

## Nutrition in pregnancy

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**INTRODUCTION** — A woman's nutritional status should be assessed preconceptionally with the goal of optimizing maternal, fetal, and infant health. Pregnancy-related dietary changes should begin prior to conception, with appropriate modifications across pregnancy and during lactation. (See ["Preconception evaluation and counseling"](#) and ["The initial prenatal assessment and routine prenatal care"](#).)

Most nutritional advice for pregnant women is based on the 1990 Institute of Medicine (IOM) Pregnancy Report, the 2005 Dietary Guidelines for Americans by the US Department of Health and Human Services and US Department of Agriculture, and the following 2006 IOM publication: Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. The Recommended Dietary Allowances (RDAs) are levels of nutrients recommended by an expert IOM panel based on extensive evaluation of available scientific evidence and mathematically adjusted to meet the needs of 97 percent of the population.

Although it is clear that prenatal nutrition impacts short- and long-term health, many scientific questions remain unanswered due to the many challenges to performing high quality scientific research in pregnancy. These challenges include the often unknown critical windows of when nutrition may impact development, many physiological changes that occur over the course of normal pregnancy, large individual differences in maternal adaptation to pregnancy, ethical and practical issues of experimenting with human pregnancy, and the lack of a good animal model that can be directly extrapolated to humans.

Nutritional concerns related to pregnancy will be discussed here. Dietary issues in nonpregnant adults are reviewed elsewhere. (See ["Diet and nutrition"](#) and ["Vitamin supplementation in disease prevention"](#) and ["Dietary and nutritional assessment in adults"](#).)

**ASSESSMENT OF NUTRITIONAL STATUS** — Where available, nutritional assessment and counseling can best be performed using a team approach, including the obstetrical provider, health professionals trained in prenatal nutrition counseling and education, and a registered dietitian with perinatal nutritional expertise.

**History** — By asking appropriate questions, the medical history can help uncover habits, eating disorders, and diseases (eg, Crohn's disease, diabetes) which pose nutrition-related health risks to the woman and her fetus. The obstetrical history is also important. As an example, a past history of a fetus/child with a neural tube defect would prompt advice to consume a higher dose of supplemental folic acid (4 mg rather than 0.4 mg) prior to conception and in early pregnancy to reduce the risk of recurrence. (See ["Folic acid for prevention of neural tube defects"](#).)

A self-administered questionnaire completed prior to the interview is helpful for reviewing the woman's typical diet, including a 24-hour dietary recall, and detecting obvious deficiencies ([algorithm 1](#)) [1]. In general, women who typically eat three meals daily consisting of several servings of vegetables, fruits, whole grains, low fat dairy products, and a few sources of protein (eg, meat, fish, eggs, dried peas or beans) are likely to have adequate nutrition. By comparison, women who skip several meals each week and/or have a high intake of soft drinks, snack foods (eg, chips, candy, cookies), and fast foods can benefit from nutritional counseling by the physician or midwife, nurse, or ideally a perinatal nutritionist (registered dietitian trained in perinatal health).

The following topics should also be addressed in the nutritional history:

- Substance abuse — cigarettes, alcohol, and illicit drugs not only pose direct health risks, but affect intake of an adequate and balanced diet. Stimulants may increase energy requirements.
- Use of vitamin, mineral, or herbal supplements — consumption of vitamin supplements containing high doses of vitamin A (greater than 10,000 international units per day) appears to be teratogenic and should be avoided; however, high vitamin A intake from excessive consumption of liver (>100 g per week) potentially may also be harmful [5]. Periconceptional folic acid supplementation is recommended since it reduces the risk of neural tube defects. An increase in calcium and iron is important for bone and red blood cell development, while too little or too much can lead to fetal goiter. The lack of safety and efficacy studies of herbal remedies preclude their use in any woman who is pregnant, contemplating pregnancy, or lactating (see ["Herbal supplements"](#) below).
- Food avoidances, special diets, skipping meals — these practices may lead to nutritional deficiencies and inadequate weight gain during pregnancy.
- Dieting history, weight fluctuations, eating disorders requiring medication or hospitalization — an eating disorder may affect fertility, be aggravated by pregnancy, or complicate pregnancy. (See ["Eating disorders: Epidemiology, pathogenesis, and clinical features"](#) and ["Eating disorders: Treatment and outcome"](#) and ["Eating disorders in pregnant women"](#).)
- Food resources — some women have financial constraints regarding the purchase, storage (eg, refrigerator), or preparation (eg, stove) of adequate amounts of nutritional food. These women require assistance from sources such as the Special Supplemental Food Program for Women, Infants, and Children (WIC) or a social service agency.

**Physical examination** — The physical examination centers on measurements of height and weight to calculate the body mass index (BMI) and assess whether the woman is at a healthy weight ([table 1A-B](#)). It is useful to ask the woman what she weighed at her last menstrual period and use this weight for baseline calculations. A prepregnancy BMI of 19.8 to 26.0 is normal. BMI tables incorporating pregnancy-related changes in weight do not exist.

The remainder of the physical examination should screen for signs of nutritional deficiency or medical disease. As an example, bulimia and other eating disorders may cause enlarged parotid glands and eroded tooth enamel; anorexia can result in irregular menses, bradycardia, or dry skin. (See ["Eating disorders: Epidemiology, pathogenesis, and clinical features"](#).)

