Nutrition in pregnancy

Author: Christine D Garner, PhD, RD
Section Editor: Charles J Lockwood, MD, MHCM
Deputy Editor: Vanessa A Barss, MD, FACOG

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INTRODUCTION — Pregnancy is a period of intense fetal growth and development, as well as maternal physiological change. Adequate intake of macronutrients and micronutrients during pregnancy promotes these processes, while undernutrition and overnutrition can be associated with adverse pregnancy outcomes [1-5]. Therefore, it is important to evaluate, monitor, and, when appropriate, make changes to improve maternal nutrition both before and during pregnancy.

The effects of inadequate or excessive intake of certain nutrients can be observed in the short-term, but possibly also in the long-term. Both fetal undernutrition and overnutrition, including development in an obesogenic environment, can lead to permanent changes of fetal metabolic pathways and thereby increase the risk of childhood and adult diseases related to these pathways. The developmental model for the origins of disease (ie, Barker Hypothesis) hypothesizes that the fetal environment causes epigenetic modifications that impact gene expression and thereby influence development of disease in children and adults [6]. Seminal studies of the health status of adult offspring of a cohort of women who were pregnant during the Dutch famine in World War II support this hypothesis [7,8].

Many questions remain unanswered due to the many challenges of performing high-quality research in pregnancy [9]. These challenges include the often unknown critical windows when nutrition may impact development, the many physiologic changes that occur over the course of normal pregnancy, the large individual differences in maternal adaptation to pregnancy, ethical and practical issues of experimenting with human pregnancy, challenges with determining effects of specific nutrients in the context of a whole diet, and the lack of a good animal model that can be directly extrapolated to humans.

This topic will discuss basic nutritional concerns related to normal pregnancy, primarily for women living in developed countries. Nutritional therapy of diabetes in pregnant women, in-depth information on specific topics related to maternal nutrition, and basic nutritional issues in healthy nonpregnant adults are reviewed elsewhere. For example:

- (See "Healthy diet in adults".)
- (See "Vitamin supplementation in disease prevention".)
- (See "Pregestational diabetes mellitus: Glycemic control during pregnancy".)
- (See "Gestational diabetes mellitus: Glycemic control and maternal prognosis".)
- (See "Preterm birth: Risk factors and interventions for risk reduction".)
- (See "Preeclampsia: Prevention", section on 'Diet and supplements'.)

- (See "Fish consumption and docosahexaenoic acid (DHA) supplementation in pregnancy", section on 'Potential neurodevelopmental effects'.)
- (See "Primary prevention of allergic disease: Maternal diet in pregnancy and lactation".)

ASSESSMENT OF NUTRITIONAL STATUS — Ideally, a woman's nutritional status is initially assessed before pregnancy so dietary changes to optimize maternal and child health can begin prior to conception. Nutritional assessment and counseling should continue across pregnancy and during lactation. Where available, these activities are best performed using a team approach, which may include the obstetric provider, health professionals trained in prenatal nutrition counseling and education, and a registered dietitian with perinatal nutritional expertise. (See "Dietary assessment in adults".)

History

- **Medical and surgical** – The medical history can help uncover behaviors and medical conditions that pose nutrition-related health risks for the woman and her fetus (table 1). For example, use of cigarettes, alcohol, and illicit drugs poses direct health risks and also affects intake of an adequate and balanced diet, while stimulants may increase energy requirements. Patients sometimes forget to disclose that they had bariatric surgery, especially if it was in the distant past. Sequelae of bariatric surgery (eg, micronutrient deficiencies, dumping syndrome) can affect pregnancy management and outcome. (See "Fertility and pregnancy after bariatric surgery".)

- **Obstetric** – The past obstetric history can impact future pregnancies. As an example, a past history of a neural tube defect in offspring 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 supplementation in pregnancy", section on 'Previously affected pregnancy or history of neural tube defect in either parent'.)

- **Dietary** – Asking the patient to complete a self-administered questionnaire is helpful for reviewing her typical diet and identifying obvious deficiencies (form 1) [10]. It is important to follow-up with specific questions about responses that suggest a possible nutritional issue. Examples of potential problems include skipping meals; limiting food; being on a special diet; consuming sweetened beverages; low frequency of consuming calcium foods, vegetables, or fruits; and high intake of foods with added sugars/fats.

  A brief screening questionnaire may be more user-friendly for health professionals in busy practices who are not specifically trained in nutrition (table 2) [10]. This questionnaire has been adapted to assess healthy eating in pregnant women and provides simple tips to improve diet quality. Although this version of the questionnaire has not been validated, a more general version has been validated for assessing diet-related chronic disease risk and has been used successfully in women [10,11].

  Women who routinely eat three meals daily that include several servings of a variety of vegetables, fruits, whole grains, low-fat dairy products, and a few sources of protein (eg, meat, poultry, seafood, beans, peas, eggs, processed soy products, nuts, seeds) are likely to meet the Daily Recommended Intakes for most nutrients. However, even nutrient-dense food choices and diets, such as those in the United States Department of Agriculture food patterns, may not meet nutrient goals for iron, vitamin D, and choline during pregnancy [12,13].

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 3A-B) (calculator 1). The woman should be asked what she weighed at her last menstrual period (prepregnancy weight) and this weight should be used for baseline calculations. A prepregnancy BMI of 18.5 to 24.9 kg/m^2 is normal for Caucasian, Hispanic, and Black individuals; however, for Asians, the upper limit of normal is BMI <23 kg/m^2 [14]. 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: Overview of epidemiology, clinical features, and diagnosis".)

Physical signs of gross vitamin deficiency are still seen in areas of the world with very poor diets. In resource-rich countries, they occur in special populations, such as women with alcoholism, malabsorption, and inborn errors of metabolism and those undergoing hemodialysis or receiving parenteral nutrition. (See "Dietary assessment in adults".)

Referrals — Consultation with a nutritionist, such as a registered dietitian, with special training in maternal nutrition is appropriate and recommended for women with special nutritional considerations, such as (table 1):

- Diabetes, hypertension, metabolic disorders, gastrointestinal disorders that cause malabsorption, and other conditions that require diet therapy.
- History of bariatric surgery or other gastrointestinal surgery affecting absorption. (See "Fertility and pregnancy after bariatric surgery".)
- Overweight and obesity, as these women are prone to excessive weight gain during pregnancy [15].
- High intake of sweetened beverages or foods with a high level of calories from added sugars or fats (especially solid fats). Low intake of calcium-containing foods, vegetables (aside from corn and potatoes), and/or fruits.
- Food avoidances, restrictive diets, skipping meals – These practices may lead to nutritional deficiencies and inadequate weight gain during pregnancy. (See 'Counseling women about nutrition in pregnancy' below and 'Prepregnancy weight and gestational weight gain' below.)
- Dieting history, weight fluctuations, eating disorders requiring medication or hospitalization – An eating disorder may affect fertility, become aggravated by pregnancy, or lead to pregnancy complications. (See "Eating disorders: Overview of epidemiology, clinical features, and diagnosis" and "Eating disorders: Overview of treatment" and "Eating disorders in pregnancy".)
- Multiple gestation. (See "Twin pregnancy: Prenatal issues", section on 'Gestational weight gain' and "Twin pregnancy: Prenatal issues", section on 'Vitamins and minerals' and "Triplet pregnancy", section on 'Weight gain and nutrition'.)
- Use of substances that may affect nutrition (eg, cigarettes, alcohol, stimulants, recreational drugs).

In addition, some women have financial constraints regarding the purchase, storage (eg, refrigerator), or preparation (eg, stove) of adequate amounts of appropriate foods. These women require assistance from sources such as the Special Supplemental Food Program for Women, Infants, and Children or a social service agency. A short survey form to screen for food insecurity is available from the US Food and Drug Administration.

Registered dietitians who specialize in maternal nutrition can be found online at Academy for Nutrition and Dietetics website by entering the patient's or provider's zip code, selecting "Search by Expertise" and selecting "Maternal Nutrition" under the Expertise Area; however, the list is not comprehensive. For women who qualify for the Supplemental Nutrition Program for Women, Infants, and Children (WIC), nutrition counseling and education should be available at WIC appointments.

Laboratory — Hemoglobin and hematocrit are routinely checked at the first prenatal visit and in the late second/early third trimester to assess for anemia. Further evaluation is appropriate in anemic women. (See "Hematologic changes in pregnancy", section on 'Anemia' and "Approach to the adult patient with anemia", section on 'Laboratory evaluation'.)

Most experts agree that it is not necessary to perform broad-based screening of serum 25-hydroxyvitamin D levels in the general population or during pregnancy [16,17]. Measurement is reasonable in pregnant women who are obese, have minimal sun exposure of skin, have a history of malabsorption (celiac disease, inflammatory bowel disease), or other risk factors for vitamin D deficiency (eg, live at northern latitudes, consume a vegan diet, dark skin). Optimal levels of 25-hydroxyvitamin D in pregnancy have not been determined, however, and this remains an active area for research. (See "Vitamin D deficiency in adults: Definition, clinical manifestations, and treatment", section on 'Vitamin D repletion' and "Vitamin D deficiency in adults: Definition, clinical manifestations, and treatment", section on 'Monitoring'.)

PRECONCEPTIONAL RECOMMENDATIONS

- Women of reproductive potential should take a multivitamin containing 0.4 to 0.8 mg of folic acid. (See "Folic acid supplementation in pregnancy".)
- 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 in the preconception period in anticipation of pregnancy. (See "The preconception office visit", section on 'Interventions'.)
- Obese women should be advised to lose weight prior to conception. (See "Obesity in pregnancy: Complications and maternal management" and "Weight gain and loss in pregnancy", section on 'Overweight and obese women'.)

