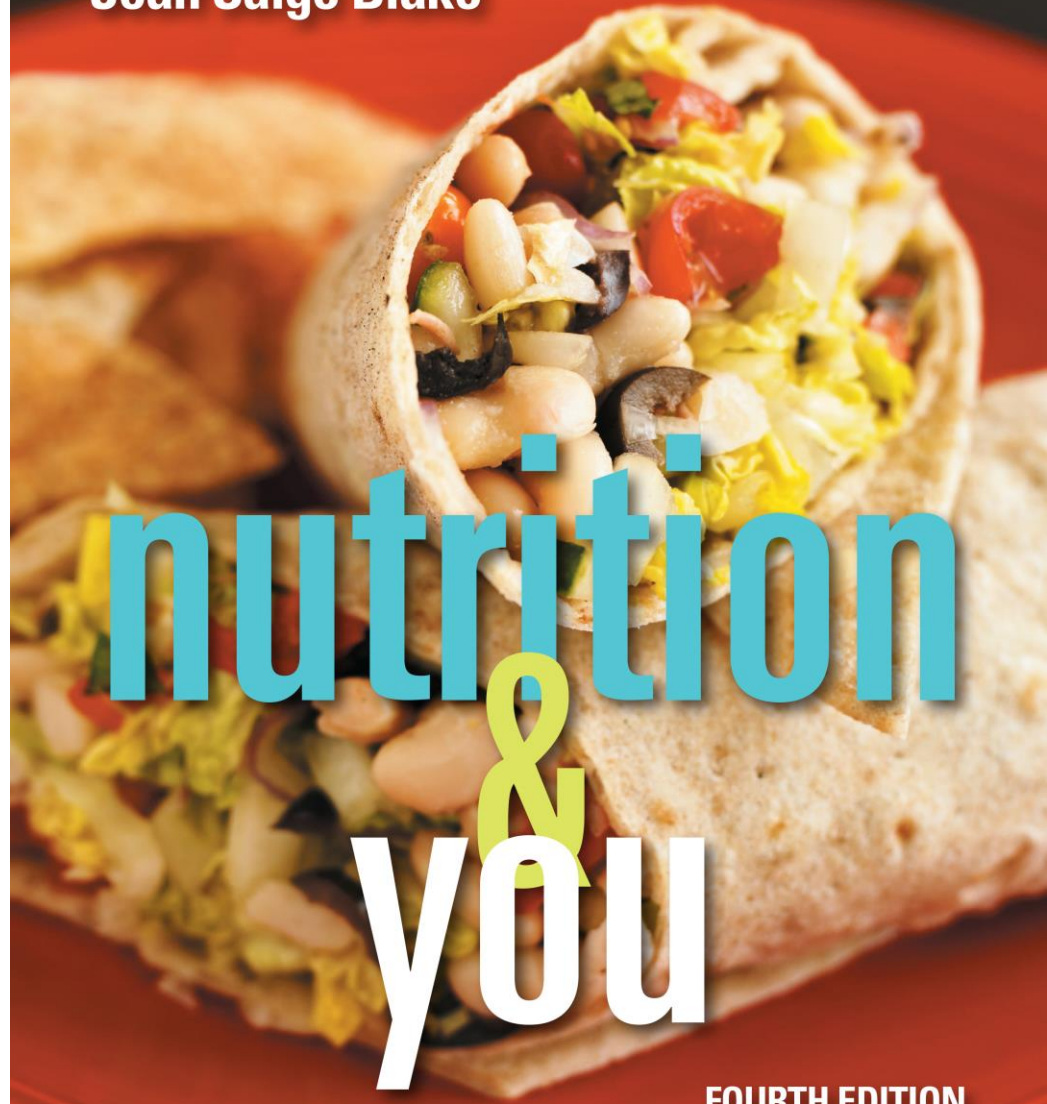


Chapter 14: Life Cycle Nutrition: Pregnancy through Infancy

Joan Salge Blake



FOURTH EDITION

Objectives for Chapter 14

- Explain the importance of lifestyle factors, including diet, for both men and women, and how they affect the likelihood of conception.
- Identify key nutrient needs for women and potential complications in the first, second, and third trimesters of pregnancy.
- List special concerns of young and older mothers-to-be.
- Describe the benefits of breast-feeding.
- Identify key nutrient needs and lifestyle factors for breast-feeding women.
- Explain why formula can be a good alternative to breast milk.
- Discuss the nutritional needs of infants.
- Explain when and how solid foods may be introduced to infants.

What Nutrients and Behaviors Are Most Important before Attempting a Healthy Pregnancy?

- A man's diet and lifestyle affect the health of his sperm
 - Smoking, alcohol and drug abuse, obesity may decrease sperm production and function
 - Zinc and folate are associated with healthy sperm production
 - Antioxidants (vitamins C and E, carotenoids) may help protect sperm from free-radical damage.
 - Should consume well-balanced diet of fruits and vegetables, whole grains, and healthy protein foods

What Nutrients and Behaviors Are Most Important before Attempting a Healthy Pregnancy?, Continued

- Women need to adopt a healthy lifestyle before conception
 - Attain a healthy weight
 - Get adequate folic acid
 - For new cells and baby's growth and development
 - Moderate fish and caffeine consumption
 - Methylmercury is a problem in some fish
 - Consume < 200 mg of caffeine/day
 - Avoid cigarettes and other toxic substances

Fishing for a Healthy Baby

Table 14.1 Fishing for a Healthy Baby

Pregnant and nursing women and women of childbearing age who may become pregnant should follow these guidelines for eating seafood:

Do Not Eat	Limit	Enjoy
<ul style="list-style-type: none">• Shark• Swordfish• King mackerel• Tilefish (golden bass or golden snapper)	<ul style="list-style-type: none">• Albacore (white) tuna to no more than 6 oz weekly• Locally caught fish from nearby lakes, rivers, and coastal areas. Check local advisories regarding its safety before consuming it. If no advice is available, eat up to 6 oz weekly. Don't consume any other fish during that week.	<p>Up to 12 oz weekly of fish with low levels of methylmercury, such as:</p> <ul style="list-style-type: none">• Canned light tuna• Cod• Catfish• Crab• Pollock• Salmon• Scallops• Shrimp

Source: Data from Food and Drug Administration. 2004. What You Need to Know About Mercury in Fish and Shellfish: EPA and FDA Advice for Women Who Might Become Pregnant, Who Are Pregnant and Nursing Mothers. Available at www.fda.gov. Accessed March 2013.