Signs of gross vitamin deficiency are still seen in areas of the world with very poor diets. In resource-rich countries, they occur only in special populations, including: patients with alcoholism, malabsorption, and inborn errors of metabolism; those undergoing hemodialysis or receiving

parenteral nutrition; and the elderly (table 2). (See ["Dietary and nutritional assessment in adults"](#))

**PRECONCEPTIONAL RECOMMENDATIONS** — (see ["Preconception evaluation and counseling"](#), section on 'Nutrition and supplements')

**PREGNANCY RECOMMENDATIONS** — The key components of a healthy lifestyle during pregnancy include appropriate weight gain; appropriate physical activity; consumption of a variety of foods in appropriate amounts to allow adequate, but not excessive, maternal weight gain; appropriate vitamin and mineral supplementation; avoidance of alcohol, tobacco and other harmful substances; and safe food handling [

**Avoidance of foodborne illnesses** — Foodborne illnesses can cause maternal disease as well as congenital disease, premature labor, miscarriage, and fetal death. To reduce the risk of foodborne illness, it is important that pregnant women:

- Practice good personal hygiene (frequent hand washing)
- Consume only meats, fish, and poultry (including eggs) that are fully cooked
- Avoid unpasteurized dairy products and fruit/vegetable juices
- Thoroughly rinse fresh fruits and vegetables under running water before eating
- Avoid eating raw sprouts (including alfalfa, clover, radish, and mung bean). Bacteria can get into sprout seeds through cracks in the shell, these bacteria are nearly impossible to wash out.
- Wash hands, food preparation surfaces, cutting boards, dishes, and utensils that come in contact with raw meat, poultry, or fish with hot, soapy water.

In addition, countertops can be sanitized by wiping with a solution of one teaspoon liquid chlorine bleach per quart of water and leaving to dry over 10 minutes. The FDA provides detailed advice on food safety for women who are pregnant or planning pregnancy ([www.fda.gov/Food/ResourcesForYou/HealthEducators/ucm082539.htm](http://www.fda.gov/Food/ResourcesForYou/HealthEducators/ucm082539.htm)).

Foodborne illnesses can have adverse effects on the pregnancy and fetus, as well as the mother. (See ["Differential diagnosis of microbial foodborne disease"](#).) The following infections are of particular concern; these infections and strategies for avoiding them are described in detail separately:

- Toxoplasmosis (see ["Toxoplasmosis and pregnancy"](#))
- Listeria monocytogenes (see ["Clinical manifestations and diagnosis of Listeria monocytogenes infection"](#))
- Brucellosis (see ["Clinical manifestations, diagnosis, and treatment of brucellosis"](#)).

**Prepregnancy weight and weight gain** — Prepregnancy body weight and gestational weight gain have independent, but cumulative, effects on infant birth weight and gestational duration. Underweight women with low weight gain during pregnancy appear to be at higher risk of having a low birth weight infant, preterm birth, and recurrent preterm birth [7-9]. Obese women are at increased risk of having a large for gestational age infant, postterm birth, and a variety of other pregnancy complications. (See ["The impact of obesity on fertility and pregnancy"](#))

The current Institute of Medicine recommendations for singleton pregnancy are [10]:

- BMI <18.5 kg/m<sup>2</sup> (underweight) — weight gain 28 to 40 lbs (12.5 to 18.0 kg)
- BMI 18.5 to 24.9 kg/m<sup>2</sup> (normal weight) — weight gain 25 to 35 lbs (11.5 to 16.0 kg)
- BMI 25.0 to 29.9 kg/m<sup>2</sup> (overweight) — weight gain 15 to 25 lbs (7.0 to 11.5 kg)
- BMI ≥30.0 kg/m<sup>2</sup> (obese) — weight gain 11 to 20 lbs (5 to 9.0 kg)

The incidence of pregnancy complications is higher at the upper and lower extremes of weight gain. There is an increase in births of small for gestational age infants among women with a weight gain below the IOM's BMI-based recommendations and women who exceed the weight gain recommendations approximately double their risk of having a macrosomic infant. Large gestational weight gain may also increase the risk of childhood obesity. In addition, excessive weight gain during pregnancy and failure to lose weight postpartum appear to predict higher BMI in the mother long after delivery, further supporting the IOM's recommendations for limited gestational weight gain. These relationships are discussed in detail separately. (See ["Weight gain in pregnancy"](#))

Interestingly, it has been observed that the birth weight of boys is about 100 g heavier than the birth weight of girls, and this appears to be due to high energy intake in pregnant women carrying males [11].

**Dietary components** — Specific dietary components do not appear to have a significant effect on birthweight (see below). Randomized trials have provided evidence that some dietary interventions increase the length of gestation, but the evidence is not conclusive. There is no high quality evidence that any dietary intervention reduces the risk of developing preeclampsia. These topics are discussed in more detail separately. (See ["Prevention of spontaneous preterm birth"](#), section on 'Nutritional intervention' and ["Prevention of preeclampsia"](#).)

The effects of prenatal dietary components on child development and health are other active areas of investigation. (See ["Fish oil and marine omega-3 fatty acids"](#), section on 'Early neurologic development' and ["Primary prevention of allergic disease: Maternal avoidance diets in pregnancy and lactation"](#).)

**Macronutrients** — Calories are the single most important nutritional factor in determining birthweight. However, the relationship between energy intake, gestational weight gain, and birthweight is complex and poorly understood [12]. If dietary supplements have any role in improving pregnancy outcome, benefits are likely restricted to undernourished women.

- Balanced energy/protein supplements — Compared with no energy supplementation, energy supplementation during pregnancy (300 to 850 kcal/day with less than 25 percent of that energy coming from protein) is associated with a small increase in maternal weight gain and birthweight, and a reduction in the risk of small for gestational age (SGA) infants. A meta-analysis of 13 trials (4665 women) using a balanced energy-protein nutritional supplement noted a small increase in birthweight compared to unsupplemented controls (mean increase 25 grams, range 4 to 55 grams), but a significant reduction in the incidence of small for gestational age infants and stillbirth (OR 0.68 and 0.55, respectively) [3]. Postnatal follow-up was limited to a few trials and showed that these benefits were not sustained: compared to controls, there was no difference in infant size or neurocognitive development at one year.

Undernourished women appear to experience the greatest benefit. A study in rural Gambian women found that birthweight increased by approximately

200 grams in those receiving an energy-dense nutritional supplement in the wet season (ie, when food shortages result in negative energy balance), but not during the dry season (ie, harvest period with positive energy balance<sup>[4]</sup>). The proportion of low birth weight babies decreased from 24 to 8 percent.