PREGNANCY RECOMMENDATIONS — The key components of healthy eating during pregnancy include [18]:

- Appropriate weight gain
- Consumption of a variety of primarily whole, unprocessed 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
- Safe food handling

Because the amount of additional calories required for a typical pregnancy is small, but some nutrient requirements are relatively large, women should focus on increasing intake of high-quality, nutrient-dense foods and attempt to limit intake of processed empty-calorie foods and beverages.

Prepregnancy weight and gestational weight gain — We monitor weight gain throughout pregnancy and advise women of the Institute of Medicine (IOM) recommendations for singleton pregnancy [19]:

- **Body mass index (BMI) <18.5 kg/m^2 (underweight)** – weight gain 28 to 40 lbs (12.5 to 18.0 kg)

  1 to 4 lbs (0.5 to 2 kg) over the first trimester and about 1 lb (0.5 kg)/week thereafter

- **BMI 18.5 to 24.9 kg/m^2 (normal weight)** – weight gain 25 to 35 lbs (11.5 to 16.0 kg)

  1 to 4 lbs (0.5 to 2 kg) over the first trimester and about 1 lb (0.5 kg)/week thereafter

- **BMI 25.0 to 29.9 kg/m^2 (overweight)** – weight gain 15 to 25 lbs (7.0 to 11.5 kg)

  1 to 4 lbs (0.5 to 2 kg) over the first trimester and about 0.5 lb (0.25 kg)/week thereafter

- **BMI ≥30.0 kg/m^2 (obese)** – weight gain 11 to 20 lbs (5 to 9.0 kg)

  1 to 4 lbs (0.5 to 2 kg) over the first trimester and about 0.5 lb (0.25 kg)/week thereafter

Prepregnancy BMI and gestational weight gain have independent, but cumulative, effects on infant birth weight and gestational duration. 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. Excessive gestational weight gain may also increase the risk of childhood obesity and maternal weight retention long after delivery, further supporting the IOM's recommendations for limited gestational weight gain. These relationships are discussed in detail separately. (See "Weight gain and loss in pregnancy".)

National data for the United States from 2012 to 2013 indicate that the prevalence of appropriate gestational weight gain (within IOM recommendations) was only 32 percent, the prevalence of inadequate gain (below IOM recommendations) was 20 percent, and the prevalence of excessive gain (above IOM recommendations) was 48 percent [15]. Excessive weight gain was particularly prevalent among overweight (62 percent) and obese (56 percent) women [15]. These data support the American College of Obstetricians and Gynecologists' (ACOG) recommendation that nutrition counseling should be offered to all overweight or obese pregnant women [4]. Women with inappropriate weight gain (inadequate or excessive) during pregnancy may benefit from nutritional counseling, as well.

Dietary recommendations — Most nutritional advice for pregnant women is based on the 1990 IOM report on nutrition in pregnancy [5], the 2009 IOM report on weight gain in pregnancy [20], the 2015 Dietary Guidelines for Americans by the United States Department of Health and Human Services and United States Department of Agriculture [21], and the 2006 IOM publication Dietary Reference Intakes: The Essential Guide to Nutrient Requirements [22]. Some dietary reference intakes have been updated since 2006, such as that for vitamin D and calcium [23], and these updated recommendations are provided in this topic.

The Recommended Dietary Allowances 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.

The following discussion applies to the general obstetric population in developed countries. Other populations may require additional nutritional considerations.

Calories — Caloric intake is a key nutritional factor in determining birth weight. Pregnant women of normal weight with a singleton pregnancy need to increase daily caloric intake by 340 and 450 additional kcal/day in the second and third trimesters, respectively, for appropriate weight gain, but do not need to increase energy intake in the first trimester (see 'Counseling about healthy eating during pregnancy' below). However, energy requirements vary by physical activity as well as age, weight, and height, so recommendations should be individualized.

In the United States, many women gain excessively during the first trimester, which often leads to excessive gestational weight gain by delivery. (See 'Prepregnancy weight and gestational weight gain' above.)

Macronutrients

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 Institute of Medicine recommends a dietary reference intake for pregnant women of 1.1 g/kg/day protein, which is moderately higher than the 0.8 g/kg/day recommended for nonpregnant adult women [24].

Use of special protein powders or high-protein beverages should be discouraged. In women who are undernourished, protein supplementation does not improve clinically important pregnancy outcomes [25-27]. In women who likely have adequate protein intake, there is evidence of possible harm from high-protein supplements [5,28].

Carbohydrate — Carbohydrate requirements increase to 175 g/day in pregnancy, up from 130 g/day in nonpregnant women [24]. The focus should be on consuming several servings of whole foods (fruits, vegetables, and whole grains); highly processed carbohydrates should be minimized to help manage weight gain. Fiber intake of 28 g/day is recommended for pregnant women, which, along with adequate fluid intake, may help prevent or reduce constipation.

Fat — The optimal types and quantity of fat intake in pregnancy is unclear. Variations in the quantity and type of fat intake have been associated with variations in birth weight, gestational age and length, and neurodevelopment; however, available data are limited and studies have reported mixed results [29]. (See "Fish consumption and docosahexaenoic acid (DHA) supplementation in pregnancy" and "Preterm birth: Risk factors and interventions for risk reduction".)

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 [30]. TFA should be minimized or avoided given their adverse effects on cardiovascular outcomes, possible adverse pregnancy effects, and lack of beneficial effects. (See "Dietary fat", section on 'Trans fatty acids'.)

Micronutrients — Recommendations for daily intake of vitamins and minerals during pregnancy and lactation are shown in the table (table 4).

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

MMN supplement content varies depending on the product used. At a minimum, the daily supplement should contain key vitamins/minerals that are often not met by diet alone, such as:

- Iron – 27 mg
- Calcium – at least 250 mg (elemental calcium 1000 mg per day)
- Folate – at least 0.4 mg (0.6 mg in the second and third trimesters)
- Iodine – 150 mcg
- Vitamin D – 200 to 600 international units (exact amount is controversial)

In addition to these key ingredients, pregnant women need to get adequate amounts of vitamins A, E, C, B vitamins, and zinc.

In the United States, the IOM and the Centers for Disease Control and Prevention (CDC) recommend multiple-micronutrient (MMN) supplements for pregnant women who do not consume an adequate diet [31-33]. In high-income countries, such as the United States, groups at increased risk for micronutrient deficiencies include women carrying a multiple gestation, heavy smokers, adolescents, complete vegetarians (vegans), substance abusers, women with history of bariatric surgery, women with gastrointestinal conditions that cause malabsorption (eg, Crohn disease, bowel resection), and women with lactase deficiency. These groups may benefit from consultation with dietitians who specialize in maternal or women's nutrition (see 'Referrals' above). In the United Kingdom, the National Institute for Health and Care Excellence and Royal College of Obstetricians and Gynaecologists recommend that women take folic acid each day, from before pregnancy until the end of the first trimester, and vitamin D daily throughout pregnancy and breastfeeding; other supplements are not recommended for routine use [34,35].

In a Cochrane review of randomized trials in low- and middle-income countries where micronutrient deficiencies are high, MMNs reduced the risk for delivery of low birth weight and small for gestational age infants [36]. However, there were no statistically significant differences for other maternal and pregnancy outcomes: preterm births, miscarriage, maternal mortality, perinatal mortality, stillbirths, and neonatal mortality. Most trials of MMNs have been conducted in low-income countries, and are not generalizable to high-income countries. Thus, national health authorities in the United Kingdom do not recommend MMNs for all women, particularly because of lack of evidence for their efficacy in well-nourished women [37].

Specific micronutrients are discussed in more detail below.

Iron — Iron is necessary for both fetal/placental development and to expand the maternal red cell mass. Prevalence of iron deficiency in pregnant women in the US is estimated to be 19 percent, ranging from 7 percent in the first trimester to 30 percent in the third trimester [38]. Iron deficiency is more prevalent among Mexican-American and non-Hispanic black pregnant women, and among grand multiparous women [38].

There are two dietary forms of iron: heme and non-heme. The most bioavailable form is heme iron, which is found in meat, poultry, and fish. Non-heme iron, which comprises 60 percent of iron in animal foods and all of the iron in plant foods, fortified grains, and supplements, is less bioavailable. Absorption of non-heme iron is enhanced by vitamin C-rich foods or muscle tissue

(meats, poultry and seafood) [39], and inhibited by consumption of dairy products and coffee/tea/cocoa. Dietary sources of iron are shown in the table (table 5).

Experts recommend an increase in iron consumption by about 15 mg/day (to about 30 mg/day) during pregnancy to prevent iron deficiency anemia; this amount is readily met by most prenatal vitamin formulations and is adequate supplementation for non-anemic women. The CDC recommends that all pregnant women take a 30 mg/day iron supplement by the first prenatal visit [40]. Intermittent iron supplementation (one to three times per week) appears to be as effective as daily supplementation for preventing anemia at term and is better tolerated [41].

A 2015 systematic review for the United States Preventive Services Task Force observed that routine iron supplementation had inconsistent effects on a variety of pregnancy outcomes, but noted a consistent reduction in the frequency of iron deficiency anemia at term (relative risk [RR] 0.29, 95% CI 0.17-0.49; four trials) [42]. However, there is no convincing evidence that iron supplementation in non-anemic pregnant women improves maternal or child clinical outcomes.

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 [43]. Iron absorption decreases with increasing dose, thus larger supplementation amounts are best split into several doses during the day. In women who do not tolerate oral iron, iron can be administered intravenously [44-46]. Iron and folate supplementation in these women are discussed in detail separately. (See "Hematologic changes in pregnancy", section on 'Anemia' and "Treatment of iron deficiency anemia in adults", section on 'Intravenous iron'.)

