver and cod liver oil

To prevent teratogenic effects of high doses of preformed vitamin A (retinol), pregnant women are advised to limit intake of foods that contain large amounts of retinol. These foods include liver and liver products and cod liver oil. The critical period appears to be during the first trimester.

Alcohol

Women who are pregnant should not drink alcoholic beverages, since no safe amount of alcohol has been identified. Alcohol can increase the risk of having an infant with physical, behavioral and cognitive deficits, called Fetal Alcohol Spectrum Disorders (FASD). These include:

- Fetal alcohol syndrome (FAS)
- Fetal alcohol effects (FAE) and possible FAE (PFAE)
- Alcohol-related neurodevelopmental disorder (ARND)

- Alcohol-related birth defects (ARBD)

A discussion about the nutrition-related implications of alcohol use during pregnancy is included in Module 4, MNT for Specific Conditions.

Read more: Fetal Alcohol Syndrome Disorders

Fetal alcohol spectrum disorders (FASDs) include fetal alcohol syndrome (FAS), alcohol-related neurodevelopmental disorder (ARND), and alcohol-related birth defects (ARBD). (The terms ARND and ARBD replaced Fetal Alcohol Effects - FAE - in 1996.) They are caused by prenatal alcohol exposure, and may affect up to 1% of the US population. (CDC, Wattendorf and Muenke 2005)Infants and children with FASDs might exhibit some of the following characteristics:

- *Small size or short stature (compared to peers or for gestational age)*
- *Facial anomalies (e.g,. thin upper lip, short palprebral fissures, long filtrum, epicanthal folds)*
- *Microcephaly*
- *Central nervous system abnormalities*
- *Cardiac defects*
- *Cognitive and behavioral problems (e.g., similar to attention-deficit/hyperactivity disorder, learning disabilities, developmental disabilities, mental retardation)*
- *Sleep and sucking disturbances in infancy*

For more information about FASDs, visit these websites:

- *http://depts.washington.edu/fasdpn/*
- *http://depts.washington.edu/fasdwa/*
- *http://www.cdc.gov/ncbddd/fas/*

Caffeine

There is an association between high maternal intake of caffeine and increased risk of low birthweight and spontaneous abortion, however there are no definitive data about the amount of caffeine associated with these risks. (Signorello and McLaughlin, 2004; Bracken, et al, 2003) Although no consensus has been reached, some guidelines suggest that pregnant women limit caffeine intake to 300 mg per day. Another concern is that women who drink large amounts of caffeine from beverages like soda, will fill up on these beverages with low nutrient density and have less room for other nutrient dense foods. Concerns about hydration status with excessive amounts of caffeine have also been raised.

Read more: Caffeine content of commonly consumed beverages

- *85 mg per 5 oz cup percolated coffee*
- *60 mg per 5 oz cup instant coffee*
- *40 mg per 1 oz espresso*
- *30 mg per 5 oz cup leaf/bag tea*
- *36 mg per 12 oz cola beverage*

Artificial Sweeteners

The use of artificial sweeteners during pregnancy receives much attention in the lay press. To date, no studies have been published that link use of artificial sweeteners with adverse pregnancy outcomes.

Read more: use of artificial sweeteners

Saccharin crosses the placenta and appears in breastmilk, but there have been no studies documenting adverse effects on the fetus or infant

Acesulfame-K crosses the placenta and appears in breastmilk, but there have been no studies documenting adverse effects on the fetus or infant

Sucralose has not been found to be teratogenic in high doses in animals; there have been no studies of sucralose in breastmilk or during lactation

Aspartame appears to be safe in pregnancy and lactation. (One of the metabolites of aspartame is phenylalanine, so use of aspartame is not appropriate for individuals with phenylketonuria.)

Herbal Remedies, Including Teas

Most herbal and botanical remedies (including supplements and teas) have not been adequately studied, especially for use during pregnancy. Some may be safe by themselves, but may be dangerous when combined with other medications or nutrients. Clients should report any herbal use to their medical provider.

Read more: herbal supplements and pregnancy

Herbal supplements are used during pregnancy for a variety of reasons; some are safe, others can be harmful. The majority of herbal remedies have not been studied, and their effects during pregnancy are not known. Herbal supplement use during lactation is covered briefly in Module 8, Breastfeeding Assessment and Support.