A Jolt of Caffeine

Table 14.2 A Jolt of Caffeine

Beverage	Caffeine (mg)
Coffee, brewed, drip (8 oz)	85
“Energy” drinks (8 oz)	80
Espresso (1 oz)	40
Tea, brewed (8 oz)	40
Tea, iced (8 oz)	25
Soft drinks (8 oz)	24
Hot cocoa (8 oz)	6
Milk chocolate (1 oz)	6
Chocolate milk (8 oz)	5
Coffee, brewed, decaffeinated (8 oz)	3

Source: Data from Caffeine Content of Food and Drugs, Centre for Science in the Public Interest. Available at <http://www.cspinet.org/new/cafchart.htm> Accessed June 2015.

Table 14.2

What Nutrients and Behaviors Are Important in the First Trimester?

- During the first trimester, the fertilized egg develops into a fetus
 - Full-term pregnancy is approximately 40 weeks long, divided into three trimesters
 - Moment of conception marks first trimester
 - During first few days, fertilized egg travels down fallopian tube to embed in lining of uterus
 - After eighth week of pregnancy, developing embryo is called a fetus

Fetal Development in the First Trimester

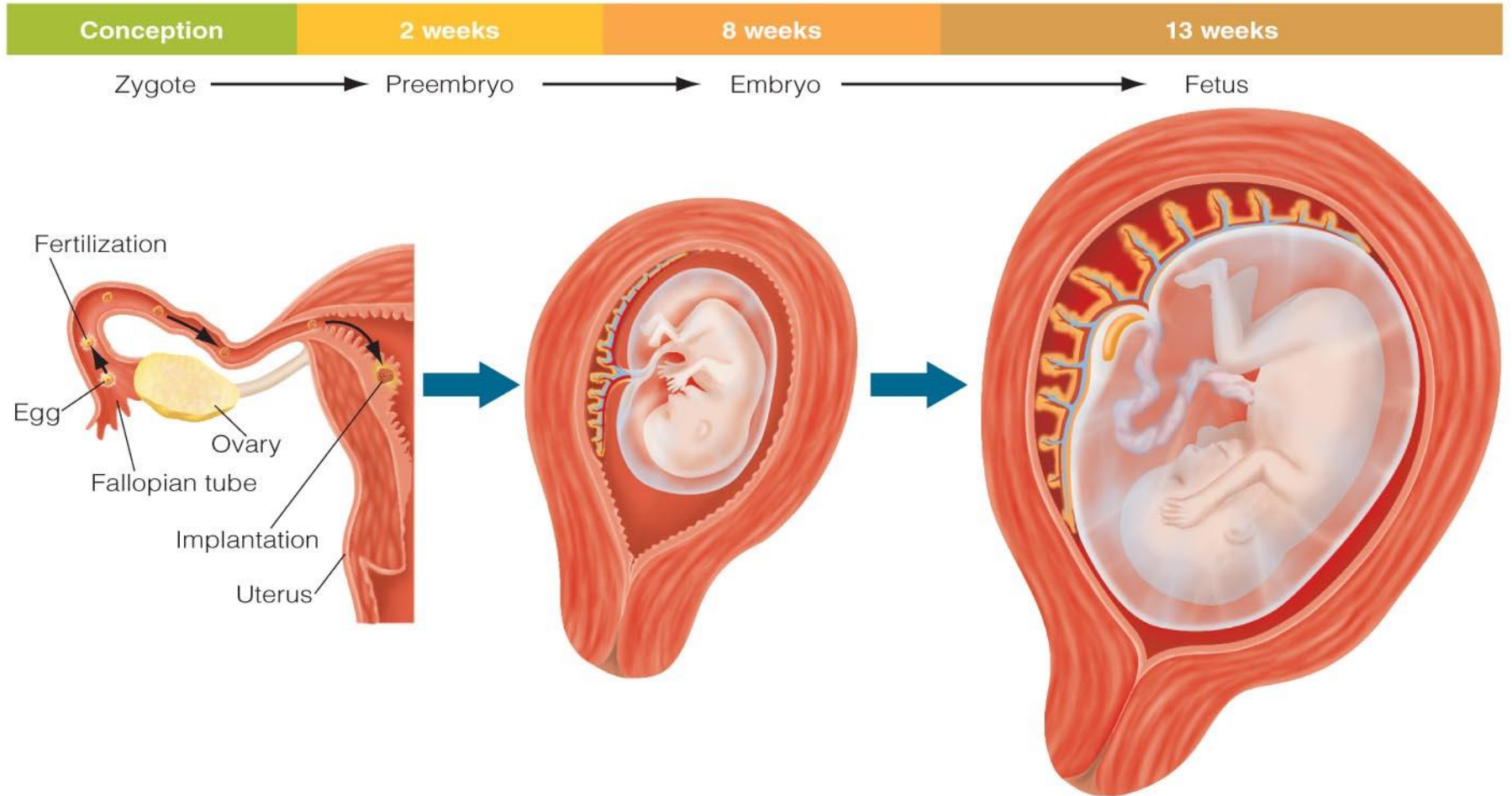


Figure 14.1

The Placenta

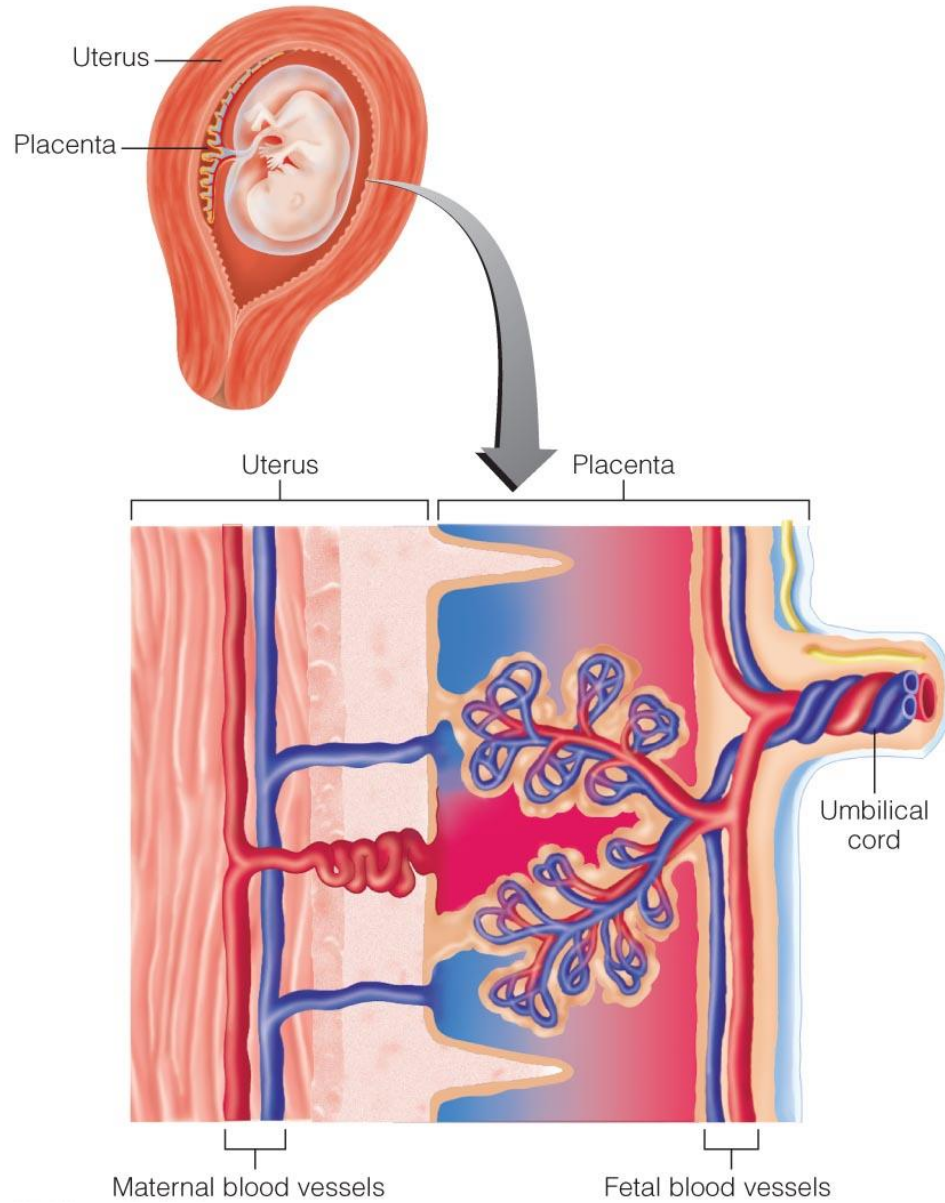


Figure 14.2

What Nutrients and Behaviors Are Most Important in the First Trimester?

- Morning sickness and cravings are common
 - Big myth of pregnancy is that morning sickness happens only in morning
 - Causes of morning sickness are unknown, but fluctuating hormone levels may play role
 - Some women develop aversion to certain foods; others have cravings
 - Pica: craving for nonfood substances, such as cornstarch, clay, dirt, baking soda

What Nutrients and Behaviors Are Most Important in the First Trimester?, Continued

- Adequate weight gain supports the baby's growth
 - Healthy women generally advised to gain 25 to 35 pounds during entire pregnancy
 - Women having twins: 37-54 pounds
 - Typical weight gain in first trimester: 1 to 4.5 pounds
 - Gaining excess weight may:
 - Make it difficult to lose weight after delivery
 - Cause overweight in mother for years
 - Increase risk that baby will be obese later in life

Recommended Weight Gain during Pregnancy