Supplementation with protein alone or isocaloric protein supplementation (less than 25 percent of energy in the supplement coming from protein) does not increase, and sometimes decreases, birthweight <sup>[3,15]</sup>.

- **Fat** — Data from randomized trials suggest that a diet low in cholesterol and saturated fat may decrease the risk of preterm delivery. (See "[Prevention of spontaneous preterm birth](#)")

Effects of enhanced dietary intake or supplementation with n-6 and n-3 polyunsaturated fatty acids (PUFA) during pregnancy are under investigation. [Docosahexaenoic acid](#) (DHA an n-3 PUFA) appears to be essential for early brain development during gestation and infancy<sup>[8]</sup>. A randomized trial compared the effect of supplementing pregnant and lactating women with n-3 PUFA (cod liver oil) versus long-chain n-6 PUFA (corn oil<sup>[9]</sup>). Offspring of mothers who had taken cod liver oil (n = 48) during pregnancy and lactation scored higher on the Mental Processing Composite of the K-ABC at 4 year of age than children whose mothers had taken corn oil (n = 36; 106.4 versus 102.3). Other studies have reported similar benefits and suggested these supplements may also improve visual acuity and decrease the risk of allergic disorders in offspring<sup>[7,18,20,21]</sup>. However, further study is needed before recommending that pregnant women increase their intake of fish (see below) or fish oil supplements to improve neurological, immunological, cognitive, or physical development in offspring<sup>[22]</sup>. The Perinatal Lipid Intake Working Group's recommendation for DHA intake by pregnant women is 200 mg daily <sup>[23]</sup>.

Trans fatty acids (TFA) are transported across the placenta in proportion to maternal intake. TFA may have adverse effects on fetal growth and development by interfering with essential fatty acid metabolism, by direct effects on membrane structures or metabolism, or by replacing maternal intake of the cis essential fatty acids <sup>[24]</sup>.

**Micronutrients** — Micronutrients generally do not have a significant effect on birthweight or gestational duration in well-nourished women. In developing countries, however, consumption of multivitamins may be beneficial. A systematic review of 13 randomized and controlled trials of the effects of prenatal multimicronutrient supplementation on pregnancy outcome found that offspring of women who received multimicronutrients had a significant 10 to 30 percent reduction in risk of low birth weight compared to infants of women who received no supplements or iron-folate supplement <sup>[25]</sup>. These infants were, on average, 54 grams (range 36 to 72 g) heavier than infants in the iron-folate supplementation group. However, there was no significant reduction in risk of preterm birth or small for gestational age infants. Although all but one of the studies were performed in countries with a high proportion of undernourished women, the characteristics (eg, underlying nutritional status) of the study populations were not defined, and there was variability in the timing and duration of supplementation and the types of supplements used.

Further investigation is needed to determine whether factors other than micronutrient supplementation contributed to these results, which micronutrients may have the potential for improving birth weight, whether supplementation affects other important outcomes (eg, perinatal mortality, neurodevelopment, long-term health), and the populations most likely to benefit from this intervention.

**Recommended daily allowances** — Recommended dietary allowances (RDAs) were arbitrarily constructed to be two standard deviations around the normal dietary intake for the US population. Therefore, by definition, 95 percent of the US population will consume adequate levels. The RDAs are different for specific age groups, males, females, and pregnant or lactating women.

**Calories** — As discussed above, calories are the single most important nutritional factor in determining birthweight<sup>[26]</sup>. The recommended intake is an increase in daily caloric intake by 340 kcal/day in the second trimester and 452 kcal/day in the third trimester<sup>[27]</sup>.

The United States Department of Agriculture provides a free internet site ([www.mypyramid.gov/mypyramidmoms/index.html](http://www.mypyramid.gov/mypyramidmoms/index.html)) to help pregnant women choose appropriate foods from a food pyramid ("My Pyramid for Moms") based on their personal characteristics<sup>[28]</sup>.

**Protein** — The fetal/placental unit consumes approximately 1 kg of protein during pregnancy, with the majority of this requirement in the last six months. To fulfill this need, the gravida should ingest 1.1 g/kg/day protein, which is moderately higher than the 0.8 g/kg/day recommended for nonpregnant adult women<sup>[27]</sup>.

**Carbohydrate** — The RDA for carbohydrates in pregnancy is 175 g/day, up from 130 g/day in nonpregnant women<sup>[29]</sup>.

**Iron** — Iron is necessary for both fetal/placental development and to expand the maternal red cell mass. Total iron loss associated with pregnancy and lactation is about 1000 mg. Experts recommend an increase in iron consumption by about 15 mg/day (to about 30 mg/day), an amount readily met by most prenatal vitamin formulations. This is adequate supplementation for nonanemic women. Most studies report iron supplementation significantly decreases the prevalence of maternal anemia at delivery<sup>[29]</sup>. It is unclear whether iron supplementation in nonanemic, well-nourished pregnant women improves birth outcome; data are conflicting<sup>[29-33]</sup>. There also may be adverse effects from routine iron supplementation<sup>[34-36]</sup>.

Women with iron deficiency anemia (first or third trimester hemoglobin [Hb] <11 g/dL or second trimester Hb ≤10.4 g/dL and low serum ferritin) should receive an additional iron supplement of 30 to 120 mg per day until the anemia is corrected<sup>[29]</sup>. The effects of iron and folate supplementation in these women is discussed in detail separately. (See "[Hematologic changes in pregnancy](#)", section on "Anemia" and "[Treatment of anemia due to iron deficiency](#)".)

**Calcium** — Fetal skeletal development requires about 30 grams of calcium during pregnancy, primarily in the last trimester. This total is a relatively small percentage of total maternal body calcium and is easily mobilized from maternal stores, if necessary. Calcium absorption increases during pregnancy and allows progressive retention throughout gestation<sup>[37]</sup>. The RDA for elemental calcium is 1000 mg per day in pregnant and lactating women 19 to 50 years of age (1300 mg for girls 14 to 18 years old<sup>[38]</sup>). The dietary recommendation for calcium is the same for lactating and nonlactating women of the same age. (See "[Calcium physiology in pregnancy](#)".)

