Chapter 15
Nutrition in Pregnancy
Prior To Pregnancy

- Goals:
  - Achieve and maintain a healthy body weight
  - Choose an adequate and balanced diet
  - Be physically active
  - Receive regular medical care
  - Manage chronic conditions
  - Avoid harmful influences
Growth and Development during Pregnancy

- Placental Development
  - Takes place in the uterus, a muscular organ
  - The amniotic sac is the fluid-filled balloon-like structure that holds the fetus.
  - The umbilical cord is a ropelike structure that delivers nutrients and oxygen and removes waste from the fetus. The umbilicus is the “belly button.”
  - The placenta performs the functions of respiration, absorption, and excretion for the fetus.
The arrows indicate the direction of blood flow.

In the placenta, maternal blood vessels lie side by side with fetal blood vessels that reach the fetus through the umbilical cord.

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Fig. 15-1, p. 471
Stages of Embryonic and Fetal Development

1. A newly fertilized ovum is called a **zygote** and is about the size of a period at the end of this sentence. Less than one week after fertilization, these cells have rapidly divided multiple times and are ready for implantation.

2. After implantation, the placenta develops and begins to provide nourishment to the developing embryo. An **embryo** 5 weeks after fertilization is about \( \frac{1}{2} \) inch long.

3. A **fetus** after 11 weeks of development is just over an inch long. Notice the umbilical cord and blood vessels connecting the fetus with the placenta.

4. A **newborn infant** after nine months of development measures close to 20 inches in length. From 8 weeks to term, this infant grew 20 times longer and 50 times heavier.
After implantation, the placenta develops and begins to provide nourishment to the developing embryo. An embryo five weeks after fertilization is about 1/2 inch long.
At 8 weeks, a fetus has a complete central nervous system, a beating heart, a digestive system, well defined fingers and toes, the beginnings of facial features. It is just over an inch long. Notice the umbilical cord and blood vessels connecting the fetus with the placenta.
Growth and Development during Pregnancy

- Critical periods are finite periods of intense development and rapid cell division.
  - The development of each organ and tissues is most vulnerable to adverse influences during its own critical period
- Neural Tube Defects
  - The critical period is 17-30 days gestation.
  - Anencephaly affects brain development.
  - Spina bifida can lead to paralysis or meningitis.
Concept of Critical Periods

An adverse influence felt late temporarily impairs development, but a full recovery is possible.

Normal development

An adverse influence felt early permanently impairs development, and a full recovery never occurs.

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Growth and Development During Pregnancy

- Neural tube defects
- Neural tube becomes brain and spinal cord
  - Critical period is 17-30 days gestation
- Anacephaly
  - Brain either missing or fails to develop
- Spina bifida
  - Incomplete closure of spinal cord & its bony encasement
- Cause is unknown
- Folate supplementation reduces the risk
At 4 weeks, the neural tube has yet to close (notice the gap at the top).

At 6 weeks, the neural tube (outlined by the delicate red vertebral arteries) has successfully closed.
Spina Bifida
Growth and Development during Pregnancy

- Neural Tube Defects
  - Risk Factors that increase occurrence of neural tube defects
    - Previous pregnancy with neural tube defects
    - Maternal diabetes
    - Maternal use of antiseizure medications
    - Maternal obesity
    - Exposure to high temperatures early on in pregnancy
    - Race/ethnicity
    - Low socioeconomic status
Folate Supplement

- Folate supplement taken 1 month before and during the 1st trimester can help prevent neural tube defects
- Women of childbearing age capable of becoming pregnant should consume 400 mcg of folate daily
- Grains in the U.S. are fortified with folate
Maternal Weight

- The **birthweight of the infant** is the most reliable indicator of an infant's health.

- Underweight infant:
  - physical and mental defects
  - has higher mortality risk than a normal weight infant.