Calcium and vitamin D — Low calcium and vitamin D levels have been associated with adverse health outcomes in mother and child, but it is unclear whether low levels are the causal factor or a marker of poor health. These issues are discussed in detail separately. (See "Clinical manifestations, diagnosis, and treatment of osteomalacia", section on 'Pregnancy' and "Vitamin D and extraskeletal health", section on 'Pregnancy outcomes' and "Vitamin D deficiency in adults: Definition, clinical manifestations, and treatment", section on 'Pregnancy'.)

- **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. Intestinal absorption and renal retention of calcium increases progressively throughout gestation [47].

  The Recommended Dietary Allowance (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) [48]. The dietary recommendation for calcium is the same for nonpregnant women of the same age. The Dietary Guidelines Scientific Report estimated that 24 percent of United States pregnant women consume less than 800 mg/day [49]. Calcium content of selected foods can be found in the table (table 6).

  For women with low baseline dietary calcium intake (particularly in non-United States populations), high-dose calcium supplementation may reduce the risk of developing a hypertensive disorder of pregnancy [50]. Calcium supplementation does not appear to reduce this risk in healthy, nulliparous women in whom baseline dietary calcium intake is adequate. Although there may be a benefit for preeclampsia prevention in high-risk populations, further study is required since available information is based upon small numbers of women and

diverse study populations. (See "Preeclampsia: Prevention", section on 'Calcium supplementation'.)

In a 2015 systematic review, calcium supplementation did not reduce the risk of spontaneous preterm birth or low birth weight [51].

- **Vitamin D** – For routine supplementation, we agree with the 2010 IOM report suggesting an RDA of 600 international units vitamin D for all reproductive-age women, including during pregnancy and lactation [52]. In a 2011 ACOG Committee Opinion, ACOG recommended routine supplementation with the dose in a standard prenatal vitamin until more evidence is available to support a different dose [17]. Most prenatal vitamins contain 400 international units of vitamin D, but some preparations contain as little as 200 or as much as 1000 to 1200 international units.

  Many commercial non-prescription products labeled vitamin D (multivitamin supplements, fortified milk and bread) contain ergocalciferol (vitamin D2) rather than cholecalciferol (vitamin D3). Supplements often specify the type of vitamin D they contain. D3 is more readily converted to active forms of vitamin D and is more effective at increasing serum 25-hydroxyvitamin D; thus, it is often preferred over D2. Most prescription prenatal vitamins contain cholecalciferol (D3), but some contain ergocalciferol (D2) and some contain a mixture.

  The value of routine vitamin D supplementation above the RDA in pregnancy is an active and controversial area of investigation, but there is no clear evidence of a reduction in adverse pregnancy outcomes (eg, preeclampsia, stillbirth) or adverse offspring outcomes (eg, neonatal death, asthma, low bone mineral content). In a 2016 Cochrane review including data from seven small trials, pregnant women who received daily vitamin D supplementation had higher 25-hydroxyvitamin D levels than those receiving placebo, but the response was heterogeneous [53]. Two of the seven studies found that vitamin D supplementation reduced the risk of preeclampsia, low birth weight, and preterm birth; however, when vitamin D supplementation was combined with calcium supplementation, risk of preterm birth increased. The authors concluded that it remains unclear whether vitamin D supplementation should be routinely recommended in pregnancy. Additional rigorous and sufficiently large randomized trials are needed to confirm the effects of vitamin D supplements above the RDA on pregnancy outcomes. (See "Vitamin D deficiency in adults: Definition, clinical manifestations, and treatment", section on 'Pregnancy'.)

Folic acid

For neural tube defect prevention — The United States Preventive Services Task Force recommends that women take a supplement containing 0.4 to 0.8 mg of folic acid one month before and for the first two to three months after conception to reduce their risk of having a child with a neural tube defect [54,55]. An RDA of 0.6 mg is recommended thereafter to meet the growth needs of the fetus and placenta [31]. Continuing folic acid supplementation after the first trimester prevents the decline in serum folate and rise in homocysteine concentrations that occur when supplementation is discontinued [56].

Although most women in the United States take folic acid-containing supplements during pregnancy, the proportion taking them during the first trimester is lower (55 to 60 percent) than that during the second (76 to 78 percent) or third (89 percent) trimesters [57]. Non-supplement users were more likely to be under 25 years old, have less education, and be unmarried compared with

supplement users. Thus, women with these characteristics may benefit from emphasis on the importance of taking folic acid preconception and in the first trimester.

Folic acid recommendations are higher for women in certain high-risk groups, which are reviewed separately. Issues related to folic acid intake and supplementation in pregnancy, including nutritional sources of folic acid (fortified foods) and folate (citrus, dark green leafy vegetables, nuts, liver (table 7)) and their role in prevention of neural tube defects, are reviewed in detail separately. (See "Folic acid supplementation in pregnancy".)

Other potential benefits — In individual trials, folic acid supplementation, usually as part of a multivitamin, has been associated with a variety of benefits unrelated to neural tube defects, but these relationships require further study and confirmation. (See "Folic acid supplementation in pregnancy", section on 'Does folic acid supplementation improve other pregnancy outcomes?'.)

Choline — Choline is an essential nutrient that is transported at high rates from mother to fetus. Choline availability is crucial for the development of the central nervous system, with evidence of effects of cognitive function in infants [58]. Most United States women consume far less choline (mean intake 260 mg/day) than the 450 mg/day that is recommended [59].

Pregnant women should consume adequate choline from food and supplemental sources, although choline in often absent or low in prenatal vitamins. Eggs, meats, fish, and dairy are good sources of choline; plant sources, such as navy beans, Brussels sprouts, broccoli, and spinach also contain choline [58].

Zinc — Zinc is essential for normal growth, severe zinc deficiency has been associated with growth restriction, and observational studies have suggested that zinc supplements can increase birth weight [60]. However, a 2015 systematic review of 21 randomized trials of zinc versus no zinc supplementation in pregnancy found that zinc supplementation did not improve any pregnancy outcome, except for a 14 percent reduction in preterm birth in trials that primarily involved low-income women (RR 0.86, 95% CI 0.76-0.97) and without a statistical reduction in low birth weight (RR 0.93, 95% CI 0.78-1.12) [61]. Multiple social, nutritional, and medical factors may have been responsible for the preterm births in low-income women and these issues are probably more important targets for intervention than zinc intake.

Contemporary data for zinc intake among pregnant women in the US is not available; the last report by the National Health and Nutrition Examination Survey 1988 to 1994 indicated a mean intake of 9 mg/day from food alone, and a total intake of 22 mg/day from food plus supplements, which meets and safely exceeds the requirement [62].

Management of women who are at risk for severe zinc deficiency (eg, active inflammatory bowel disease, acrodermatitis enteropathica, pica) is discussed separately. (See "Zinc deficiency and supplementation in children and adolescents".)

Iodine — Iodine deficiency has potentially harmful effects, such as maternal and fetal/neonatal hypothyroidism. The IOM recommends daily iodine intake of 220 mcg during pregnancy and 290 mcg during lactation; the World Health Organization (WHO) recommends iodine intake of 250 mcg for both pregnant and lactating women.

United States data indicate that, among pregnant women, 56 percent had urinary iodine concentrations that were indicative of inadequate intake [63]. Non-Hispanic black women were particularly likely to have low levels. Similar results have been found in the United Kingdom and in Sweden [64].

Declining intakes of iodine may be related to increased intake of non-iodized salt from processed foods and in the home (such as sea salt). Pregnant women should be encouraged to use iodized salt (contains 95 mcg iodine per one-quarter teaspoon), consume seafood that is naturally rich in iodine, and/or take an iodine supplement to attain adequate intake. The American Thyroid Association recommends that women who are planning pregnancy, pregnant, or lactating supplement their diet with a daily oral multivitamin supplement that contains 150 mcg of iodine in the form of potassium iodide [65]; it should be noted that many prenatal vitamins contain no iodine [66]. A Cochrane review found insufficient data to reach any clinically useful conclusions on the benefits and harms of routine iodine supplementation preconception, during pregnancy, or postpartum [67].

Excessive iodine intake is also harmful (discussed below).

Vitamin A — Vitamin A requirements increase slightly during pregnancy, from 700 mcg/day in nonpregnant women to 770 mcg/day in pregnant women. In some developing countries, vitamin A deficiency is a concern as it is associated with maternal xerophthalmia and night blindness, anemia, and susceptibility to infection [68]. In contrast, in developed countries excessive intake of vitamin A is the primary concern. (See 'Adverse effects from excessive supplementation and dietary intake' below.)

Where vitamin A deficiency is endemic, such as Southeast Asia and sub-Saharan Africa, a daily supplement less than 10,000 international units (3000 mcg retinol equivalents) or a weekly supplement less than 25,000 international units (8500 mcg retinol equivalents) appears to have some maternal and fetal/neonatal health benefits (eg, reduction in maternal anemia and night blindness) with no evidence of teratogenicity [69,70], but does not reduce maternal or perinatal mortality [71], which was suggested by some early studies. Vitamin A supplementation is unnecessary where habitual vitamin A intake exceeds three times the RDA (ie, 8000 international units or 2400 mcg retinol equivalents).

Adverse effects from excessive supplementation and dietary intake — 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. Excessive maternal consumption of specific foods can also be potentially toxic to the fetus.

- Vitamin A – Excessive intake of vitamin A affects the developing embryo and can be teratogenic. In the absence of severe deficiency, pregnant women should avoid multivitamin or prenatal supplements that contain more than 5000 international units (1500 mcg) of vitamin A. Most supplements contain beta-carotene rather than retinol, and high beta-carotene intakes have not been related to birth defects [72]. Consumption of vitamin supplements containing high doses of vitamin A (greater than 10,000 international units per day [1 international unit = 0.3 mcg retinol equivalents]) appears to be teratogenic [69,73].