Calcium supplementation has also been used to prevent hypertensive disorders of pregnancy. It does not appear to be effective for healthy, nulliparous women in whom baseline dietary calcium intake is adequate. There may be a benefit for preeclampsia prevention in high-risk populations, but further study is required since current information is based upon small numbers of women and diverse study populations. (See "[Prevention of preeclampsia](#)", section on "Calcium supplementation".)

**Folic acid** — The United States Preventive Services Task Force (USPSTF) recommends that women take a supplement containing 0.4 mg to 0.8 mg of folic acid one month before and for the first 2 to 3 months after conception to reduce their risk of having a child with a neural tube defect<sup>[1]</sup>. An RDA of 0.6 mgs is recommended thereafter to meet the growth needs of the fetus and placenta<sup>[2]</sup>.

**Multivitamin and mineral supplements** — The IOM and CDC recommend multivitamin supplements for pregnant women who do not consume an adequate diet ([table 3](#)) <sup>[12,42]</sup>. Women at higher risk for dietary deficiencies include those who are carrying a multiple gestation, heavy smokers, adolescents, complete vegetarians, substance abusers, and women with lactose deficiency.

Multivitamin content varies depending on the product used. A reasonable option is a daily multivitamin-mineral supplement that contains:

- Iron — 30 mg
- Zinc — 15 mg
- Copper — 2 mg
- Calcium — 250 mg
- [Vitamin B6](#) — 2 mg
- Folate — 0.6 mg
- [Vitamin C](#) — 50 mg
- [Vitamin D](#) — 5 mcg (200 international units)

The RDA for vitamin D is likely to be revised upward when new recommendations are published in May 2010 ([selenium physiology in pregnancy](#)). Most commercial non-prescription products labeled vitamin D (multivitamin supplements, fortified milk and bread) contain ergocalciferol (unactivated vitamin D2). The FDA permits non-prescription products and supplemented foods containing either or both vitamin D2 or D3 to be labeled simply vitamin D. Prescription products specify which form of vitamin D is supplied. Most prescription prenatal vitamins contain cholecalciferol D3, but some contain D2 and some contain a mixture. Assuming normal renal function, the only difference is that D3 may be more efficiently absorbed than D2.

Individual adjustments should be made based upon the woman's specific needs. Well-nourished women may not need multivitamins to satisfy these daily requirements [\[43\]](#), but in the absence of a careful evaluation by a nutritionist, it is prudent to recommend them.

The use of self-prescribed supplements is commonplace and has led to numerous case reports of vitamin or mineral toxicities due to overuse of over-the-counter medicines. Specific substances identified as potentially toxic when taken in large quantities include, but are not limited to: iron; [selenium](#); and vitamins A (>10,000 international units per day may be teratogenic) and D (which can cause hypercalcemia [\[44-46\]](#)). However, the toxic dose of [vitamin D](#) is poorly defined and vitamin D deficiency appears to be far more common than excess intake [\[48\]](#). A safe upper limit seems to be 50 mcg (2000 IU daily) [\[49\]](#). Low vitamin D intake may be associated with a slight reduction in birth weight [\[50\]](#).

Excessive quantities of [iodine](#) can cause fetal goiter. Intake of large amounts of vitamins E and K may also be toxic. However, iodine and vitamin deficiencies also have potentially harmful effects. The Institute of Medicine recommends daily iodine intake of 220 mcg during pregnancy and 290 mcg during lactation; the World Health Organization recommends iodine intake of 250 mcg for both pregnant and lactating women. The American Thyroid Association recommends that women receive 150 mcg iodine supplements daily during pregnancy and lactation, and that all prenatal vitamin/mineral preparations contain 150 mcg of iodine [\[51, 52\]](#); many contain no iodine [\[33\]](#).

**Dietary restrictions** — Self-imposed or physician-advised dietary restraints that attempt to avoid excessive weight gain during pregnancy serve no useful purpose. Essential nutrients are often left out of the diet and the goal of an ideal weight gain is not achieved. As an example, one study of 62 women who restrained their intake found that these women were more likely to gain too little or too much weight, rather than the recommended amount [\[54\]](#).

Certain foods should be limited or avoided during pregnancy because of potentially toxic effects. These include consumption of some types of fish, high [caffeine](#) intake, unwashed fruits/vegetables, unpasteurized dairy products, and undercooked meats. (See [Epidemiology and pathogenesis of Listeria monocytogenes infection](#) and [Toxoplasmosis and pregnancy](#), section on 'Prevention')

**Vegetarian diet** — Vegetarian diets, particularly those that exclude all animal products, may not provide adequate amounts of essential amino acids, iron, trace minerals, vitamin B-12, [vitamin D](#) and calcium, or complex lipids for normal embryonic and fetal development. In addition, the high bulk of food required in vegetarian diets (especially for vegans) can make meeting energy requirements during pregnancy difficult. These deficiencies can usually be resolved with minor dietary alterations; consultation with a registered dietitian is advisable [\[55-58\]](#).

For example, the important difference between proteins of plant and animal origin is in the concentration of indispensable or essential amino acids. Animal foods are considered complete or high-quality proteins because they contain all nine essential amino acids that the body needs for growth and repair of body tissues [\[59\]](#). Plant-based foods are usually incomplete, meaning that they are deficient in one or more of the essential amino acids. These deficiencies can be corrected by use of fortified soy products, consumption of foods with complementary amino acids, and increased intake of dairy products (if acceptable to the women).

Phytoestrogens consumption tends to be higher among herbivores than among omnivores. One prospective longitudinal study suggested this exposure during pregnancy may increase the prevalence of hypospadias in male offspring [\[60\]](#).