Table 14.3 Recommended Weight Gain during Pregnancy

Body Mass Index (BMI) Prior to Conception	Recommended Weight Gain for a Single Baby* (in Pounds)	Recommended Rate of Weight Gain Weekly in the Second and Third Trimesters (Mean range in pounds)
< 18.5 kg/m ² (Underweight)	28-40	1 (1.0-1.3)
18.5 – 24.9 kg/m ² (Normal weight)	25-35	1 (0.8-1.0)
25.0 – 29.9 kg/m ² (Overweight)	15-25	0.6 (0.5-0.7)
≥ 30.0 kg/m ² (Obese)	11-20	0.5 (0.4-0.6)

Note: *Suggested weight gain is higher for multiple fetuses.

Source: America College of Obstetricians and Gynecologists, "Weight Gain during Pregnancy. Committee Opinion No. 548," *Obstetrics & Gynecology* 121 (2013): 210-212.

Components of Weight Gain during Pregnancy



First trimester



Second trimester



Third trimester

**Total weight gain
25–35 lbs**

- Maternal fat stores (4–11 lbs)
- Uterus and breast (4 lbs)
- Blood (3–4 lbs)
- Fetus (7–8 lbs)
- Placenta, amniotic fluid, and other fluids (7–8 lbs)

Figure 14.3

What Nutrients and Behaviors Are Most Important in the First Trimester?, Continued-1

- The need for certain nutrients increases
 - From moment of conception, pregnant woman needs certain vitamins and minerals in higher quantities
 - Most needs can be met with diet, but some nutrients require special attention
 - Folate/folic acid: need 400 mcg/day before conception, continued after
 - Iron: supplement needed for red blood cells, anemia prevention, fetal development
 - Zinc and copper: key to baby's cell growth
 - Calcium and vitamin D: to preserve bone mass

What Nutrients and Behaviors Are Most Important in the First Trimester?, Continued-2

- Other nutrients also a concern, especially for those who eat no animal products (vegans, vegetarians)
 - Omega-3 fat DHA (in seafood) for brain, retina
 - Choline for healthy cell division, especially in brain
 - Vitamin B₁₂ (in animal foods) for nerve cells, red blood cells, production of nucleic acids
- Too much preformed vitamin A can be toxic, increase risk for birth defects
 - Limit supplements to no more than 3,000 IU/day