  Some foods are fortified with vitamin A and others are rich in vitamin A (eg, liver). For this reason, some groups (eg, Finnish Food Safety Authority, National Health Service) recommend avoiding liver consumption during pregnancy [74-79]. Limiting the intake of liver and liver products during the first trimester is likely prudent, particularly in high-income countries where vitamin A deficiency is rare.

  For women who commonly consume liver, we advise checking local food composition databases as vitamin A content of livers from different animals vary. For example, in the United States Department of Agriculture Nutrient Database [80], vitamin A content of liver and

liver products vary from 4900 international units in one raw chicken liver to 59,500 international units in 3 ounces of cooked New Zealand beef liver.

- **Iodine** – Excessive intake of iodine can cause fetal goiter [81-83], but the safe upper limit of iodine intake in pregnancy is unclear. Fetal hypothyroidism has been reported in women ingesting 12.5 mg iodine daily [81] and 2.3 to 3.2 mg of iodine daily [83]. Excessive dietary iodine intake has been reported in Japanese women whose diets contain large amounts of seaweed [83].

- **Vitamin D** – The toxic dose of vitamin D is poorly defined; a safe upper limit seems to be 100 mcg (4000 international units daily) [17].

- **Vitamin E** – A Cochrane review showed that vitamin E supplementation during pregnancy in combination with vitamin C or other supplements or drugs does not improve outcomes of stillbirth, preterm birth, preeclampsia or low birth weight [84]. Some evidence suggested that vitamin E increased self-reported abdominal pain and premature rupture of membranes at term; however, preterm premature rupture of membranes was not increased.

- **Vitamin C** – In a Cochrane review, vitamin C supplementation during pregnancy either alone or in combination with other supplements had no beneficial or harmful effects [85]. No effects were observed on prevention of stillbirth, preterm birth, pre-eclampsia, or low birth weight. Vitamin C supplementation alone resulted in a decreased risk of preterm PROM, however, the quality of evidence was poor.

Fluid requirements — During pregnancy, adequate fluid intake from consumption of beverages (water and other liquids) is estimated to be approximately 2.3 L/day (76 fl oz or about 10 cups), per the National Academy of Medicine (formerly Institute of Medicine) [86]. Additional water is consumed in foods other than beverages to meet the total adequate intake of 3 L/day. Numerous factors (eg, ambient temperature, humidity, physical activity, exercise influence) also influence total water needs.

COUNSELING WOMEN ABOUT NUTRITION IN PREGNANCY — Healthcare professionals have an important role in assessing and counseling women about nutrition to promote optimal outcomes for pregnancy. Providers who monitor gestational weight gain have key opportunities to provide information and tools to help women. In a 2014 systematic review of 25 studies in developed countries, women reported that they received inadequate nutrition information from healthcare professionals [87]. Importantly, the same review found that women who received nutrition information from their healthcare professionals were more likely to comply with advice when it was specific and explanations were provided for the recommendations. Furthermore, women were more likely to take prenatal supplements if it was verbally recommended by their provider and they received ongoing counseling at subsequent visits. Thus, healthcare professionals have the potential to impact the nutritional status of pregnant women.

Counseling about healthy eating during pregnancy — Women who are pregnant should eat plenty of fruits and vegetables as well as whole grains, low-fat dairy, and a variety of proteins. The exact amount of foods from each food group (ranges provided blow) needed by a woman depends on her prepregnancy body mass index (BMI), activity level, age, and trimester. It is important for pregnant women to choose foods that are nutrient-dense (foods that contain high levels of important nutrients compared with the amount of calories, such as fruits and vegetables, nuts/nut butters, yogurt) to meet the higher nutrient requirements in pregnancy without exceeding caloric needs. Women should also avoid foods with empty calories (foods that are high in added sugars

and solid fats, such as soda, desserts, fried foods, whole-fat dairy, and high-fat meats) because they provide little nutritional value beyond calories.

Use of a nutrition screening tool can help health professionals identify pregnant women who may be at risk for lower quality diets. (See 'History' above.)

In the first trimester of pregnancy, women typically do not need to increase their caloric intake. In the second and third trimesters, most women will need to increase their caloric consumption to promote appropriate weight gain. However, the old adage "eating for two" neither accurately nor appropriately depicts the increased needs of pregnant women. On average, women need only approximately 340 and 450 additional kcal/day in the second and third trimesters, respectively [13].

Most pregnant women in the latter two trimesters will require between 2200 and 2900 kcal/day [13], although calorie needs can vary widely, and this should be assessed individually. The ranges of number of servings for each food group needed to meet these caloric requirements (2200 to 2900 kcal/day) are:

- Fruits: 2 to 2.5 cups
- Vegetables: 3 to 3.5 cups
- Grains: 6 to 10 oz
- Protein: 6 to 7 oz
- Dairy: 3 cups

Online resources — For personalized guidance, women can be directed to the free online United States Department of Agriculture MyPlate Supertracker program. In this program, women will enter information, including their due date, age, height, prepregnancy weight, and activity level. The program will provide them with the exact number of servings in each food group that are recommended for them, as well as sample food plans [88]. Additional online information is also available at:

- Pregnancy and breastfeeding
- Patient education material ("Tips for Pregnant Moms")

Counseling about common dietary concerns in pregnancy — Self-imposed dietary restraints can be problematic if essential nutrients are left out of the diet or weight gain is inadequate. However, 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
- Undercooked meats

Vegetarian diet — Balanced vegetarian diets do not appear to have any adverse effects on pregnancy outcome, although high-quality evidence is sparse [89,90]. These diets vary considerably, as do omnivorous diets. The nutritional adequacy of a vegetarian diet must be judged individually, not on the basis of what it is called, but on the type, amount, and variety of nutrients that are consumed [91].

Vegetarian diets that are well-balanced are similar to well-balanced omnivore diets in that they meet most nutrient goals except for iron, vitamin D, vitamin E, and choline [13,92]. Additional potential nutrients of concern, particularly for vegans, are calcium, vitamin B12, and essential n-3 fatty acids (eicosapentaenoic acid [EPA] and docosahexanoic acid [DHA]). In one review, women on a vegan diet were at higher risk for both iron and vitamin B12 deficiencies [90].

Dietary deficiencies can usually be resolved with minor dietary alterations or supplements. For example, fortified vegetarian/vegan food products are now widely available and include some nondairy milks (such as fortified soy beverages), meat analogs, and breakfast cereals. These products can be good sources of key nutrients, such as calcium, iron, zinc, vitamin B12, vitamin D, riboflavin, and long-chain n-3 fatty acids. Individual nutritional assessment of a vegetarian's diet with a registered dietitian is advisable [89,93-95].

Vegetarian diets vary according to the degree of avoidance of foods of animal origin [96]. According to the strictest definition, a vegan vegetarian diet consists primarily of cereals, fruits, vegetables, legumes, and nuts; animal foods, including milk, dairy products, and eggs generally are excluded [97,98]. Several less restrictive vegetarian diets may include animal flesh, eggs, or milk and dairy products. Vegetarian diets frequently are grouped as follows (ordered from less restricted to more restricted):

- Semi-vegetarian – People who consume meat, fish or chicken in their diet on occasion. Some people who follow such a diet may not eat red meat, but may eat fish and perhaps chicken. This identification is used mainly in research studies.
- Pescatarian – Vegetarian whose diet includes fish on occasion in addition to eggs, milk, and milk products, but no other animal meats.
- Lacto-ovovegetarian – Eggs, milk, and milk products (lacto = dairy; ovo = eggs) are included, but no meat is consumed.
- Lactovegetarian – Milk and milk products are included in the diet, but no eggs or meat are consumed.
- Macrobiotic – Whole grains, especially brown rice, are emphasized and vegetables, fruits, legumes, and seaweeds are included in the diet. Locally-grown fruits are recommended. Animal foods limited to white meat or white-meat fish may be included in the diet once or twice a week.
- Vegan – All animal products, including eggs, milk, and milk products, are excluded from the diet. Some vegans do not use honey. They also may avoid foods that are processed or not organically grown [99].
- Fruitarian – Vegan diet based on fruits, nuts and seeds. Vegetables classified botanically as fruits (avocado, tomatoes) are commonly included in fruitarian diets; all other vegetables, grains, beans and animal products are excluded.

Limited research in populations outside of the United States showed that the macronutrient intake of pregnant vegetarians was similar to that of pregnant non-vegetarians except pregnant vegetarians consumed statistically lower amounts of protein and higher amounts of carbohydrate than pregnant non-vegetarians; however, none of the studies reported protein deficiency in pregnant vegetarians [89].

Protein quality in well-balanced vegetarian diets need not be a concern. Although individual plant sources of protein tend to be incomplete in their provision of all essential amino acids, eating a variety of types of plant protein sources (grains, legumes, nuts) over the course of a day can provide all essential amino acids [89].

Protein consumption in the United States tends to be significantly higher than in other parts of the world. In some Asian cultures, animal protein sources may be consumed only once or twice a week. Although these individuals would not label themselves as vegetarian, in American research studies they would be categorized as semi-vegetarian.

Phytoestrogen consumption tends to be higher among vegetarians than among omnivores. Concerns have been raised regarding phytoestrogen intake and reproductive development. Studies in animal models have reported conflicting effects of prenatal exposure to phytoestrogens (primarily genistein) with both beneficial and adverse effects depending on timing of exposure, dose, and outcomes examined [100]. In one prospective longitudinal study in humans, pregnant women consuming a vegetarian diet had increased the prevalence of hypospadias in male offspring [101]. Most of the research in humans, however, has investigated the effects of postnatal exposure of phytoestrogens through soy-based formulas on later reproductive health. More research in humans is needed that examines the effects of high-level exposure to phytoestrogens prenatally.