**Fish** — Methylmercury exposure, primarily through ingestion of contaminated fish, can cause severe central nervous system damage, as well as milder intellectual, motor, and psychosocial impairment. For this reason, the FDA and Environmental Protection Agency (EPA) recommend that pregnant women (or woman who might become pregnant or who are nursing) should:

- Avoid eating any shark, swordfish, king mackerel, or tilefish because they may contain high levels of mercury.
- Eat up to 12 ounces (two average meals) a week of a variety of fish and shellfish that are lower in mercury. Commonly eaten fish that are low in mercury include shrimp, canned light tuna, salmon, pollock, and catfish. Albacore (white) tuna has more mercury than canned light tuna, therefore consumption of albacore tuna should be limited to 6 ounces (one average meal) of the total. Levels of methylmercury in other species are available at the FDA food safety website [www.fda.gov/Food/FoodSafety/Product-SpecificInformation/Seafood/FoodbornePathogensContaminants/Methylmercury/ucm115644.htm](http://www.fda.gov/Food/FoodSafety/Product-SpecificInformation/Seafood/FoodbornePathogensContaminants/Methylmercury/ucm115644.htm)

or the EPA website at [www.epa.gov/waterscience/fish/](http://www.epa.gov/waterscience/fish/).

- Check local advisories about the safety of fish caught in local lakes, rivers, and coastal areas. If no advice is available, up to 6 ounces (one average meal) per week of fish caught in local waters may be consumed, but additional fish consumption should be avoided that week.

Tuna steaks should be limited to 6 ounces per week. Many physicians recommend that pregnant women avoid eating any tuna steaks because large tuna can have high mercury levels. Canned tuna is made from smaller fish, which typically have lower levels of mercury.

These thresholds were based upon limited data and may reflect adverse effects noted in studies in which pregnant women had high intake of fish with high mercury concentrations (whale 1.6 mcg/g [\[61, 62\]](#) and shark 2.2 mcg/g [\[63, 64\]](#)). Different findings were reported in a study of women from the Seychelles, who averaged 12 meals per week of ocean fish with lower mercury concentrations (0.3 mcg/g, similar to that in fish consumed by American women) [\[65\]](#). This study did not find significant cognitive or behavioral effects in offspring of women with high fish consumption when other factors, such as social and environmental developmental modifiers and postnatal mercury exposure, were considered. These results are reassuring that women who consume a variety of ocean fish probably do not have to reduce intake during pregnancy; however, the governmental recommendations cited above remain in effect. The risks and benefits of prenatal and postpartum fish consumption are reviewed in detail separately. (See ["Risks and benefits of fish consumption and fish oil supplements during pregnancy"](#))

Contamination of fresh water fish varies with locale; the EPA and local health departments provide advice on fish consumption from fresh water lakes and streams (for current information, contact the Environmental Protection Agency at 1-888-SAFEFOOD or view the internet site

[www.epa.gov/waterscience/fishadvice/advice.html](http://www.epa.gov/waterscience/fishadvice/advice.html)). Information from the FDA is accessible at [www.fda.gov/Food/FoodSafety/Product-SpecificInformation/Seafood/default.htm](http://www.fda.gov/Food/FoodSafety/Product-SpecificInformation/Seafood/default.htm)

A more detailed discussion of potential adverse effects of various mercury compounds, including dental amalgams, can be found separately. (See ["Epidemiology and toxicity of mercury."](#))

Pregnant women are advised to eat only cooked fish in order to avoid potentially harmful organisms; however, appropriate freezing of raw fish [\[67\]](#) eliminates most parasites and bacteria so pregnant women who have consumed "sushi grade" raw fish can be reassured that this is generally safe [\[68\]](#). A variety of marine toxins (eg, ciguatera) can be ingested via fish consumption (cooked or raw), but there are only rare reports of adverse effect on pregnancy or the fetus. (See ["Marine toxins."](#))

**Caffeine** — Observational studies have reported an association between caffeine intake ([table 4](#)) and several adverse pregnancy outcomes, including miscarriage and impaired fetal growth. A limitation of these studies is their inability to adjust for confounders or accurately measure caffeine intake, which depends upon the size of the cup, brand of coffee, and brewing method. Given the limitations and inconsistencies of available data, it may be prudent for women who are attempting to conceive or who are pregnant to limit caffeine consumption to less than 200 mg per day to potentially reduce their risk of possible adverse reproductive effects.

The effects of caffeine on pregnancy outcomes are discussed in detail separately. (See ["The effects of caffeine on fertility and on pregnancy outcome."](#))

**Antigen avoidance diet** — The bulk of evidence suggests that antigen avoidance diets during pregnancy do not reduce the frequency of atopic disease in offspring and should not be recommended. (See ["Primary prevention of allergic disease: Maternal avoidance diets in pregnancy and lactation."](#))

On the other hand, breastfeeding may reduce the risk of allergic disease in offspring. (See ["The impact of breastfeeding on the development of allergic disease."](#))

**Artificial sweeteners** — There is no evidence that use of aspartame (NutraSweet®), sucralose (Splenda®), saccharin (Sweet 'N Low®), acesulfame potassium (Sunnet®), or stevioside (Stevia®) by pregnant women increases the risk of birth defects above the baseline risk in the general population [\[69\]](#). One study showed an increased risk of bladder cancer in offspring of pregnant rats that consumed very high doses of saccharin; the other study did not show an increased risk. Since there are alternatives to using saccharin, some clinicians recommend avoiding it in pregnancy.

A task force of the American Academy of Pediatrics' Committee on Nutrition concluded that aspartame is safe for both the pregnant mother and developing baby. In addition, the United States FDA and the Council on Scientific Affairs of the American Medical Association concluded that women who are pregnant or breastfeeding can safely use aspartame [\[70\]](#). Although methanol is a breakdown product of aspartame, methanol is also produced as a breakdown product of many fruits; the levels produced from either of these sources are very low and considered safe in pregnancy.