Product	***Purported Use***	***Comments (Including safety, efficacy, evidence)***
Black Cohosh	*Uterine stimulant* *Labor-inducing aid*	*Efficacy is unclear* *Caution during pregnancy (especially during the first trimester) because of potential (though unproven) labor-inducing properties* *Caution during lactation is suggested, due to potential hormonal effects* *Blue cohosh (not black) is also used for gynecologic disorders and has a greater potential for toxicity than black cohosh.*
Echinacea	*Anti-infective agent, remedy for viral infections (especially upper respiratory infections)*	*Evidence for use in treating upper respiratory infections is strong* *Oral consumption during the first trimester was not associated with an increased risk of major malformations* *Caution for use during lactation until stronger evidence about safety is available* *Consider potential for interactions between echinacea and other medications*
Ginger	*Treatment of hyperemesis*	*250 mg powdered capsules* *The American College Obstetricians and Gynecologists Practice Pattern suggests this as option (ACOG, 2004)* *Some controversy over safety of high doses (in vitro studies of specific, isolated constituents indicated mutagenicity; not borne out in clinical trials)*
Ginkgo	*Memory boosting* *Treatment for asthma, sexual disfunction, hormonal changes*	*Major safety concern with use during pregnancy is anti-platelet activity and prolonged bleeding during delivery* *Some case reports of adverse effects during*

		pregnancy related to product adulteration; clinicians should be aware of manufacturers who use Good Manufacturing Practices (GMP) *Theoretical evidence for avoiding raw ginkgo seed during pregnancy and lactation* *Consider potential for interactions between gingko and other medications*
St. John's Wort	*Enhance uterine tone* *Treatment for depression*	*Caution is warranted related to use during pregnancy; safety studies are weak* *Potential side effects during lactation include colic, drowsiness, lethargy* *Consider potential for serious interactions between St. John's Wort and other medications*

References:

Belew C. Herbs and the childbearing woman: Guidelines for midwives. Journal of Nurse-Midwifery*. 1999;44(3):231-252.*

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Dogoua JJ, Mills E, Perri D, Koren G.Safety and efficacy of St. John's Wort (hypericum) during pregnancy and lacatation. Can J Clin Pharmacol *2006;e268-e276.*

*Dugoua JJ, Seely D, Perri D, Koren G, Mills E. Safety and efficacy of black cohosh (*cimicifuga racemosa*) during pregnancy and lacatation.* Can J Clin Pharmacol *2006;e257-e261.*

*Perri D, Dugoua JJ, Mills E, Koren G. Safety and efficacy of echinacea (*echinacea angustifolia*,* e. purpurea *and* e. pallida*) during pregnancy and lacatation.* Can J Clin Pharmacol *2006;e262-e267.*

Vutyavanich T, Kraisarin T, Ruangsri R. Ginger for nausea and vomiting in pregnancy: randomized, double-masked, placebo-controlled study. Obstet Gynecol *2001;97:577-582.*

Table 2-1. Selected herbal supplements and implications during pregnancy

Herbs to avoid during pregnancy	
Herb	*Action*
Blue cohosh	*Oxytoxic*
Black cohosh	*Uterine stimulant effects (used by some midwives in*

	preparation for labor)
Chamomile, valerian	*Antispasmodic, sedative*
Goldenseal	*Oxytoxic*
Dong quai	*Stimulant, relaxant*
Comfrey "internal use"	*Liver toxicity*
Ephedra	*Uterine stimulant*
Chaste tree	*Uterine stimulant*
Pharmacologic dose of zinc	*Premature and stillbirth*
Reference: Born D, Barron ML. Herb use in pregnancy: what nurses should know. MCN *2005; 30(3):201-206.*	

Table 2-2. Herbs to avoid during pregnancy

For more information, see
http://www.americanpregnancy.org/pregnancyhealth/naturalherbsvitamins.html

Resources:

- http://www.nlm.nih.gov/medlineplus/druginfo/herb_All.html - Medline Plus index of herbs and other supplements
- http://nccam.nih.gov/ - The National Center for Complementary and Alternative Medicine website (NIH)

Diet- and Food-Related Concerns

Other issues

Nausea and vomiting
"Morning sickness," though not necessarily limited to the morning, is reported to occur in about 50-75% of all pregnancies, especially in the first trimester. Some recommendations for minimizing problems with nausea and vomiting include:

- eating small frequent meals
- using high-carbohydrate snacks (e.g., crackers, toast), especially early in the morning
- taking a multivitamin
- drinking cold, tart or sweet beverages
- eating salty potato chips

It has been suggested that increased estrogen levels during pregnancy may heighten an individual's sense of smell (including aversion to strong food odors). Recommendations to avoid food and non-food triggers are also common. (Erick, 1994). Other recommendations include use of supplemental vitamin B6 (10-25 mg, 3-4 times per day) and ginger (ACOG, 2004; Vutyavanich, et al, 2001).