- A mother’s weight prior to conception and weight gain during pregnancy will influence an infant’s birth weight.
Maternal Weight

- Weight Prior to Conception
  - Underweight
    - Tend to have lower birth weight babies
    - Higher rates of preterm (premature <38 weeks) infants and infant deaths
    - Term infant is born between 38 and 42 weeks of pregnancy
Maternal Weight

- Weight Prior to Conception
  - Overweight and Obesity
    - Tend to be born post term (>42 weeks)
    - Tend to be greater than 9 pounds at birth (macrosomia)
    - More difficult labor and delivery, birth trauma, and cesarean sections
    - Higher risk for neural tube defects, heart defects and other abnormalities
    - Weight loss should be postponed until after delivery.
# Recommended Weight Gains

## TABLE 15-1 Recommended Weight Gains Based on Prepregnancy Weight

<table>
<thead>
<tr>
<th>Prepregnancy Weight</th>
<th>For single birth</th>
<th>For twin birth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight (BMI &lt;18.5)</td>
<td>28 to 40 lb</td>
<td>Insufficient data to make recommendation</td>
</tr>
<tr>
<td></td>
<td>(12.5 to 18.0 kg)</td>
<td></td>
</tr>
<tr>
<td>Healthy weight (BMI 18.5 to 24.9)</td>
<td>25 to 35 lb</td>
<td>37 to 54 lb</td>
</tr>
<tr>
<td></td>
<td>(11.5 to 16.0 kg)</td>
<td>(17.0 to 25.0 kg)</td>
</tr>
<tr>
<td>Overweight (BMI 25.0 to 29.9)</td>
<td>15 to 25 lb</td>
<td>31 to 50 lb</td>
</tr>
<tr>
<td></td>
<td>(7.0 to 11.5 kg)</td>
<td>(14.0 to 23.0 kg)</td>
</tr>
<tr>
<td>Obese (BMI ≥30)</td>
<td>11 to 20 lb</td>
<td>25 to 42 lb</td>
</tr>
<tr>
<td></td>
<td>(5.0 to 9.0 kg)</td>
<td>(11.0 to 19.0 kg)</td>
</tr>
</tbody>
</table>

Recommended Prenatal Weight Gain based on Pregnancy Weight

**Normal-weight women** should gain about 3lb pounds in the first trimester and just under 1 pound/week thereafter, achieving a total gain of 25 to 35 pounds by term.

**Underweight women** should gain about 5 pounds in the first trimester and just over 1 pound/week thereafter, achieving a total gain of 28 to 40 pounds by term.

**Overweight women** should gain about 2 pounds in the first trimester and 2lb pound/week thereafter, achieving a total gain of 15 to 25 pounds.

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Components of Weight Gain during Pregnancy

- Increase in breast size: 2 lb
- Increase in mother’s fluid volume: 4 lb
- Placenta: 1 1/2 lb
- Increase in blood supply to the placenta: 4 lb
- Amniotic fluid: 2 lb
- Infant at birth: 7 1/2 lb
- Increase in size of uterus and supporting muscles: 2 lb
- Mother’s necessary fat stores: 7 lb

Total weight gain: 30 lb
Maternal Weight

- Weight loss after pregnancy
  - Return to prepregnancy weight
    - Not typical
  - Retain a couple of pounds with each pregnancy
  - Seven or more pounds; BMI increase 1 unit
    - Diabetes and hypertension
    - Chronic diseases later in life
Exercise in Pregnancy

- Low impact aerobic activities
- Avoid sports in which you can fall or be injured
- Avoid high body temperatures and dehydration

Pregnant women can enjoy the benefits of exercise.
Nutrition Needs in Pregnancy

Energy:
- 340 kcal/day in 2\textsuperscript{nd} trimester
- 450 kcal/day in the 3\textsuperscript{rd} trimester

Protein:
- Additional 25 grams
- Generally can easily get from foods
- Supplementation is not recommended
Nutrition Needs in Pregnancy

Nutrients for Blood Production & Cell Growth

- Folate - 600 mcg/day
- B12 - 2.6 mcg/day
- Iron - 27 mg/day 2nd and 3rd trimester
  - Menstruation ceases, absorption increases
  - Supplement is recommended for 2\textsuperscript{nd} and 3\textsuperscript{rd} trimester
- Zinc - 11 mg/day
Nutrient Needs in Pregnancy

- Nutrients for Bone Development:
  - Vitamin D- Sunlight and fortified milk
  - Calcium- AI is 1000 mg
    - Calcium absorption more than doubles
    - In last trimester, as fetal bones calcify, 300 mg/day are transferred to fetus
    - 600 mg supplement needed if mom unable to meet calcium needs (3 servings milk/day)
Example of a Prenatal Supplement