**Lactose intolerance** — Women with lactose malabsorption appear to handle lactose better in late pregnancy [\[71,72\]](#). This has been attributed to slower intestinal transit during pregnancy and bacterial adaptation to increased lactose intake. For women unable to consume adequate amounts of calcium through dairy and other dietary components, calcium supplements can be prescribed. There are no data on the safety of commercially available "lactase" preparations during pregnancy; however, beta-galactosidases are normal constituents of human tissues.

**Fluoride** — Theoretically, pregnant women who live in areas where water is not fluoridated, or who consume only unfluoridated bottled water, may not achieve adequate intake of fluoride, which is 3 mg/day in nonpregnant, pregnant, and breastfeeding women [\[73\]](#). Fluoride intake is difficult to determine, given that fluoride may be present in liquids used in bottled drinks and prepared foods (eg, soups, canned vegetables) and is present in tea and seafood that contains edible bones or shells (eg, canned sardines).

Fluoride supplementation is not recommended during pregnancy [\[74\]](#). Prenatal fluoride supplementation is not incorporated into primary teeth [\[75\]](#) and does not reduce caries in offspring [\[76\]](#). The benefits of fluoride occur almost entirely after tooth eruption as a direct topical effect on teeth; earlier hypotheses that ingested fluoride is systemically incorporated into developing tooth enamel have been largely discredited as a primary mechanism of fluoride action [\[78,79\]](#). There is good evidence that postnatal exposure of newly erupted teeth to topical fluoride from water or dentifrice is efficacious [\[78,79\]](#). Excess ingestion of fluoride during pregnancy does not appear to produce fluorosis in offspring [\[80\]](#), [probably because the placenta provides a selective barrier to transfer of excess fluoride [\[81\]](#). (See ["Overview of dietary trace minerals"](#) and ["Preventive dental care and counseling for infants and young children."](#))

**MULTIPLE GESTATION** — Women carrying a multiple gestation should increase their daily dietary intake. Guidelines are provided separately in the topic review on management of twin gestation. (See ["Antepartum issues in management of twin gestations", section on "Nutrition"](#))

**HERBAL SUPPLEMENTS** — There are no randomized trials evaluating the efficacy and safety of traditional herbal preparations in pregnancy [\[82\]](#). [Some practitioners suggest patients take herbal supplements to help alleviate symptoms of pregnancy, prevent or treat obstetrical complications (eg, miscarriage, preterm birth, preeclampsia), or ripen the cervix or induce labor at term [\[83-85\]](#). There is a lack of consensus on the appropriate dose and administration of these preparations.

We recommend avoiding use of herbal medicines in pregnancy [\[86,87\]](#). The practitioner has no control over the strength or purity of the individual herbs; herbal preparations can interact with commonly prescribed medications and lead to dangerous side effects [\[88,89\]](#); and several cases of potentially harmful effects to the pregnancy have been reported [\[90-92\]](#). (See ["Overview of herbal medicine."](#))

**POSTPARTUM AND BREASTFEEDING** — An adequate, balanced diet is important for replenishment of maternal stores that are expended during the pregnancy, for promoting loss of excess weight, and for nourishing the breastfed infant.

**Postpartum weight changes** — Retention of pregnancy-related weight gain is a problem for many women and has contributed to the obesity epidemic in developed countries. Diet and exercise can help women lose weight postpartum and appear to be safe, even in breastfeeding women. (See ["Overview of postpartum care", section on "Weight"](#))

**Breastfeeding** — Women who are breastfeeding should increase their daily caloric intake by 300 to 500 kcal above prepregnancy levels and consume 1000 mg/day of calcium [\[93\]](#). Theoretically, this level of caloric intake should mobilize the excess fat stored antepartum and promote modest weight loss, since the caloric demand of lactation is estimated at 640 kcal/day [\[94\]](#). In practice, however, lactation has a variable effect on maternal weight [\[95,96\]](#). (See ["Maternal nutrition during lactation"](#))

**INFORMATION FOR PATIENTS** — Educational materials on this topic are available for patients. (See ["Patient information: Maternal health and nutrition during breastfeeding."](#)) We encourage you to print or e-mail this topic review, or to refer patients to our public web site, [www.uptodate.com/patients](http://www.uptodate.com/patients), which includes this and other topics.

## SUMMARY AND RECOMMENDATIONS

- The United States Preventive Services Task Force (USPSTF) recommends that women take folic acid supplement of 0.4 to 0.8 mg per day preconceptionally and during the first trimester. Higher doses (4 milligrams per day) are recommended for women known to be at increased risk for

offspring with neural tube defects (eg, history of a previously affected infant, maternal use of some anticonvulsant medications). (See [Section 10.1.1](#) above.)

- Women with metabolic diseases (eg, diabetes mellitus, phenylketonuria) should try to normalize abnormal metabolite levels to minimize adverse effects on the fetus. These women should have formal nutritional counseling, ideally in the preconception period, in anticipation of pregnancy. (See [Section 10.1.2](#) above.)

- The Institute of Medicine recommendations for weight gain during pregnancy are:

- 12.5 to 18 kg for underweight women — BMI <19.8 kg/m<sup>2</sup>
- 11.5 to 16 kg for normal weight women — BMI 19.9 to 26.0 kg/m<sup>2</sup>
- 7 to 11.5 kg for overweight women — BMI 26.0 to 29.0 kg/m<sup>2</sup>
- ≥6.8 kg for obese women — BMI >29.0 kg/m<sup>2</sup>

(See [Section 10.1.3](#) above.)

- The Institute of Medicine recommends an increase in daily caloric intake by 340 kcal/day in the second trimester and 452 kcal/day in the third trimester. (See [Section 10.1.4](#) above.)

- Iron supplementation decreases the prevalence of maternal anemia at delivery, but it is unclear whether iron supplementation in nonanemic, well-nourished pregnant women improves birth outcome. (See [Section 10.1.5](#) above.)