Food avoidance to prevent atopic disease in offspring — Both avoidance and ingestion of specific antigens, such as peanuts, milk, and eggs, during pregnancy have been hypothesized to reduce the frequency of atopic disease in offspring, but the bulk of evidence does not support either approach. These diets should not be recommended; women should consume their usual diets. (See "Primary prevention of allergic disease: Maternal diet 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".)

Gluten-free diet — Although gluten-free diets are popular and promoted in the lay press for their health benefits, there is no evidence that following a gluten-free diet has any significant health benefits in women without celiac disease or gluten sensitivity [102,103]. Elimination of gluten-rich foods during pregnancy could result in inadequate intakes of thiamin, riboflavin, niacin, folate, and iron; however, substitution of other whole grain foods should prevent any nutritional deficiency and these diets are generally considered safe.

Women with celiac disease benefit from a gluten-free diet. In a systematic review of case-control and cohort studies, women with untreated celiac disease were at increased risk of reproductive failure compared with women in the general population [104]. Treatment with a gluten-free diet eliminated the excess risk of complications. (See "Pathogenesis, epidemiology, and clinical manifestations of celiac disease in adults", section on 'Menstrual and reproductive issues'.)

Lactose intolerance — Women with lactose malabsorption have improved lactose tolerance in late pregnancy [105,106]. This has been attributed to slower intestinal transit during pregnancy and bacterial adaptation to increased lactose intake.

Women who are unable to consume adequate amounts of calcium through dairy and other dietary components can take calcium supplements or consume fortified foods and beverages. There are no data on the safety of commercially available "lactase" preparations during pregnancy; however,

beta-galactosidases are normal constituents of human tissues. (See "Lactose intolerance: Clinical manifestations, diagnosis, and management".)

Use of artificial sweeteners — There is no evidence that use of aspartame (NutraSweet), sucralose (Splenda), saccharin (Sweet 'N Low), acesulfame potassium (Sunett), or stevioside (Stevia) by pregnant women increases the risk of birth defects above the baseline risk in the general population [107].

The Acceptable Daily Intake (ADI) is defined as an estimate of the amount of a food additive that can be ingested daily over a lifetime without appreciable health risk. Average use of artificial sweeteners is usually below this limit. For example, the ADI for aspartame is 50 mg/kg/day; Diet Coke contains 131 mg aspartame per 355 mL can and one packet of Equal contains 33 mg of aspartame. The ADI for saccharin and sucralose is 5 mg/kg/day, for acesulfame potassium it is 15 mg/kg/day, and for stevioside it is 4 mg/kg/day.

In utero exposure to saccharin has been a concern because saccharin crosses the placenta and is eliminated much more slowly in the fetus than in the adult [108]. One study reported an increased risk of bladder cancer in offspring of pregnant rats that consumed very high doses of saccharin; however, the only other study of this issue did not show an increased risk. Since there are alternatives to using saccharin, avoiding it in pregnancy is prudent.

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 FDA and the Council on Scientific Affairs of the American Medical Association concluded that women who are pregnant or breastfeeding can safely use aspartame [109]. 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.

Some observational studies suggest that chronic consumption of artificial sweeteners may increase the risk of obesity and metabolic diseases in adults [110,111]; however, results have been conflicting and no intervention trials have been conducted [112]. The first cohort study examining this issue in pregnancy reported that daily maternal consumption of artificial sweeteners during pregnancy was associated with higher infant body mass index at one year of age [113]. The effect was primarily seen in male infants and was not explained by maternal body mass index, diet quality, total energy intake, other obesity risk factors, or breastfeeding duration, and there were no comparable associations for sugar-sweetened beverages. Further study is warranted, ideally a randomized trial.

Fluoride intake — 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 [114,115]. Fluoride intake is difficult to determine, given that fluoride may be present in liquids used for bottled drinks and prepared foods (eg, soups, canned vegetables) and is present in tea and seafood that contains edible bones or shells.

The CDC does not recommend fluoride supplementation during pregnancy [116] because prenatal fluoride supplementation is not incorporated into primary teeth [117] and does not reduce caries in offspring [118]. 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

[119,120]. There is good evidence that postnatal exposure of newly erupted teeth to topical fluoride from water or dentifrice is efficacious [119,120].

Excessive ingestion of fluoride during pregnancy does not appear to produce fluorosis in offspring [121], probably because the placenta provides a selective barrier to transfer of excess fluoride [122]. (See "Overview of dietary trace minerals" and "Preventive dental care and counseling for infants and young children".)

Fasting — Pregnant women may fast for several hours during the day, for one or more days, for religious or other reasons. During an overnight 12- to 18-hour fast, plasma glucose, insulin, and alanine levels fall, and plasma-free fatty acids and beta-hydroxybutyrate levels rise, a phenomenon termed "accelerated starvation" [123]. With early conversion to fat metabolism, other fuels, such as glucose and amino acids, are more available for the fetus. Free fatty acids and beta-hydroxybutyrate are also transferred across the placenta and metabolized by the fetus.

The effects of daytime fasting in otherwise healthy pregnant women are not well-defined. In ovine and human studies, the most consistently reported effect of fasting is reduction in fetal breathing movements, with resolution in the fed state [124-128]. There is no information on the effect of ketonuria on fetal/neonatal outcome in the absence of ketoacidosis. Studies of pregnancy outcome in healthy women who fasted during the month of Ramadan have generally reported no adverse effects on the fetus or uterine blood flow [129-135]. However, some authors have hypothesized that prolonged fasting during pregnancy can lead to permanent alterations in fetal physiology that have consequences in adult life [136].

Long-chain polyunsaturated fatty acids — Fish is the primary dietary source of docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), two n-3 (also known as omega-3) long-chain polyunsaturated fatty acids (n-3 LCPUFA). DHA is necessary for normal development of the brain and retina. The body's ability to produce sufficient DHA for optimal health and development is probably inadequate; therefore, consumption of preformed n-3 LCPUFA, such as in fish, is recommended. The number of weekly servings of fish needed to achieve the DHA intake goal of 200 to 300 mg/day depends on the type of fish, as shown in the table (table 8). Importantly, women of childbearing age should choose fish that are low in mercury and other contaminants (table 9). (See 'Fish consumption' below.)

There is no clear evidence that n-3 LCPUFA supplements during pregnancy improve neurodevelopment in offspring. For pregnant women who are not able or willing to consume fish, we suggest other food sources of n-3 LCPUFA to achieve an intake of 200 to 300 mg/day of DHA. A number of foods fortified with DHA are available, including yogurt, milk, and eggs. Supplements containing either fish oil or DHA synthesized by algae are also available.

Increased maternal fish and fish oil intake has not resulted in significant reductions in disorders with an inflammatory component, such as spontaneous preterm labor and birth or asthma in mothers or offspring. Therefore, our recommendations for intake of fish and other sources of n-3 LCPUFA are not different for women with a personal or family history of preterm birth, allergic disorders, or other adverse pregnancy outcomes. These issues are discussed in detail separately. (See "Fish consumption and docosahexaenoic acid (DHA) supplementation in pregnancy".)

Food safety

Avoidance of foodborne infections — Foodborne illnesses can cause maternal disease as well as congenital disease, miscarriage, premature labor, and fetal death. To reduce the risk of foodborne illness, it is important that pregnant women [137]:

- 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 (about 30 seconds) 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. 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 US Food and Drug Administration (FDA) provides detailed advice on food safety for women who are pregnant or planning pregnancy.

The following foodborne infections can have adverse effects on pregnancy. These infections and strategies for avoiding them are described in detail separately:

- Toxoplasmosis – Toxoplasmosis is caused by ingestion of undercooked or cured meat or meat products, fruit or vegetables contaminated by infected garden soil, and contaminated unfiltered water. (See "Toxoplasmosis and pregnancy".)
- Listeria monocytogenes – Listeria is a common low-level contaminant of both processed and unprocessed foods of plant and animal origin; hot cooked foods are not a vehicle of Listeria transmission. It is most commonly associated with processed/delicatessen meats, hot dogs, soft cheeses, smoked seafood, meat spreads, and pâté, but has also been transmitted by fresh fruits and vegetables that are commonly eaten uncooked. (See "Clinical manifestations and diagnosis of Listeria monocytogenes infection".)
- Brucellosis – Brucellosis is caused by ingestion of contaminated food such as raw milk, cheeses made from unpasteurized (raw) milk, or raw meat. (See "Clinical manifestations, diagnosis, and treatment of brucellosis".)

Information about current foodborne illness outbreaks can be found at the Centers for Disease Control and Prevention website.

Fish consumption — Pregnant women are advised to eat only cooked fish to avoid potentially harmful organisms [138]. However, pregnant women who have consumed "sushi grade" raw fish can be reassured that this is generally safe [139], as long as the raw fish was frozen appropriately [140], as this eliminates most parasites and bacteria. These women should be advised to discontinue future raw fish consumption. A variety of marine toxins (eg, ciguatoxin) can be ingested via fish consumption (cooked or raw), but there are only rare reports of adverse effects on pregnancy or the fetus. (See "Overview of shellfish and pufferfish poisoning".)