Supplement Facts
Serving Size 1 Tablet

<table>
<thead>
<tr>
<th>Amount Per Tablet</th>
<th>% Daily Value for Pregnant/ Lactating Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A 4000 IU</td>
<td>50%</td>
</tr>
<tr>
<td>Vitamin C 100 mg</td>
<td>167%</td>
</tr>
<tr>
<td>Vitamin D 400 IU</td>
<td>100%</td>
</tr>
<tr>
<td>Vitamin E 11 IU</td>
<td>37%</td>
</tr>
<tr>
<td>Thiamin 1.84 mg</td>
<td>108%</td>
</tr>
<tr>
<td>Riboflavin 1.7 mg</td>
<td>85%</td>
</tr>
<tr>
<td>Niacin 18 mg</td>
<td>90%</td>
</tr>
<tr>
<td>Vitamin B6 2.6 mg</td>
<td>104%</td>
</tr>
<tr>
<td>Folate 800 mcg</td>
<td>100%</td>
</tr>
<tr>
<td>Vitamin B12 4 mcg</td>
<td>50%</td>
</tr>
<tr>
<td>Calcium 200 mg</td>
<td>15%</td>
</tr>
<tr>
<td>Iron 27 mg</td>
<td>150%</td>
</tr>
<tr>
<td>Zinc 25 mg</td>
<td>167%</td>
</tr>
</tbody>
</table>

INGREDIENTS: calcium carbonate, microcrystalline cellulose, dicalcium phosphate, ascorbic acid, ferrous fumarate, zinc oxide, acacia, sucrose, ester, niacinamide, modified cellulose gum, dl-alpha tocopheryl acetate, hydroxypropyl methylcellulose, hydroxypropyl cellulose, artificial colors (FD&C blue no. 1 lake, FD&C red no. 40 lake, FD&C yellow no. 5 lake, titanium dioxide), polyethylene glycol, starch, pyridoxine hydrochloride, vitamin A acetate, riboflavin, thiamin mononitrate, folic acid, beta carotene, cholecalciferol, maltodextrin, gluten, cyanocobalamin, sodium bisulfite.
Common Nutrition-Related Concerns of Pregnancy

- Nausea
  - “Morning sickness”
  - Hormonal changes
- Constipation and hemorrhoids
- Heartburn
- Food cravings and aversions
  - Hormone-induced changes
- Nonfood cravings
  - Pica- cravings for ice, clay, dirt
  - Associated with iron deficiency anemia
Strategies to Alleviate Maternal Discomforts

<table>
<thead>
<tr>
<th>To Alleviate the Nausea of Pregnancy</th>
<th>To Prevent or Alleviate Constipation</th>
<th>To Prevent or Relieve Heartburn</th>
</tr>
</thead>
<tbody>
<tr>
<td>- On waking, arise slowly.</td>
<td>- Eat foods high in fiber (fruits, vegetables, and whole grains).</td>
<td>- Relax and eat slowly.</td>
</tr>
<tr>
<td>- Eat dry toast or crackers.</td>
<td>- Exercise regularly.</td>
<td>- Chew food thoroughly.</td>
</tr>
<tr>
<td>- Chew gum or suck hard candies.</td>
<td>- Drink at least eight glasses of liquids a day.</td>
<td>- Eat small, frequent meals.</td>
</tr>
<tr>
<td>- Eat small, frequent meals.</td>
<td>- Respond promptly to the urge to defecate.</td>
<td>- Drink liquids between meals.</td>
</tr>
<tr>
<td>- Avoid foods with offensive odors.</td>
<td>- Use laxatives only as prescribed by a physician; do not use mineral oil, because it interferes with absorption of fat-soluble vitamins.</td>
<td>- Avoid spicy or greasy foods.</td>
</tr>
<tr>
<td>- When nauseated, drink carbonated beverages instead of citrus juice, water, milk, coffee, or tea.</td>
<td></td>
<td>- Sit up while eating; elevate the head while sleeping.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Wait 3 hours after eating before lying down.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Wait 2 hours after eating before exercising.</td>
</tr>
</tbody>
</table>
High Risk Pregnancy