Nutrient Needs during Pregnancy



Nutrient	Recommended DRI for Nonpregnant Women Age 19-50 Years	Recommended Nutrient Intake during Pregnancy
Protein	46 g	71 g
Carbohydrates (minimum)	130 g	175 g
Dietary folate equivalents	400 µg	600 µg*
Thiamin	1.1 mg	1.4 mg
Riboflavin	1.3 mg	1.4 mg
Niacin equivalents	14 mg	18 mg
Vitamin B ₆	1.3-1.5 mg	1.9 mg
Vitamin B ₁₂	2.4 µg	2.6 µg
Vitamin C	75 mg	85 mg
Vitamin E	15 mg	19 mg
Vitamin A	700 µg	770 µg
Vitamin D	15 µg	15 µg
Calcium	1,000 mg	1,000 mg
Magnesium	310-320 mg	350-360 mg
Copper	900 µg	1,000 µg
Iron	18 mg	27 Mg †
Phosphorus	700 mg	700 mg
Zinc	8 mg	11 mg
Calories	2,000-2,200 ‡	§

* Dietary supplements and/or fortified foods are recommended.

† Dietary supplements are usually needed to meet iron needs.

‡ Varies depending upon activity level and weight.

§ Add 340 calories/day in second trimester; 450 calories/day in third trimester.

Figure 14.4

What Nutrients and Behaviors Are Most Important in the First Trimester?, Continued-3

- Pregnancy increases risk for foodborne illness
 - *Listeria monocytogenes* may cause miscarriage, premature labor, low birth weight, developmental problems, infant death
 - Avoid raw and undercooked meat, fish, or poultry; unpasteurized milk, cheese, juices; raw sprouts
- Pregnant women should avoid many other substances
 - Nicotine, alcohol, illicit drugs
 - Risks: SIDS, FASDS, birth defects
 - Restrict caffeine intake to 200 mg or less

Practical Nutrition Tips Video: Eating Fish

Take Care When Eating Fish

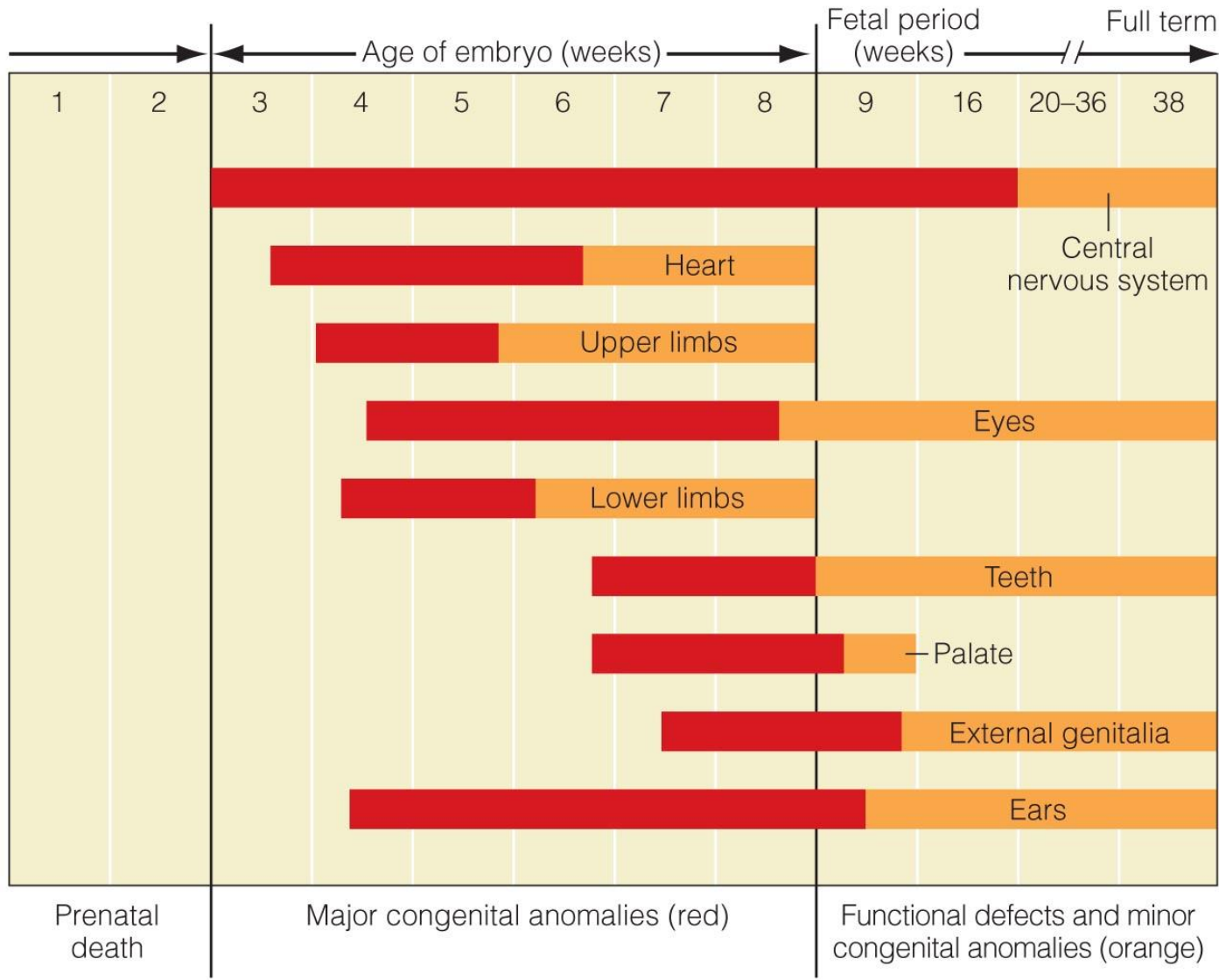
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What Nutrients and Behaviors Are Most Important in the First Trimester?, Continued-4

- The importance of critical periods
 - **Critical periods:** developmental stages in first trimester when cells and tissue rapidly grow and differentiate to form body structures
 - Embryo and fetus are highly vulnerable to nutritional deficiencies, toxins, other harmful factors
 - Risk of miscarriage is greatest

Critical Periods of Development



*Red indicates highly sensitive periods when teratogens may induce major anomalies.

Figure 14.5

What Nutrients and Behaviors Are Important in the Second Trimester?