Hyperemesis gravidarum is different than the usual "morning sickness," and is thought to occur in about 2% of pregnancies. It is typically accompanied by an increase in maternal free thyroid hormone. Hyperemesis gravidarum often requires hospitalization and parenteral nutrition support. (Erick, 1995)

Read more: hyperemesis gravidarum

It is estimated that 1-2% of pregnant women have hyperemesis gravidarum. (Hamaoui, 1998) Diagnostic criteria include intractable vomiting, disturbance of nutritional status, weight loss of at least 5%, ketosis, acetonuria. Hyperemesis gravidarum can result in neurologic disturbances, liver damage, retinal hemorrhage, and renal damage.

Hyperemesis gravidarum is different than the "morning sickness" that is not unusual among pregnant women. Symptoms are not time-specific and occur throughout the day (vs. being worse, for example, in the morning). Women are often unable to perform activities of daily living, and hyperemesis gravidarum interferes with sleep. Ketones are often present, dehydration and electrolyte imbalances are common, and urine is scant, dark, and malodorous.

The etiology of hyperemesis gravidarum is not known, however theories include the influence of adrenal dysfunction, hormonal changes, and human chorionic gonadotropin (hCG) levels. Olfactory triggers have also been documented; these are thought to be a result of enhanced chemoreception with increased estrogen levels. (Erick, 1995)

Treatment is "symptomatic," and usually includes rehydration therapy and avoidance of "trigger smells," (both food and non-food); antiemetics, hyperalimentation, and hospitalization are often necessary.

Pica

Pica is the ingestion of non-food items. The most commonly reported pica practices among pregnant women are geophagia (eating dirt or clay) or amylophagia (eating starch). Chewing on ice is not uncommon, but chewing on large quantities of ice can be a red flag, indicative of other forms of pica. Complications of pica can include interference with iron absorption, intestinal obstruction, excessive energy intake (e.g., with amylopagha), infection with worms, and toxicity (lead). (Rose et al, 2000; Rainville, 1998)

The etiology of pica, especially during pregnancy, is not understood. One thought is that iron deficiency in pregnancy may result in pica. (Rose et al, 2000)Some cultures also promote pica believing it helps with the pregnancy, for example, eating clay among the Hispanic population.

Resources:

- http://www.anred.com/pica.html - ANRED (Anorexia Nervosa and Related Eating Disorders, Inc.) website with information about pica
- http://www.emedicine.com/ped/topic1798.htm - emedicine article - Eating Disorder: Pica

Reflux

Most cases of reflux during pregnancy result from a combination of factors:

- hormonal changes cause the esophageal sphincter to relax
- the enlarged uterus puts increasing pressure on the stomach and intestines

Recommendations for the treatment and prevention of reflux during pregnancy include limiting intake before bed, elevating the head of the bed, wearing loose-fitting clothing, drinking beverages between meals, and eating smaller, more frequent meals and snacks. Some people find that limiting or avoiding specific foods (e.g., acidic foods such as tomatoes and orange juice) or avoiding eating about during the 3 hours before bed also helps to minimize reflux. Smoking and caffeine also contribute to reflux.

Constipation and hemorrhoids

Constipation and hemorrhoids are two complications of pregnancy due to the slowing of the GI tract and the increase of iron. Increasing physical activity (walking), fiber and fluids may make the problems more manageable.

Issues for Specific Groups

Several conditions and groups of women present special consideration related to nutrient needs and intake during pregnancy. A few are highlighted in the next few pages.

Vegetarian and vegan food patterns

Women who consume a vegetarian or vegan food pattern may be at risk for some specific nutrient deficiencies, depending upon the foods and food groups that are avoided. (See Table)

Food Pattern	Nutrients at Risk	Vegan or Vegetarian Food Sources
Lacto- ovo- vegetarian – consumes milk and eggs; avoids meat and fish	Iron	Legumes, dark green leafy vegetables, fortified foods including breads and cereals, dried fruit, nuts, seeds
	Zinc	Legumes, beans, nuts, seeds, green vegetables, and fortified cereals
Lacto-vegetarian – consumes milk; avoids meat, fish, and eggs	Iron and zinc	(See above)
Vegan – consumes only foods of plant origin; avoids meat, fish, eggs, and milk	Iron and zinc	(See above)
	Calcium	Green leafy vegetables, fortified soy foods including bread, soy milk, tofu, corn tortillas
	Vitamin D	Fortified foods including margarine, breakfast cereals, soy milk, and other soy products; sunlight
	Riboflavin	Yeast extract, wheat germ, almonds, soy beans, tempeh, fortified foods, mushrooms, seaweed
	Vitamin B12	Fortified foods, including yeast extract, soy milk, textured soy protein, and breakfast cereals
	Iodine	Iodized salt
Adapted from Williamson, 2006.		