- Infants Birth Weight
  - Low birth weight -5 1/2 pounds or less
    - May result with high-risk pregnancy
    - Immature lungs
    - May have complications in delivery
    - Greater risk of physical or mental problems
  - 2/3 of the infants that die before their 1st birthday are low birth weight
# High-Risk Pregnancy Factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>Condition that Raises Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal weight</td>
<td></td>
</tr>
<tr>
<td>• Prior to pregnancy</td>
<td>Prepregnancy BMI either &lt;18.5 or ≥25</td>
</tr>
<tr>
<td>• During pregnancy</td>
<td>Insufficient or excessive pregnancy weight gain (see Table 15-1)</td>
</tr>
<tr>
<td>Maternal nutrition</td>
<td>Nutrient deficiencies or toxicities; eating disorders</td>
</tr>
<tr>
<td>Socioeconomic status</td>
<td>Poverty, lack of family support, low level of education, limited food available</td>
</tr>
<tr>
<td>Lifestyle habits</td>
<td>Smoking, alcohol or other drug use</td>
</tr>
<tr>
<td>Age</td>
<td>Teens, especially 15 years or younger; women 35 years or older</td>
</tr>
<tr>
<td>Previous pregnancies</td>
<td></td>
</tr>
<tr>
<td>• Number</td>
<td>Many previous pregnancies (3 or more to mothers younger than age 20; 4 or more to mothers age 20 or older)</td>
</tr>
<tr>
<td>• Interval</td>
<td>Short or long intervals between pregnancies (&lt;18 months or &gt;59 months)</td>
</tr>
<tr>
<td>• Outcomes</td>
<td>Previous history of problems</td>
</tr>
<tr>
<td>• Multiple births</td>
<td>Twins or triplets</td>
</tr>
<tr>
<td>• Birthweight</td>
<td>Low- or high-birthweight infants</td>
</tr>
<tr>
<td>Maternal health</td>
<td></td>
</tr>
<tr>
<td>• High blood pressure</td>
<td>Development of gestational hypertension</td>
</tr>
<tr>
<td>• Diabetes</td>
<td>Development of gestational diabetes</td>
</tr>
<tr>
<td>• Chronic diseases</td>
<td>Diabetes; heart, respiratory, and kidney disease; certain genetic disorders; special diets and medications</td>
</tr>
</tbody>
</table>
Malnutrition and Pregnancy

- Reduced fertility
- Malnutrition prior to and around conception prevents the placenta from fully developing
- Impairs fetal growth and infant health
  - Growth retardation, birth defects, miscarriage, stillbirth, premature birth, low birthweight
Food Assistance Programs

- WIC- Supplemental food program for women, infants, and children
- Provides nutrition education and nutritious food to infants, children up to age 5, pregnant and breastfeeding women, who have a financial need and nutrition or medical problem
- Includes foods such as tuna, eggs, milk, iron-fortified cereal, juice, cheese, legumes, peanut butter, infant formula
Benefits of WIC

- Earlier prenatal care
- Better diet during pregnancy
- Better weight gain
- Longer duration of pregnancy
- Fewer low birthweights
- Better growth in infants and children
- Less iron deficiency anemia in children
- Improved intellectual development
Mother’s Age

Adolescents:
- >400,000 adolescent pregnancies in U.S. annually
- Problems include anemia
- Higher rates of:
  - still births
  - preterm births
  - low birth weight infants

Recommendation:
- 35 lb weight gain
- Prenatal care
- WIC
Older Women

Women over the age of 35:
- Preterm and low birth weight
- More C-Sections
- Genetic abnormalities
- Birth defects
- Growth retardation
Practices Incompatible with Pregnancy

- Alcohol: Fetal alcohol syndrome
- Medicinal Drugs: Consult with M.D.
- Herbal Supplements: Consult with M.D.
- Illicit Drugs: Cross placental barrier
  Impair fetal growth
  Pre-term, LBW, SID
High-Risk Pregnancies
Practices Incompatible with Pregnancy

- **Smoking and Chewing Tobacco**
  - Restricts blood supply and limits oxygen and nutrients to the baby
    - Fetal growth retardation
    - Low birthweight
    - Complications at birth

- Mislocation of the placenta
- Premature separation of the placenta
- Vaginal bleeding
- Spontaneous bleeding
- Fetal death
- Sudden infant death syndrome (SIDS)
- Middle ear diseases
- Cardiac and respiratory diseases
Placenta Previa, and Effect of Smoking During Pregnancy
Practices Incompatible with Pregnancy