- Pregnant women should reduce consumption of some fish to minimize fetal exposure to mercury and other water-borne contaminants. (See [Section 10.1.6](#) above.)

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## **GRAPHICS**



## Dietary questionnaire

What you eat and some of the life-style choices you make can affect your nutrition and health now and in the future. Your nutrition can also have an important effect on your baby's health. Please answer these questions by circling the answers that apply to you.

### Eating behavior

1. Are you frequently bothered by any of the following? (circle all that apply)  
 Nausea Vomiting Heartburn Constipation
2. Do you skip meals at least 3 times a week? No Yes
3. Do you try to limit the amount or kind of food you eat to control your weight? No Yes
4. Are you on a special diet now? No Yes
5. Do you avoid any foods for health or religious reasons? No Yes

### Food sources

6. Do you have a working stove? No Yes
- Do you have a working refrigerator? No Yes
7. Do you sometimes run out of food before you are able to buy more? No Yes
8. Can you afford to eat the way you should? No Yes
9. Are you receiving any food assistance now? (circle all that apply) No Yes  
 Food stamps School breakfast School lunch WIC  
 Donated food Commodity supplemental food program
10. Do you feel you need help in obtaining food? No Yes

### Food and drink

11. Which of these did you drink yesterday? (circle all that apply)  
 Soft drinks Coffee Tea Fruit drink  
 Orange juice Grapefruit juice Other juices Milk  
 Kool-Aid® Beer Wine Alcoholic drinks  
 Water Other beverages (list) \_\_\_\_\_
  12. Which of these foods did you eat yesterday? (circle all that apply)  
 Cheese Pizza Macaroni and cheese  
 Cereal with milk Yogurt
- Other foods made with cheese (such as tacos, enchiladas, lasagna, cheeseburgers)
- |               |                |                  |                  |
|---------------|----------------|------------------|------------------|
| Corn          | Potatoes       | Sweet potatoes   | Green salad      |
| Carrots       | Collard greens | Spinach          | Turnip greens    |
| Broccoli      | Green beans    | Green peas       | Other vegetables |
| Apples        | Bananas        | Berries          | Grapefruit       |
| Melon         | Oranges        | Peaches          | Other fruit      |
| Meat          | Fish           | Chicken          | Eggs             |
| Peanut butter | Nuts           | Seeds            | Dried beans      |
| Cold cuts     | Hot dog        | Bacon            | Sausage          |
| Cake          | Cookies        | Doughnut         | Pastry           |
| Chips         | French fries   | Deep-fried foods | Bread            |
| Rolls         | Rice           | Cereal           | Noodles          |
| Spaghetti     | Tortillas      |                  |                  |

- Were any of these whole grain? No Yes
13. Is the way you ate yesterday the way you usually eat? No Yes

### Life style

14. Do you exercise for at least 30 minutes on a regular basis (3 times a week or more)? No Yes
15. Do you ever smoke cigarettes or use smokeless tobacco? No Yes
16. Do you ever drink beer, wine, liquor, or any other alcoholic beverages? No Yes
17. Which of these do you take (circle all that apply)  
 Prescribed drugs or medications Any over-the-counter products (such as  
 aspirin, acetaminophen, antacids, or vitamins)  
 Street drugs (such as marijuana, speed, downers, crack, or heroin)

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## Determining body mass index from weight and height

	Good weights							Overweight					Obesity	
BMI, kg/m <sup>2</sup>	19	20	21	22	23	24	25	26	27	28	29	30	35	40
Height, inches*	Weight, pounds*													
58"	91	96	100	105	110	115	119	124	129	134	138	143	167	191
59"	94	99	104	109	114	119	124	128	133	138	143	148	173	198
60"	97	102	107	112	118	123	128	133	138	143	148	153	179	204
61"	100	106	111	116	122	127	132	137	143	148	153	158	185	211
62"	104	109	115	120	126	131	136	142	147	153	158	164	191	218
63"	107	113	118	124	130	135	141	146	152	158	163	169	197	225
64"	110	116	122	128	134	140	145	151	157	163	168	174	204	232
65"	114	120	126	132	138	144	150	156	162	168	174	180	210	240
66"	118	124	130	136	142	148	155	161	167	173	179	186	216	247
67"	121	127	134	140	146	153	159	166	172	178	185	191	223	255

68"	125	131	138	144	151	158	164	171	177	184	190	197	230	262
69"	128	135	142	149	155	162	169	176	182	189	196	203	236	270
70"	132	139	146	153	160	167	174	181	188	195	202	209	243	278
71"	136	143	150	157	165	172	179	186	193	200	208	215	250	286
72"	140	147	154	162	169	177	184	191	199	206	213	221	258	294
73"	144	151	159	166	174	182	189	197	204	212	219	227	265	302
74"	148	155	163	171	179	186	194	202	210	218	225	233	272	311
75"	152	160	168	176	184	192	200	208	216	224	232	240	279	319
76"	156	164	172	180	189	197	205	213	221	230	238	246	287	328

The health risk from any level of BMI is increased if the patient has gained more than 5 kg (11 pounds) since age 25, or if the waist circumference is above 100 cm (40 in) due to central fatness

\* Divide weight by 2.2 to convert pounds into kilograms; multiply height by 2.54 to convert inches into centimeters.