Fish may be contaminated by environmental pollutants, such as methylmercury. Methylmercury exposure, primarily through ingestion of contaminated fish, can cause severe fetal central nervous system damage, as well as milder intellectual, motor, and psychosocial impairment. For this reason, the US FDA and Environmental Protection Agency recommend that pregnant women (or women who might become pregnant or who are nursing) should [138]:

- Avoid eating any shark, swordfish, king mackerel, marlin, orange roughy, tilefish (Gulf of Mexico), or bigeye tuna (other kinds of tuna are acceptable) because they may contain high levels of mercury (table 9).
- Eat two to three servings (8 to 12 oz total) per week of seafood that is likely very low in mercury or other contaminants ("best choices") **or** one serving of seafood (4 oz) that is likely low in mercury or other contaminants ("good choices") (table 9). Information on specific levels of methylmercury and other contaminants is available through the FDA food safety website and the EPA website.
- Check local advisories about the safety of fish caught in local lakes, rivers, and coastal areas.

The risks and benefits of fish consumption during pregnancy are reviewed in detail separately. (See "Fish consumption and docosahexaenoic acid (DHA) supplementation in pregnancy".)

Caffeine intake — Meta-analyses of observational studies have reported negative effects from caffeine intake in pregnancy, and the risk increased with increasing caffeine dose. In one systematic review that included over 100,000 women, the risk of low birth weight increased 13 percent for each 100 mg/day of caffeine consumed [141]. Another systematic review that included data from 26 studies reported a 19 percent increased risk of pregnancy loss for every 150 mg/day of caffeine consumed [142]. Because of the limitations of observational data, the ability to adjust for confounders is poor, and higher-quality evidence is needed, preferably from randomized trials, to confirm these findings.

A 2010 ACOG Committee Opinion recommends limiting caffeine consumption to less than 200 mg/day in pregnancy [143]. A list of the caffeine content of beverages and foods is available in the table (table 10).

The effects of caffeine on pregnancy outcomes are discussed in detail separately. (See "The effects of caffeine on reproductive outcomes in women".)

Herbal products — We and others recommend avoiding herbal medicines and supplements during pregnancy [144,145], except for ginger (see "Treatment and outcome of nausea and vomiting of pregnancy", section on 'Ginger'). 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 [146,147]; and several cases of potentially harmful effects to the pregnancy have been reported [148-151]. In the United States, makers of supplements are not required to prove efficacy, safety, or quality of a product before it is on the market, and numerous recalls of supplements have taken place due to product adulteration. (See "Overview of herbal medicine and dietary supplements", section on 'Regulation'.)

Consumption of herbal products is common. In the United States, 5 to 10 percent of pregnant women reported herbal intake during pregnancy [152,153] and 15 percent reporting using an herbal product or non-vitamin supplement, most commonly fish oil, melatonin, probiotics or prebiotics, acai, and cranberry [154]. Estimates of herbal intake have been higher in Europe and Australia, as high as 58 percent of pregnant women in one United Kingdom sample [155]. The

most common products were herbal teas, chamomile, ginger, cranberry, raspberry leaf, echinacea, and ephedra.

There is a paucity of high-quality randomized trials evaluating the efficacy and safety of traditional herbal preparations in pregnancy [156]. In a 2016 Cochrane review that examined the effects of herbal medicines on miscarriage, none of nine randomized trials compared herbal medicines with either placebo or bedrest; thus, the authors concluded that there was insufficient data to make recommendations [157]. Some studies have reported lack of positive effects of herbal remedies [158], while others have reported negative effects on pregnancy and infant outcomes [159].

Consumption of liver-based foods — As discussed above, high consumption of liver or liver-based foods (eg, patties, sausage) may be harmful in pregnancy because of excessive intake of vitamin A. Some groups (eg, Finnish Food Safety Authority, March of Dimes, National Health Service) have recommended that pregnant women limit or avoid liver consumption for this reason [74-79]. (See 'Adverse effects from excessive supplementation and dietary intake' above.)

Exposure to environmental toxins — ACOG has deemed reducing exposure to toxic environmental agents a critical area for intervention because of effects of toxins on the developing fetus [160]. Good nutrition is one way to buffer exposure to toxic agents [161,162]. Pregnant women should be encouraged to eat plenty of fruits and vegetables (either conventional or organic), legumes, and whole grains every day, and to avoid processed foods and fast foods.

Food can be a source of exposure to environmental toxins, such as bisphenol A (BPA) and pesticides. BPA is ubiquitous in food, particularly in the lining of canned goods. Exposure is a concern during pregnancy because of potential neural and behavioral effects in fetuses and infants. Women should be encouraged to avoid use of plastics for food and beverage containers that contain BPA, and avoid canned goods that use BPA linings (BPA-free canned goods are becoming increasingly available). (See "Overview of occupational and environmental risks to reproduction in females", section on 'Bisphenol A' and "Overview of occupational and environmental risks to reproduction in females", section on 'Interference with fetal development'.)

The effects of pesticide exposure from foods are unclear. The American Academy of Pediatrics recognizes that early pesticide exposure may adversely impact birth weight, risk of pediatric cancers, and cognitive function and behavior [163]. The Environmental Protection Agency sets a maximum residue limit, which is the amount of pesticide residue allowed to remain on each food or product [164]. This limit is set to ensure that "there is reasonable certainty of no harm." Much of the public, however, is still concerned about pesticides in food. A 2012 systematic review determined that consumption of organic foods may reduce exposure to pesticide residues and antibiotic-resistant bacteria [165]. On the other hand, organic foods have not been found to be nutritionally superior and tend to be more expensive and less accessible, particularly for vulnerable populations. (See "Overview of occupational and environmental risks to reproduction in females", section on 'Interference with fetal development'.)

MULTIPLE GESTATION — Nutritional requirements and weight gain recommendations are higher in multiple gestations. Guidelines are provided separately. (See "Twin pregnancy: Prenatal issues", section on 'Pregnancy counseling and management' and "Triplet pregnancy", section on 'Weight gain and nutrition'.)

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. (See "Overview of postpartum care", section on 'Postpartum weight retention' and "Maternal nutrition during lactation".)

RESOURCES

- The Food and Information Center of the United States Department of Agriculture provides several online resources for pregnant women, including information on folic acid, food safety, foods to avoid, and nutrition

INFORMATION FOR PATIENTS — UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topics (see "Patient education: Nutrition before and during pregnancy (The Basics)" and "Patient education: Health and nutrition for women who breastfeed (The Basics)")

- Beyond the Basics topic (see "Patient education: Maternal health and nutrition during breastfeeding (Beyond the Basics)")

SUMMARY AND RECOMMENDATIONS

- Nutrition is a key modifiable factor that affects birth outcomes and has long-term effects on the health of offspring. (See 'Introduction' above.)

- Patient nutrition risk and habits should be assessed early in pregnancy. Completion of a self-administered dietary questionnaire prior to seeing the clinician can be helpful (form 1 and table 2). Potential problems that require attention include (see 'Assessment of nutritional status' above):

    - Use of supplements
    - Food avoidances/special diets/skipping meals
    - Eating disorders
    - Lack of resources for adequate nutrition
    - Low intake of nutrient-dense foods (fruits and vegetables)
    - High intake of added sugars and fats (fried foods, processed foods, desserts)
    - Overweight or obesity
    - Medical history of bariatric surgery or other conditions that cause malabsorption
    - Substance misuse

- Consultation with a trained specialist in maternal nutrition, such as a registered dietitian, is recommended for women with high nutrition risk. (See 'Referrals' above.)

- The incidence of pregnancy complications is higher at the upper and lower extremes of weight gain. The Institute of Medicine recommendations for weight gain during singleton pregnancy are (see 'Prepregnancy weight and gestational weight gain' above):
    - Body mass index (BMI) <18.5 kg/m^2 (underweight) – weight gain 28 to 40 lbs (12.5 to 18.0 kg)
    - BMI 18.5 to 24.9 kg/m^2 (normal weight) – weight gain 25 to 35 lbs (11.5 to 16.0 kg)
    - BMI 25.0 to 29.9 kg/m^2 (overweight) – weight gain 15 to 25 lbs (7.0 to 11.5 kg)
    - BMI ≥30.0 kg/m^2 (obese) – weight gain 11 to 20 lbs (5 to 9.0 kg)
- The Institute of Medicine and the Centers for Disease Control and Prevention recommend multiple-micronutrient supplements (commonly called multivitamin supplements) for pregnant women who do not consume an adequate diet or may have malabsorption. Well-nourished women may not need multiple-micronutrient supplements, but in the absence of careful evaluation by a nutritionist, it is prudent to recommend them. At a minimum, the daily multiple-micronutrient supplement should contain key vitamins/minerals that are often not met by diet alone, such as (see 'Micronutrients' above):
    - Iron – 27 mg
    - Folate – at least 0.4 mg (0.6 mg in the second and third trimesters)
    - Calcium – at least 250 mg (elemental calcium 1000 mg per day)
    - Iodine – 150 mcg (preferably in the form of potassium iodide)
    - Vitamin D – 200 to 600 international units (exact amount is controversial)
- Preconceptionally and during the first trimester, women should take a folic acid supplement of 0.4 to 0.8 mg per day. Higher doses (4 mg 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 'Folic acid' above.)
- Excessive intake of vitamin A (greater than 10,000 international units per day) and/or iodine can have harmful fetal effects. (See 'Adverse effects from excessive supplementation and dietary intake' above.)
- Women should be counseled to eat a healthy diet during pregnancy. This includes plenty of fruits and vegetables, whole grains, low-fat dairy, and a variety of proteins. Nutrient-dense foods should be encouraged, and empty calories should be minimized or avoided. These eating patterns will help women meet nutrient needs without exceeding calorie needs. "Eating for two" during pregnancy is a misnomer, as women require no additional calories during the first trimester and only a moderate increase in calories (additional 340 to 450 kcal/day) in the second and third trimesters. Exact needs vary among women based on age, prepregnancy weight, height, and activity level. Tools are available to help clinicians counsel women and for women to monitor their own nutrition. (See 'Counseling about healthy eating during pregnancy' above.)
- Self-imposed dietary restraints can be problematic if essential nutrients are left out of the diet or weight gain is inadequate. However, 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, herbal

products, liver-based foods, and undercooked meats. (See 'Counseling women about nutrition in pregnancy' above.)