Table 2-3. Vegetarian and vegan food patterns

A vegetarian food guide has been developed:
http://www.eatright.org/cps/rde/xchg/ada/hs.xsl/governance_5105_ENU_HTML.htm.

Adolescents

The adolescent who is pregnant presents unique nutritional considerations, because in addition to nutrients needed to support a healthy pregnancy, nutrients are also needed for the adolescent's growth and development.

Although some hypothesize that the smaller birthweights of infants born to adolescent mothers is adaptive (i.e., because the infants' mothers are smaller than adult women), a 1996 study indicated that the lowest mortality rates were seen in infants with birthweights between 3000 and 4499 grams, regardless of mother's age. (Rees et al, 1996) Thus, estimates of energy needs for adolescent pregnancy may be higher than for adult pregnancy, in order to promote adequate weight gain. Recommendations for weight gain during pregnancy may be as high as 28-40 pounds (12-18 kg), depending on the adolescent's age and pre-pregnancy weight.

Many adolescents do not have adequate intakes of calcium, folic acid, and/or iron and may, in fact, have iron deficiency anemia before pregnancy. These nutrients are of special concern, both to maintain good nutritional status of the mother, and because of potential long-term effects on their children. A study of adolescent mothers found long-term effects of iron deficiency. At age 3, children of iron deficient mothers were less active than children whose mothers had adequate iron status.

When working with teens consider their food preferences, ability to cook, access to grocery shopping, lifestyle (e.g., school, work), and support around food.

Read more: What is an adolescent?

Data about teen birth rates generally include births to girls ages 15-19 years, and this age range seems to be the accepted definition for "adolescent" in terms of pregnancy. Considerations in the nutrition assessment of an individual should include physical maturity as well as social and emotional maturity.

Overweight

The weight gain goals for mothers who are overweight before pregnancy may be lower than those for women with "normal" weights, depending on the degree of overweight. It is critical to ensure that the woman's nutrient intake (especially vitamins and minerals) is adequate to support a healthy pregnancy. Specific recommendations for women who are

overweight are reviewed in Module 4, Medical Nutrition Therapy for Specific Conditions.

Multiparous

The number of multiple births (e.g., twins, triplets) is increasing in the US, in part because of use of fertility drugs. Multiparity is associated with increased risks for the infant (prematurity, intrauterine growth restriction, low birthweight) as well as for the mother (pre-eclampsia, iron-deficiency anemia).

The literature calls for "optimal maternal nutrition," however this is not always clearly defined. Weight gain goals and intakes of some nutrients are increased for multiparous pregnancies:

- ***Weight gain*** – The IOM recommendations suggest a total weight gain of 35-45 lb (16-20.5 kg) for twin pregnancies. This is a rate of about 1.5 lb per week during the second and third trimesters.
- ***Energy intake*** – Needs for a twin pregnancy are approximately 150 kcal per day higher than needs for a singleton pregnancy. It is assumed that essential fatty acid needs are also increased, however there are no studies to quantify this.
- ***Protein intake*** – An additional 50 grams per day, beginning in the 2nd trimester is recommended. This is approximately 96 grams protein per day.
- ***Minerals*** – The IOM recommends supplementation with 30 mg iron, 250 mg calcium, 15 mg zinc, and 2 mg copper per day after the 12th week, for multifetal pregnancies.
- ***Vitamins*** – The IOM recommends supplementation with 2 mg vitamin B6, 300 ucg folate, 50 mg vitamin C, and 200 IU vitamin D after the 12th week, for multifetal pregnancies.

Dieting during pregnancy

In general, dieting (restricting energy intake) should be discouraged during pregnancy. Restricted maternal energy intakes have been associated with low gestational weight gain, poor fetal growth and development, low birthweight, and preterm delivery. Some studies also indicate an association with neural tube defects, miscarriage, and post-partum depression. Maternal ketosis may be related to cognitive problems, including mental retardation, for the developing fetus.

Instead, if women are overweight or obese prior to pregnancy they should be encouraged to eat healthy, increase exercise (walking), and maintain a slow steady weight gain.

Case Example: Kayla

Kayla is a 20-year-old woman, who is about four months pregnant. She has not received medical care for her pregnancy because she has no medical insurance. She has financial problems, and sometimes "runs out of food."