- Vitamins/Mineral Mega-doses:
  - Vitamin A - Malformations
- Environmental Contaminants
  - Avoid shark, swordfish, king mackerel, tilefish
  - Limit other fish to 12 ounces/week or 6 ounces of white albacore tuna
- Caffeine:
  - Heavy use (3 or more cups of coffee) may increase risk of miscarriage
    - Limit caffeine to 1 cup of coffee or 2 cups of cola
- Weight Loss Dieting: Hazardous
- Sugar substitutes:
  - Use in moderation
Facial Characteristics of FAS

- Head: Small head size
- Forehead: Narrow, receding forehead
- Nose: Short upturned nose, flattened nose bridge
- Jaw: Underdeveloped jaw, receding chin, receding or flattened upper jaw
- Eyes: Extra skin folds on eyelids, drooping eyelids, downward slant of eyes, unusually small eyes and/or eye openings, short-sightedness, inability to focus ("wandering eyes")
- Lips: Absence of groove in upper lip, flat upper lip, thin upper lip
- Ears: Uneven in placement and size, poorly formed outer ear, backward curve

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Fetal Alcohol Syndrome
Nutrient Needs in Lactation

Energy:

- Need to produce 25 oz milk
- At least 1800 kcal/day
- Extra 330 kcal day 1st 6 months
- Extra 400 kcal day 2nd 6 months

Vitamins and Minerals:

- Nutrient inadequacies reduce the quantity not quality of milk
- Milk quality is maintained at the expense of maternal stores
- May need an iron supplement
# Benefits of Breastfeeding

**TABLE 15-4 Benefits of Breastfeeding**

<table>
<thead>
<tr>
<th>For Infants</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Provides the appropriate composition and balance of nutrients with high bioavailability</td>
</tr>
<tr>
<td>- Provides hormones that promote physiological development</td>
</tr>
<tr>
<td>- Improves cognitive development</td>
</tr>
<tr>
<td>- Protects against a variety of infections and illnesses, including diarrhea, ear infections, and pneumonia</td>
</tr>
<tr>
<td>- May protect against some chronic diseases—such as diabetes (both types), obesity, atherosclerosis, asthma, and hypertension—later in life</td>
</tr>
<tr>
<td>- Protects against food allergies</td>
</tr>
<tr>
<td>- Reduces the risk of SIDS</td>
</tr>
<tr>
<td>- Supports healthy weight</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>For Mothers</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Contracts the uterus</td>
</tr>
<tr>
<td>- Delays the return of regular ovulation, thus lengthening birth intervals (this is not, however, a dependable method of contraception)</td>
</tr>
<tr>
<td>- Conserves iron stores (by prolonging amenorrhea)</td>
</tr>
<tr>
<td>- May protect against breast and ovarian cancer and reduce the risk of diabetes (type 2)</td>
</tr>
<tr>
<td>- Increases energy expenditure, which may contribute to weight loss</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Cost and time savings from not needing medical treatment for childhood illnesses or leaving work to care for sick infants</td>
</tr>
<tr>
<td>- Cost and time savings from not needing to purchase and prepare formula (even after adjusting for added foods in the diet of a lactating mother)</td>
</tr>
<tr>
<td>- Environmental savings to society from not needing to manufacture, package, and ship formula and dispose of the packaging</td>
</tr>
<tr>
<td>- Convenience of not having to shop for and prepare formula</td>
</tr>
</tbody>
</table>

*Estimated savings of $1200–$1500 in the first year.*
# Tips for Successful Breastfeeding

**TABLE 15-5** Tips for Successful Breastfeeding

- Learn about the benefits of breastfeeding
- Initiate breastfeeding within 1 hour of birth
- Ask a health-care professional to explain how to breastfeed and how to maintain lactation
- Give newborn infants no food or drink other than breast milk, unless medically indicated
- Breastfeed on demand
- Give no artificial nipples or pacifiers to breastfeeding infants\(^a\)
- Find breastfeeding support groups, books, or websites to help troubleshoot breastfeeding problems

\(^a\)Compared with nonusers, infants who use pacifiers breastfeed less frequently and stop breastfeeding at a younger age.
Nutrient Needs in Lactation

Water

Nutrient supplements:
- Well balanced diet is adequate
- May need iron to replace stores.

Particular foods:
- Strong flavors may alter breast milk flavor
Substances that Enter Breast Milk

- Alcohol
- Medicinal Drugs
- Illicit Drugs
- Tobacco
- Environmental Contaminants
- Caffeine
End of Chapter 15
Nutrition in Pregnancy