#### Determining body mass index using kilograms and centimeters\*

BMI, kg/m <sup>2</sup>	19	20	21	22	23	24	25	26	27	28	29	30	35	40
Height, cm*	Weight, kg*													
147	41	43	45	48	50	52	54	56	58	61	63	65	76	86
150	43	35	47	50	52	54	56	59	61	63	65	68	79	90
152	44	46	49	51	53	55	58	60	62	65	67	69	81	92
155	46	48	50	53	55	58	60	62	65	67	70	72	84	96
158	47	50	52	55	57	60	62	65	67	70	72	75	87	100
160	49	51	54	56	59	61	64	67	69	72	74	77	90	102
162	50	52	55	58	60	63	66	68	71	73	76	79	92	105
165	52	54	57	60	63	65	68	71	74	76	79	82	95	109
168	54	56	59	62	65	68	71	73	76	79	82	85	99	113
170	55	58	61	64	66	69	72	75	78	81	84	87	101	116
173	57	60	63	66	69	72	75	78	81	84	87	90	105	120
175	58	61	64	67	70	74	77	80	83	86	89	92	107	123
178	60	63	67	70	73	76	79	82	86	89	92	95	111	127
180	62	65	68	71	75	78	81	84	87	91	94	97	113	134
183	64	67	70	74	77	80	84	87	90	94	97	100	117	134
185	65	68	72	75	79	82	86	89	92	96	99	103	120	137
188	67	71	74	78	81	85	88	92	95	99	102	106	124	141
190	69	72	76	79	83	87	90	94	97	101	105	108	126	144
193	71	74	78	82	86	89	93	97	101	104	108	112	130	149

\* The health risk from any level of BMI is increased if the patient has gained more than 5 kg (11 pounds) since age 25, or if the waist circumference is above 100 cm (40 in) due to central fatness.

#### Vitamin deficiency syndromes

Vitamin	Deficiency syndrome	Main symptoms/signs
A	Xerophthalmia	Dry eyes and skin, blindness
D	Rickets, osteomalacia	Bone deformity
E		Anemia
K		Bleeding diathesis

C	Scurvy	Capillary fragility, bleeding
Thiamine (B1)	Beriberi	Neuropathy, cardiomyopathy, encephalopathy
Riboflavin (B2)		Angular stomatitis, dermatitis
Niacin	Pellagra	Dermatitis, dementia, diarrhea
Pyridoxine (B6)		Glossitis, neuropathy
Folate		Macrocytic anemia
Cobalamin (B12)		Combined systems disease, anemia, dementia, spinal degeneration

### Recommended daily dietary allowances for adult pregnant and lactating women

	Pregnant women*	Lactating women
<b>Fat-soluble vitamins</b>		
Vitamin A	770 µg	1300 µg
Vitamin D•	5 µg	5 µg
Vitamin E	15 mg	19 mg
Vitamin K	90 µg	90 µg
<b>Water-soluble vitamins</b>		
Vitamin C	85 mg	120 mg
Thiamin	1.4 mg	1.4 mg
Riboflavin	1.4 mg	1.6 mg
Niacin	18 mg	17 mg
Vitamin B <sub>6</sub>	1.9 mg	2 mg
Folate	600 µg	500 µg
Vitamin B <sub>12</sub>	2.6 µg	2.8 µg
<b>Minerals</b>		
Calcium•	1000 mg	1000 mg
Phosphorus	700 mg	700 mg
Iron	27 mg	9 mg
Zinc	11 mg	12 mg
Iodine	220 µg	290 µg
Selenium	60 µg	70 µg

\* Females over 18 years old.

• Recommendations measured as adequate intake (AI) instead of recommended daily dietary allowance (RDA). An AI is set instead of an RDA if insufficient evidence is available to determine an RDA. The AI is based on observed or experimentally determined estimates of average nutrient intake by a group (or groups) of healthy people.

Adapted from: *Guidelines for Perinatal Care, sixth edition, 2007.*

### Caffeine content in foods and beverages

Product	Serving size	Caffeine, mg
<b>Coffee</b>		
Brewed	8 oz	135
Roasted and ground, percolated	5 oz	74
Roasted and ground, drip	5 oz	112
Roasted and ground, decaffeinated	5 oz	2
Instant	5 oz	66
Instant, decaffeinated	5 oz	3

Starbucks espresso	1 oz	35
Starbucks espresso, decaffeinated	1 oz	5
Starbucks caffe latte, short	8 oz	35
Starbucks caffe latte, tall	12 oz	35
Starbucks caffe latte, grande	16 oz	70
Starbucks coffee, short	8 oz	250
Starbucks coffee, tall	12 oz	375
Starbucks coffee, grande	16 oz	550
Maxwell House, capuccino	8 oz	25-60
Maxwell House, cappuccino, decaffeinated	8 oz	3

#### Tea

Tea, leaf or bag	8 oz	35
Tea, green	8 oz	30
Tea, instant	8 oz	15
Tea, decaffeinated	8 oz	0
Lipton, Iced tea	8 oz	15-25
Lipton, Iced tea, decaffeinated	8 oz	<5
Celestial Seasons herbal tea, all kinds	8 oz	0

#### Chocolate beverages

Chocolate milk	8 oz	8
1 envelope hot-cocoa mix	8 oz	5

#### Chocolate containing foods

Chocolate cake	80 g	6
Dark chocolate cake, chocolate frosting	93 g	13
Chocolate cookies	15 g	1
Chocolate chip cookies	20 g	4
Chocolate brownies	42 g	10
Chocolate pudding	145 g	9
Chocolate mousse	90 g	15
Chocolate bar, Hersheys	1.5 oz	10
Chocolate bar, Hersheys, dark	1.5 oz	31
Coffee nips (hard candy)	1 oz	6
Bakers, baking chocolate	1 oz	8-25
Bakers chocolate chips, ¼ cup	43 g	13
Chocolate syrup, 2 tbsp	30 g	5
Chocolate dietary formula, Ensure Plus	8 oz	10

#### Ice cream

Haagen-Danz, coffee ice cream	8 oz	58
Starbucks coffee ice cream	1 cup	40

#### Soft drinks/energy drinks

Coca Cola	12 oz	46
Coca Cola, diet	12 oz	46

Dr. Pepper	12 oz	40
Jolt Energy	16 oz	190
Josta Drink	8 oz	39
Mello Yello	12 oz	53
Mountain Dew	12 oz	54
Pepsi	12 oz	38
Pibb Xtra	12 oz	41
RC Cola	12 oz	36
Red Bull	8.3 oz	80
7-Up	8 oz	0
Shasta	12 oz	44
Sprite	8 oz	0

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