- Patients should be educated about the risk for and prevention of foodborne infections. (See 'Avoidance of foodborne infections' above.)
- Pregnant women should limit seafood consumption to 12 oz of cooked seafood (about three 4 oz servings) per week, and completely avoid some types of seafood to minimize fetal exposure to mercury and other water-borne contaminants. Specific recommendations are described in the table (table 9). (See 'Fish consumption' above.)

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GRAPHICS

Medical history that poses potential nutrition-related risks in pregnancy

Medical history or condition	Examples*
Diabetes	▪ Type 1 diabetes
	▪ Type 2 diabetes
Obstetric history	▪ Previous child with neural tube defect
	▪ Gestational diabetes
	▪ Hyperemesis gravidarum
	▪ Hypertensive disorder of pregnancy
	▪ Current multifetal pregnancy
Inborn metabolic disorders	▪ Phenylketonuria
	▪ Maple syrup urine disease
Surgical history	▪ Bariatric surgery
	▪ Bowel resection
Gastrointestinal disease/conditions that cause malabsorption	▪ Crohn disease
	▪ Ulcerative colitis
	▪ Cystic fibrosis
Nutrition issues	▪ Obesity
	▪ Overweight
	▪ Eating disorder (past or current)
Unhealthy behaviors	▪ Use of cigarettes, alcohol, stimulants, illicit drugs

* Not an exhaustive list.

Graphic 107824 Version 1.0

Dietary questionnaire

What you eat and some of the lifestyle 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 three 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)
   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

Lifestyle

14. Do you exercise for at least 30 minutes on a regular basis (three 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 asaspirin, acetominophen, antacids, or vitamins)
    Street drugs (such as marijuana, speed, downers, crack, or heroin)

WIC: Women, Infants, and Children.

Graphic 53845 Version 3.0

Brief dietary assessment questionnaire

Over the past few months:	0 points	1 point	2 points
1. How many times a week do you eat fast food meals or snacks?	❑ Less than one time	❑ One to three times	❑ Four or more times
2. How many servings of fruit did you eat each day?	❑ Five or more	❑ Three to four	❑ Two or less
3. How many servings of vegetables did you eat each day?	❑ Five or more	❑ Three to four	❑ Two or less
4. How many regular sodas or glasses of sweet tea did you drink each day?	❑ Less than one	❑ One to two	❑ Three or more
5. How many times a week did you eat beans (like pinto or black beans), chicken, or fish?	❑ Three or more times	❑ One to two times	❑ Less than one time
6. How many times a week did you eat regular snack chips or crackers (not low-fat)?	❑ One time or less	❑ Two to three times	❑ Four or more times
7. How many times a week did you eat desserts and other sweets (not the low-fat kind)?	❑ One time or less	❑ Two to three times	❑ Four or more times
8. How much margarine, butter, or meat fat do you use to season vegetables or put on potatoes, bread, or corn?	❑ Very little	❑ Some	❑ A lot
Summary score (sum of all items) = _____			

Responses in the first points column indicate healthy eating habits (scored 0), responses in the second points column indicate less healthy eating habits (scored 1), and responses in the third points column indicate the least healthy eating habits (scored 2). Summary scores may range from 0 to 16, with lower numbers indicating good dietary habits and higher scores indicating poorer dietary habits.

Graphic 107808 Version 1.0

Determining body mass index from weight and height

	Good weights							Overweight					Obesity	
BMI, kg/m^2	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 years, or if the waist circumference is above 100 cm (40 in) due to central fatness.

BMI: body mass index.

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

Graphic 63600 Version 3.0

Determining body mass index using kilograms and centimeters*

BMI, kg/m^2	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

BMI: body mass index.

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

Graphic 74762 Version 3.0

Recommended Dietary Allowances (RDA) or Adequate Intake (AI) and Tolerable Upper Limits (UL) for adult pregnant and lactating women

	RDAs		ULs for pregnant and lactating women
	Pregnant women*	Lactating women*	
Fat-soluble vitamins			
Vitamin A	770 mcg	1300 mcg	3000 mcg
Vitamin D	600 international units (15 mcg)	600 international units (15 mcg)	4000 international units (100 mcg)
Vitamin E	15 mg	19 mg	1000 mg
Vitamin K¶	90 mcg	90 mcg	ND
Water-soluble vitamins			
Vitamin C	85 mg	120 mg	2000 mg
Thiamin	1.4 mg	1.4 mg	ND
Riboflavin	1.4 mg	1.6 mg	ND
Niacin	18 mg	17 mg	35 mg
Vitamin B_6	1.9 mg	2 mg	100 mg
Folate	600 mcg	500 mcg	1000 mcg
Vitamin B_{12}	2.6 mcg	2.8 mcg	ND
Minerals			
Calcium	1000 mg	1000 mg	2500 mg
Phosphorus	700 mg	700 mg	4000 mg
Iron	27 mg	9 mg	45 mg
Zinc	11 mg	12 mg	40 mg
Iodine	220 mcg	290 mcg	1100 mcg
Selenium	60 mcg	70 mcg	400 mcg

ND: Not determinable due to lack of data of adverse effects and concern with regard to lack of ability to handle excess amounts.

* Females over 18 years old.

¶ The requirement for vitamin K is given as an "Adequate Intake (AI)" rather than an RDA, because there was insufficient scientific evidence to calculate the RDA.

Adapted from: Guidelines for Perinatal Care, sixth edition (2007); and Institute of Medicine Dietary Reference Intakes for Calcium and Vitamin D (2011), which can be accessed via www.nap.edu.

Graphic 60019 Version 8.0

Iron-rich foods

Food	Amount
Foods that provide 3 to 12 mg of iron	
Clams	Four large or nine small
Oysters	Six medium
Octopus	3 oz cooked
Spinach	1/2 cup cooked
Lentils	1/2 cup cooked
Pumpkin seeds	1 oz roasted
Fortified cereals	1 cup
Foods that provide 1.6 to 3 mg of iron	
Sirloin steak	3 oz
Roast beef	3 oz
Lean hamburger	3 oz
Pork	3 oz
Lamb	3 oz
Salmon	3 oz
Tilapia	3 oz
Kidney beans	1/2 cup cooked
Lima beans	1/2 cup cooked
Navy beans	1/2 cup cooked
Oatmeal	1 cup cooked
Cashew nuts	1 oz dry roasted
Foods that provide 0.5 to 1.5 mg of iron	
Chicken	3 oz
Eggs	One whole
Green peas	1/2 cup
Tomato juice	6 oz
Broccoli	1/2 cup
Brussels sprouts	1/2 cup cooked
Almonds	1 oz roasted
Peanuts	2 oz roasted
Dried apricots	Five halves
Raisins	1 oz (about 60 raisins)
Raspberries	1 cup
Strawberries	1 cup
Foods high in vitamin C that enhance iron absorption when consumed with iron-containing foods	
Broccoli	
Bell peppers	

Cantaloupe
Grapefruit and grapefruit juice
Kiwi
Orange and orange juice
Tomatoes and tomato sauces
Strawberries

mg: milligrams; oz: ounces.

Graphic 107826 Version 1.0

Calcium content of foods

Food	Amount	Calcium (mg)*
Dairy		
Milk, sheep's	1 cup	470
Milk, goat's	1 cup	325
Milk, cow's	1 cup	300
Yogurt	1 cup (8 oz)	400
Greek yogurt	½ cup (4 oz)	120
Cheddar cheese	1 oz	200
Parmesan cheese	1 tbsp	45
Ice cream	½ cup	84
Cottage cheese	½ cup	125
Dairy alternatives		
Soy milk, calcium fortified	1 cup	200 to 400
Almond milk, calcium fortified	1 cup	200 to 500
Legumes		
Edamame, cooked	½ cup	50
Garbanzo beans, cooked	½ cup	40
Pinto beans, cooked	½ cup	40
Tofu, firm, calcium-set	4 oz	300 to 780
Tofu, regular	4 oz	90 to 170
White beans	½ cup	90
Vegetables		
Arugula, raw	1 cup	30
Bok choy, cooked	½ cup	80
Broccoli, raw	1 cup	45
Broccoli, cooked	½ cup	30
Chard, cooked	½ cup	50
Kale, raw	1 cup	25
Kale, cooked	½ cup	50
Spinach, raw	1 cup	30
Spinach, cooked	½ cup	120
Fruits		
Figs, raw	Two medium	35
Figs, dried	½ cup	120
Kiwi, raw	½ cup	30
Orange juice, calcium fortified	4 oz	175
Orange juice, regular	4 oz	15
Nuts		

Almonds, roasted	1 oz	80
Brazil nuts	1 oz	45
Chia seeds, dried	1 oz	180
Sesame seeds, whole toasted	1 oz	280

mg: milligrams; tbsp: tablespoons; oz: ounces.
* Adult women (pregnant, lactating, and nonpregnant) require 1000 mg calcium/day. Note that absorption of calcium is best when it is consumed at amounts equal to or less than 500 mg at a time.

Reproduced from: United States Department of Agriculture (USDA) National Agricultural Library. USDA National Nutrient Database for Standard Reference. Available at: https://ndb.nal.usda.gov/ (Accessed on April 27, 2016).