- Pregnant women need to consume adequate calories, carbohydrate, and protein to support growth
 - Should consume 340 calories more in second trimester than before pregnancy, and gain about 1 pound/week
 - Need 175 g of carbohydrates/day (vs 130 g for nonpregnant women)
 - Protein needs increase 35 percent, to about 71 g/day, during second and third trimesters

Adding Calories and Nutrients

1 whole-wheat English muffin
2 tbs peanut butter
5 baby carrots



340

total calories

Figure 14.6

What Nutrients and Behaviors Are Important in the Second Trimester?, Continued

- Exercise is important for pregnant women
 - Should get at least 150 minutes of moderate-intensity aerobic activity per week, spread over 7 days
 - Benefits:
 - Improves weight gain within targeted ranges
 - Decreases aches and pains
 - Lessens constipation
 - Improves energy level
 - Reduces stress
 - Improves sleep
 - Lowers risk of gestational diabetes

Safe and Unsafe Exercises during Pregnancy

Table 14.4 Safe and Unsafe Exercises during Pregnancy

Safe Activities	Unsafe Activities (Contact Sports and High-Impact Activities)
Walking	Hockey (field and ice)
Stationary cycling	Basketball
Low-impact aerobics	Football
Swimming	Soccer
Dancing	Gymnastics
	Horseback riding
	Skating
	Skiing (snow and water)
	Vigorous racquet sports
	Weight lifting

Source: Adapted From T. Wang and B. Apgar, "Exercise during Pregnancy," *American Family Physician* 57 (1998). Copyright © 1998 by American Academy of family Physicians. Adapted with permission.

What Nutrients and Behaviors Are Important in the Second Trimester?, Continued-1

- Potential complications: gestational diabetes and hypertension
- **Gestational diabetes:** diabetes that occurs in women during pregnancy
 - Can result in **macrosomia:** large baby, weighing more than 8 lb, 13 oz
 - Increases risk of baby having jaundice, breathing problems, birth defects

What Nutrients and Behaviors Are Important in the Second Trimester?, Continued-2

- Pregnancy-induced hypertension includes:
 - **Gestational hypertension:** high blood pressure develops about halfway through pregnancy
 - **Preeclampsia:** includes hypertension and protein in urine, a sign of kidney damage
 - Treatment includes bed rest, medication, even hospitalization until baby can be safely delivered
 - If untreated, can lead to eclampsia
 - **Eclampsia:** can cause seizures in mother and is major cause of death of women during pregnancy

What Nutrients and Behaviors Are Important in the Third Trimester?

- Women should be taking in 450 extra calories/day and gaining about 1 pound/week
 - Growing baby puts pressure on stomach and intestines; hormones slow food through GI tract
 - Heartburn and constipation may result
 - Small, frequent meals and avoiding spicy foods can help heartburn
 - More fiber-rich foods can help prevent constipation
 - Hemorrhoids may also develop

What Special Concerns Might Younger or Older Mothers-to-Be Face?

- Pregnant teenagers face special challenges: still growing and likely to have unbalanced diets
 - May be short on iron, folic acid, calcium, and calories
 - Higher risk of pregnancy-induced hypertension, premature and low birth weight babies
- Women older than 35 more likely to develop diabetes and hypertension
 - Achieve healthy weight prior to conception, avoid smoking, eat balanced diet, consume adequate folic acid

What Is Breast-Feeding and Why Is It Beneficial?

- **Lactation:** production of breast milk in woman's body after childbirth
 - Prolactin causes milk to be produced
 - Oxytocin causes milk to be released (let down)
- Breast-feeding provides physical, emotional, and financial benefits for mothers
 - Breast-feeding helps with pregnancy recovery; reduces risk of some chronic diseases
 - Breast milk is less expensive, more convenient than formula
 - Breast-feeding promotes bonding with baby

The Let-Down Response



Figure 14.7

What Is Breast-Feeding and Why Is It Beneficial?, Continued

- Breast-feeding provides nutritional and health benefits
 - Breast milk is best for an infant's unique nutritional needs
 - Composition of breast milk changes as infant grows
 - **Colostrum:** fluid produced after birth that contains antibodies, protein, minerals, vitamin A
 - Breast milk is high in lactose, fat, B vitamins
 - Low in protein and in more digestible form: alpha-lactalbumin

What Is Breast-Feeding and Why Is It Beneficial?, Continued-1

- Breast-feeding protects against infections, allergies, and chronic diseases and may enhance brain development
 - Decreases risk and severity of diarrhea; meningitis; respiratory, ear, and urinary tract infections
 - Lactoferrin protein protects against bacteria, viruses
 - May reduce risk of childhood obesity
 - May help infant's intellectual development
 - Two fatty acids, DHA and AA, aid nervous system, brain development

What Are the Best Dietary and Lifestyle Habits for a Breast-Feeding Mother?

- In first 6 months, mother produces ~24 oz of breast milk/day; in second 6 months ~16 oz/day
 - Mother needs about 13 cups of fluids/day
 - Extra calories needed:
 - First 6 months: 500/day (170 from fat stores, 330 from food)
 - Second 6 months: 400/day
 - Well-balanced diet should be similar to diet during pregnancy
 - Avoid alcohol and illicit drugs, limit caffeine, and follow FDA's guidelines on fish consumption

When Is Infant Formula a Healthy Alternative to Breast Milk?

- Some women may not be able to breast-feed
 - Women with HIV, AIDS, human T-cell leukemia, or active tuberculosis; receiving chemotherapy and/or radiation; or using illegal drugs should not breast-feed
 - Infants with galactosemia cannot metabolize lactose and should not be breast-fed
 - Women taking prescription medications should check with health care provider regarding safety

When Is Infant Formula a Healthy Alternative to Breast Milk?, Continued

- Formula is the best alternative to breast-feeding
 - Cow's milk doesn't meet nutritional needs
 - Too high in potassium and sodium
 - Too low in fat and linoleic acid
 - Iron is poorly absorbed
 - Infant formula is as similar as possible to breast milk
 - Regulated by FDA: sets nutrient requirements
 - Made from cow's milk (altered to improve nutrient content and availability) or soy protein
 - Powdered, concentrated liquid, or ready-to-use

Nutritional Similarities between Infant Formula and Breast Milk

Table 14.5 Nutritional Similarities between Infant Formula and Breast Milk

Nutrient	Amount in Breast Milk	Amount in Formula
Protein (g/100 ml)	1.1	1.8
Fat (g/100 ml)	4	4.8
Carbohydrate (g/100 ml)	7	7.3
Sodium (mg/100 ml)	1.3	0.7
Calcium (mg/100 ml)	22	53
Phosphorus (mg/100)	14	38
Iron (mg/100 ml)	0.03	0.1
Zinc (mg/100 ml)	3.2	5.1
Vitamin D (IU/100 ml)	4	41

Table 14.5

What Are the Nutrient Needs of an Infant and Why Are They So High?