Kayla says she experienced nausea and vomiting for about three months, and lost weight during that time. Her current weight is ten pounds more than her reported pre-pregnancy weight; her pre-pregnancy weight was appropriate for her height. She is approximately 5 feet, 5 inches tall and weighs about 145 pounds.

1. Estimate Kayla's energy needs. You estimated her pre-pregnancy energy needs to be about 2100 calories. (See table on nutrient needs during pregnancy)

a. 1500 calories per day
b. 1760 calories per day
c. 2440 calories per day
d. 2600 calories per day

2. Estimate Kayla's protein needs. (See table on nutrient needs during pregnancy)

a. 65 grams per day
b. 72 grams per day
c. 100 grams per day
d. 160 grams per day

3. What nutrients are you concerned about? (Check all that apply)

a. folate
b. iron
c. vitamin C
d. DHA

Case Example: Eileen

Eileen is a 24-year old woman who is about 5 months pregnant. She had morning sickness throughout the first several months of pregnancy, but found that eating small amounts of cornstarch helps with GI discomfort. She has read about the benefits of fish oil, so tries to eat fish at least two times each week. Eileen is 5 feet, 3 inches tall, and her pre-pregnancy weight was 130 pounds.

1. Estimate Eileen's energy needs. You have estimated her pre-pregnancy energy needs to be about 2000 calories. (See table on nutrient needs during pregnancy)

a. 1860 calories per day
b. 2340 calories per day
c. 2500 calories per day
d. 3000 calories per day

2. Estimate Eileen's protein needs. (See table on nutrient needs during pregnancy)

a. 65 grams per day
b. 72 grams per day
c. 100 grams per day
d. 160 grams per day

3. What nutrients are you concerned about? (Check all that apply)

a. folate
b. iron
c. vitamin C
d. DHA

4. What else might be a risk factor? (Check all that apply)

a. eating cornstarch
b. GI discomfort
c. Use of fish oil
d. overweight

References and Resources

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Resources

Quiz

1. Underweight pre-pregnancy increases the risk of

a. low birthweight
b. gestational diabetes only
c. low birthweight and premature delivery
d. gestational diabetes and macrosomia

2. Overweight pre-pregnancy increases the risk of:

a. low birthweight
b. calcium deficiency
c. maternal cardiovascular disease
d. long-term maternal obesity and pregnancy-induced hypertension

3. True or false: Since the fortification of many grains in the US with folic acid, concerns about pre- and peri-conceptual folate status are no longer needed.

a. true
b. false

4. Energy needs increase during pregnancy for a number of reasons, including:

a. increased basal metabolic rate
b. products of conception
c. accretion of maternal tissue
d. all of the above
e. B and C only

5. During pregnancy, requirements for the essential fatty acids linoleic and alpha-linolenic acid are:

a. increased above pre-pregnancy levels
b. decreased below pre-pregnancy levels
c. unchanged from pre-pregnancy levels
d. depend on the individual's usual fat intake

6. For the most part, requirements of minerals during pregnancy are not different from requirements for non-pregnant women. However, needs for some minerals do increase. These include:

a. iron only
b. calcium and iron
c. magnesium and iron
d. calcium and magnesium

7. To prevent problems associated with methylmercury, recommendations during pregnancy include:

a. avoiding shark, swordfish, king mackerel, and tilefish
b. limiting consumption of marlin, halibut, and catfish to 6 ounces a week
c. avoiding all fish
d. none of the above

8. Some recommendations for minimizing problems with nausea and vomiting include all of the following EXCEPT:

a. taking a multivitamin
b. eating small frequent meals
c. eating a large meal in the evening
d. drinking cold, tart or sweet beverages

9. Complications of pica can include which of the following:

a. increased energy needs
b. interference with iron absorption
c. development of other eating disorders
d. interference with calcium absorption

10. Reflux during pregnancy:

a. Should not be treated with antiacids
b. Can be minimized by eating larger, less frequent meals
c. Is common because of hormonal changes that cause the esophageal sphincter to relax
d. Is not more common during pregnancy, but is more pronounced in women who have reflux when they are not pregnant.

11. True or false: smaller birthweights of infants born to adolescent mother is adaptive (i.e., because the infants' mothers are smaller than adult women).

a. true
b. false

12. In general, nutrient intake recommendations during multiparous pregnancies are:

a. increased over singleton pregnancies
b. no different than for singleton pregnancies
c. no different than for singleton pregnancies, except for energy intake, which is increased
d. no different than for singleton pregnancies, except for mineral intake, which is increased