Graphic 107827 Version 1.0

Selected food sources of folate and folic acid

Food	Micrograms (µg)
Breakfast cereals fortified with 100 percent of the DV, ¾ cup*	400
Beef liver, cooked, braised, 3 ounces	185
Cowpeas (blackeyes), immature, cooked, boiled, ½ cup	105
Breakfast cereals, fortified with 25 percent of the DV, ¾ cup*	100
Spinach, frozen, cooked, boiled, ½ cup	100
Great Northern beans, boiled, ½ cup	90
Asparagus, boiled, 4 spears	85
Rice, white, long-grain, parboiled, enriched, cooked, ½ cup*	65
Vegetarian baked beans, canned, 1 cup	60
Spinach, raw, 1 cup	60
Green peas, frozen, boiled, ½ cup	50
Broccoli, chopped, frozen, cooked, ½ cup	50
Egg noodles, cooked, enriched, ½ cup*	50
Broccoli, raw, 2 spears (each 5 inches long)	45
Avocado, raw, all varieties, sliced, ½ cup sliced	45
Peanuts, all types, dry roasted, 1 ounce	40
Lettuce, Romaine, shredded, ½ cup	40
Wheat germ, crude, 2 tablespoons	40
Tomato Juice, canned, 6 ounces	35
Orange juice, chilled, includes concentrate, ¾ cup	35
Turnip greens, frozen, cooked, boiled, ½ cup	30
Orange, all commercial varieties, fresh, 1 small	30
Bread, white, 1 slice*	25
Bread, whole wheat, 1 slice*	25
Egg, whole, raw, fresh, 1 large	25
Cantaloupe, raw, ¼ medium	25
Papaya, raw, ½ cup cubes	25
Banana, raw, 1 medium	20

* Items marked with an asterisk (*) are fortified with folic acid as part of the Folate Fortification Program.

Reproduced from: US Department of Agriculture, Agricultural Research Service 2003. USDA National Nutrient Database for Standard Reference, Release 16. Nutrient Data Laboratory Home Page, http://www.nal.usda.gov/fnic/cgi-bin/nut_search.pl.

Graphic 72855 Version 2.0

Weekly servings of fish to achieve 250 mg/day of EPA + DHA

Fish name	Number of 3.5 ounce (100 gram) servings*
Oily fish	
Anchovy, canned	1
Herring, Atlantic	1
Salmon, Atlantic	1
Tuna, Bluefin	2
Mackerel, Atlantic	2
Bluefish	2
Trout, Rainbow	2
Sardines, Atlantic canned	2
Striped Bass	2
Tilefish	2
Swordfish	2
Tuna, Albacore canned	3
Salmon, Sockeye	3
Carp	4
Salmon, smoked (lox)	4
King Mackerel	5
White fish	
Sea Bass	3
Pollock, Atlantic	4
Snapper	6
Flounder and Sole	6
Tuna, light canned	7
Grouper	8
Catfish, wild	8
Halibut	8
Haddock	12
Cod, Atlantic	12
Shellfish	
Mussels	3
Crab, Alaska King	5
Oysters, eastern raw	6
Clams	7
Shrimp	7
Lobster, northern	10
Scallops	11
Crab, Blue	11

EPA: eicosapentaenoic acid; DHA: docosahexaenoic acid.
* Servings rounded up to a whole number of servings.

Data from: United States Department of Agriculture (USDA) National Nutrient Database for Standard Reference. USDA website 2012. Available at: http://ndb.nal.usda.gov/. (Accessed June 10, 2013.)

Graphic 79454 Version 2.0

FDA advice on fish consumption in women who are pregnant, might become pregnant, or are nursing

Best choices (eat two to three servings a week)

- Anchovy
- Atlantic croaker
- Atlantic mackerel
- Black sea bass
- Butterfish
- Catfish
- Clam
- Cod
- Crab
- Crawfish
- Flounder
- Haddock
- Hake
- Herring
- Lobster, American and spiny
- Mullet
- Oyster
- Pacific chub mackerel
- Perch (freshwater and ocean)
- Pickerel
- Plaice
- Pollock
- Salmon
- Sardine
- Scallop
- Shad
- Shrimp
- Skate
- Smelt
- Sole
- Squid
- Tilapia
- Trout (freshwater)
- Tuna, canned light (includes skipjack)
- Whitefish
- Whiting

Good choices (eat one serving a week)

- Bluefish
- Buffalofish
- Carp
- Chilean sea bass/Patagonian toothfish
- Grouper
- Halibut
- Mahi mahi/dolphinfish
- Monkfish
- Rockfish
- Sablefish
- Sheepshead
- Snapper
- Spanish mackerel
- Striped bass (ocean)
- Tilefish (Atlantic Ocean)
- Tuna, albacore/white tuna, canned and fresh/frozen
- Tuna, yellowfin
- Weakfish/sea trout
- White croaker/Pacific croaker

Choices to avoid (highest mercury levels)

- King mackerel
- Marlin
- Orange roughy
- Shark
- Swordfish
- Tilefish (Gulf of Mexico)
- Tuna, bigeye

Note: On average, farm-raised fish tend to be lower in mercury compared with wild-caught fish.[1]

Reference:

1. *Karimi R, Fitzgerald TP, Fisher NS. A quantitative synthesis of mercury in commercial seafood and implications for exposure in the United States. Environ Health Perspect 2012; 120:1512.*

Reproduced from: U.S. Food and Drug Administration. Food: Eating Fish: What Pregnant Women and Parents Should Know. Available at: http://www.fda.gov/Food/FoodborneIllnessContaminants/Metals/ucm393070.htm (Accessed January 26, 2017).

Graphic 111607 Version 3.0

Caffeine content in foods and beverages

Coffees	**Serving size, oz (mL)**	**Caffeine, mg**
Coffee, brewed	8 (235)	133 (range: 102 to 200)
Coffee, generic instant	8 (235)	93 (range: 27 to 173)
Coffee, generic decaffeinated	8 (235)	5 (range: 3 to 12)
Espresso	1 (30)	40 (range: 30 to 90)
Espresso decaffeinated	1 (30)	4
Teas	**Serving size, oz (mL)**	**Caffeine, mg**
Tea, brewed	8 (235)	53 (range: 40 to 120)
Arizona Iced Tea, black	16 (470)	32
Arizona Iced Tea, green	16 (470)	15
Nestea	12 (355)	26
Snapple, Just Plain Unsweetened	16 (470)	18
Snapple, Kiwi Teawi	16 (470)	10
Snapple, Lemon, Peach, or Raspberry	16 (470)	42
Starbucks Tazo Chai Tea Latte (Grande)	16 (470)	100
Soft drinks	**Serving size, oz (mL)**	**Caffeine, mg**
FDA official limit for cola and pepper soft drinks	**12 (355)**	**71**
7-Up, regular or diet	12 (355)	0
Barq's Diet Root Beer	12 (355)	0
Barq's Root Beer	12 (355)	22
Coke, regular or diet	12 (355)	35 to 47
Dr. Pepper, regular or diet	12 (355)	42 to 44
Fanta, all flavors	12 (355)	0
Fresca, all flavors	12 (355)	0
Jolt Cola	12 (355)	72
Mellow Yellow	12 (355)	53
Mountain Dew, regular or diet	12 (355)	54 (20 oz = 90)
Mountain Dew MDX, regular or diet	12 (355)	71 (20 oz = 118)
Mug Root Beer, regular or diet	12 (355)	0
Pepsi, regular or diet	12 (355)	36 to 38
Sierra Mist, regular or free	12 (355)	0
Sprite, regular or diet	12 (355)	0
TAB	12 (355)	46.5
Energy drinks	**Serving size, oz (mL)**	**Caffeine, mg**
5-hour ENERGY	2 (60)	215*
Amp	8.4 (250)	74
Cocaine	8.4 (250)	288

Enviga	12 (355)	100
Full Throttle	16 (470)	144
Glaceau Vitamin Water Energy Citrus	20 (590)	50
Monster Energy	16 (470)	160
Red Bull	8.3 (245)	80
Red Bull Sugarfree	8.3 (245)	80
Rip It, all varieties	8 (235)	100
Rockstar Energy Drink	8 (235)	80
SoBe Adrenaline Rush	8.3 (245)	79
SoBe Essential Energy, Berry or Orange	8 (235)	48
SoBe No Fear	8 (235)	83
Spike Shooter	8.4 (250)	300
Tab Energy	10.5 (310)	95
Frozen desserts	**Serving size, oz (mL)**	**Caffeine, mg**
Ben & Jerry's Coffee Ice Cream	8 (235)	68 to 84
Häagen-Dazs Coffee Ice Cream or Yogurt	8 (235)	58
Starbucks Coffee Ice Cream	8 (235)	50 to 60
Chocolates/candies/other	**Serving size, various units**	**Caffeine, mg**
Hershey's Chocolate Bar	1.55 oz (45 g)	9
Hershey's Kisses	41 g (9 pieces)	9
Hershey's Special Dark Chocolate Bar	1.45 oz (41 g)	31
Hot cocoa	8 oz (235 mL)	3 to 13
Powdered caffeine	1/16 tsp	200

FDA: US Food and Drug Administration.
* Reported by Consumer Reports.
Oz: ounce

References:

1. *Harland BF. Caffeine and nutrition. Nutrition 2000; 16:522.*
2. *Juliano LM, Griffiths RR. Caffeine. In: Substance Abuse: A Comprehensive Textbook, Fourth Edition, Lowinson JH, Ruiz P, Millman RB, Langrod JG (Eds), Baltimore: Lippincott Williams, & Wilkins, 2005.*
3. *Center for Science in the Public Interest. Caffeine Content of Food and Drugs.*

Graphic 79304 Version 9.0

Contributor Disclosures

Christine D Garner, PhD, RD Nothing to disclose **Charles J Lockwood, MD, MHCM** Consultant/Advisory Boards: Celula [Aneuploidy screening (No current products or drugs in the US)]. **Vanessa A Barss, MD, FACOG** Nothing to disclose

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