- Infants grow at an accelerated rate
 - Double birth weight by about 6 months of age; triple by 12 months
- Monitoring infant growth
 - Infants not receiving adequate nutrition may have difficulty reaching milestones
 - Failure to thrive (FTT): delayed in physical growth or size or does not gain enough weight
 - Growth charts track physical development.
 - Head circumference, length, weight, and weight for length measures used to assess growth

Foods for Baby's First Year

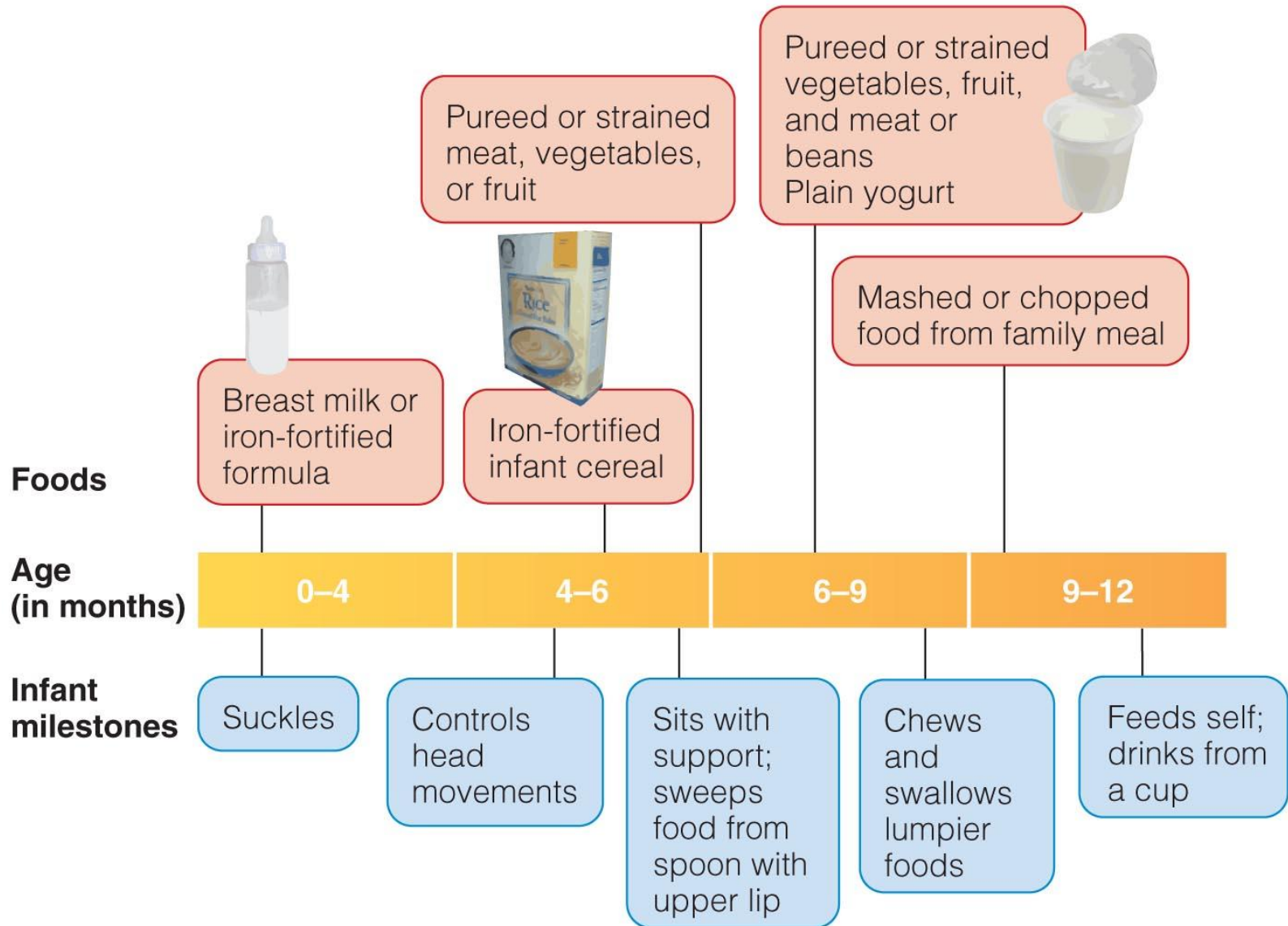


Figure 14.9

Growth Chart

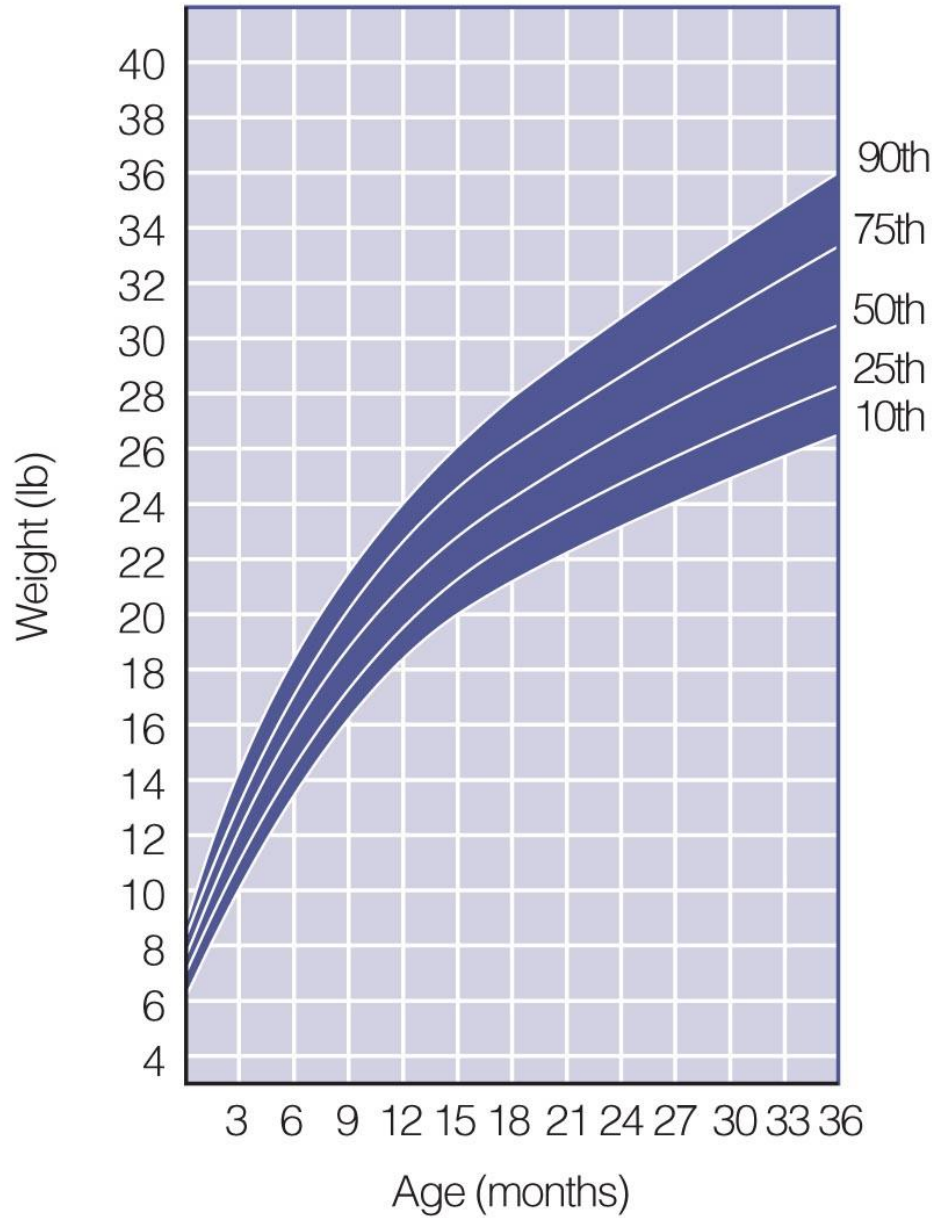


Figure 14.10

What Are the Nutrient Needs of an Infant and Why Are They So High?, Continued

- Infants have higher nutrient needs
 - 82 calories/kg of body weight for first 6 months
 - Need for increased carbohydrate and protein with age
 - Fat and overall calories should not be limited
 - Vitamin K injection needed due to sterile gut
 - Vitamin D drops needed (not enough in breast milk to prevent rickets)
 - Iron-rich foods (fortified cereals, puréed meats) should be introduced at 6 months
 - Vitamin B₁₂ may be needed if mother's diet is deficient
 - May need fluoride if not in water used for formula

ABC News Video: GMA Investigates Baby Food Labels



When Are Solid Foods Safe?

- Solid foods may be introduced once certain milestones are met
 - Infant needs to be nutritionally ready: at 6 months old, infant iron stores depleted
 - Infant needs to be physiologically ready
 - GI tract and kidneys cannot process solid foods in early infancy
 - Doubled birth weight to at least 13 pounds
 - Tongue-thrust reflex has faded (4 to 6 months)
 - Swallowing skills have matured adequately
 - Has head and neck control, able to sit with support

Feeding the Baby

- Natural mechanisms help newborns eat
 - Rooting reflex
 - Suck/swallow reflex
 - Tongue-thrust reflex
 - Gag reflex
- Infants should eat when hungry, not on set schedule
 - Cues include waking/tossing, sucking on fist, crying/fussing

When Are Solid Foods Safe?, Continued

- Solid foods should be introduced gradually
 - First puréed, then mashed
 - Puréed meat, fortified rice cereal are good first foods
 - Parents should be patient; infants often reject food at first
 - Commercial baby foods are of high quality, but homemade food may be cheaper

When Are Solid Foods Safe?, Continued-1

- Some foods are dangerous for infants and should be avoided
 - Certain foods, such as hot dog rounds or raw carrots, may present choking hazard
 - Food allergens (dangerous for those with allergies)
 - Honey may contain bacteria that causes botulism, which can be fatal
 - Fruit juices may contribute unneeded calories, displace other nutritious foods
 - Overabundance of breast milk and infant formula may decrease interest in other foods important for growth

A Taste Could Be Dangerous: Food Allergies

- **Food allergy:** abnormal reaction by immune system to a particular food
 - Two stages: sensitization and allergic reaction
 - Reactions can occur with minimal exposure
 - Symptoms: vomiting, diarrhea, hives, asthma
 - Anaphylactic reactions are life-threatening
 - Common sources in children: eggs, milk, peanuts
- **Food intolerance:** adverse reaction to a food that does not involve immune response
 - Example: lactose intolerance

Immune Response to a Food Allergy

Stage 1: Sensitization

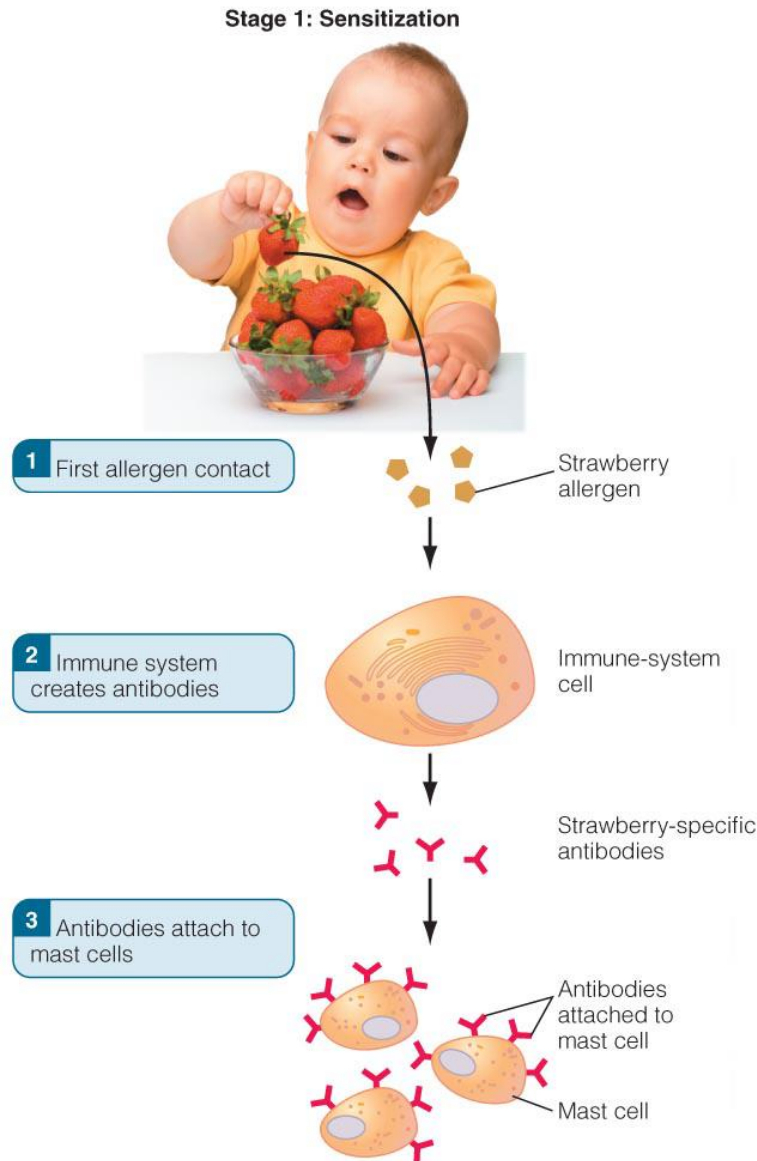


Figure 14.11 (1 of 2)

Immune Response to a Food Allergy

Stage 2: Allergic Reaction

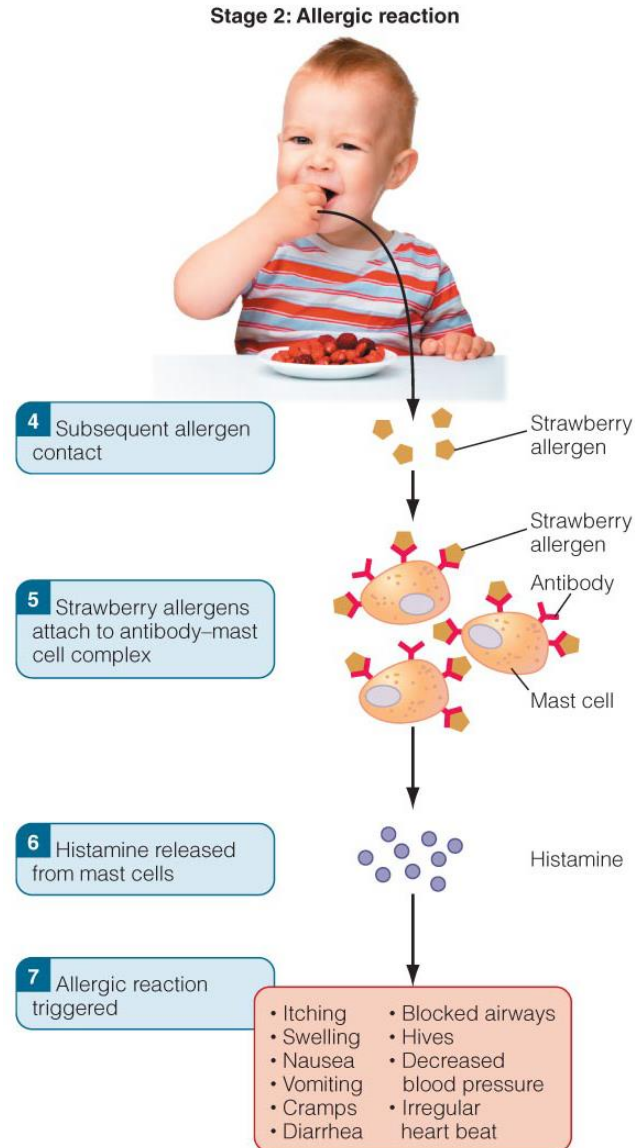


Figure 14.11 (2 of 2)

Summary of Nutritional Guidelines






 Prior to conception	 First trimester	 Second trimester	 Third trimester	 First year
Father <ul style="list-style-type: none"> • Stop smoking • Limit alcohol • Maintain a healthy weight • Consume a balanced diet 				
Mother <ul style="list-style-type: none"> • Consume a balanced diet • Maintain a healthy weight • Add folic acid to diet • Limit caffeine • Avoid certain fish with high levels of methylmercury • Avoid alcohol, herbs, illicit drugs, and smoking • Exercise regularly 	<ul style="list-style-type: none"> • Consume a balanced diet • Continue getting folic acid • Take an iron-rich supplement • Limit caffeine • Avoid too much vitamin A • Avoid foodborne illness • Continue exercising 	<ul style="list-style-type: none"> • Consume a balanced diet with adequate calories for growth • Continue exercising 	<ul style="list-style-type: none"> • Consume a balanced diet with adequate calories for growth • Eat frequent small meals if more comfortable • Choose high-fiber foods • Drink plenty of fluids • Continue nonimpact exercises 	<ul style="list-style-type: none"> • Consume a balanced diet with adequate calories and fluids for breast-feeding • Nursing mothers should avoid illicit drugs, smoking, and alcohol • Limit caffeine • Avoid certain fish with high levels of methylmercury

Figure 14.12

Summary of Nutritional Guidelines, Continued

Baby				<ul style="list-style-type: none">• Supplement diet with vitamins K and D and sources of iron or iron-fortified foods• Avoid common food allergens, honey, and herbal tea• Consume breast milk or formula as primary source of calories• Do not start drinking cow's milk until after this year• Introduce solid foods gradually and one at a time• Avoid too much fiber and excessive amounts of juice
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