

Nutrition-Related Special Concerns of Adolescent Pregnancy

Irene Alton

This chapter addresses nutrition-related concerns of pregnancy, specifically:

- Iron Deficiency Anemia
- Diabetes Mellitus
- Hypertensive Disorders
- Pica
- Eating Disorders

IRON DEFICIENCY ANEMIA

Iron deficiency anemia is the final and most severe stage of iron deficiency. It is characterized by hypochromic, microcytic red blood cells, a decreased hemoglobin and hematocrit level and a reduction in oxygen delivery to body cells and tissues. The Centers for Disease Control criteria for anemia in pregnancy,¹ which are based on indices from iron-supplemented pregnant women, are listed in Table 1.

PREVALENCE

Iron deficiency anemia occurs in approximately 11% of adolescents during the first, and 16% during the

second trimester of pregnancy.² The prevalence of iron deficiency, which precedes anemia, is higher.³

CONTRIBUTING FACTORS

Physiologic Changes in Blood Volume

- Beginning early in pregnancy and continuing throughout the 34th to 37th week of gestation, maternal plasma volume rapidly increases to 40–50% above prepregnant levels.
- A disproportionate expansion in red cell mass (20% with, and 15–18% without iron supplementation), occurs later in pregnancy, peaking at 20–25 weeks gestation.⁴
- “Dilution” of circulating red cells results in a fall in hemoglobin level until approximately 16 weeks, which increases by 24 weeks gestation if iron status is adequate.⁵
- Hemoglobin levels above 15 g/dL or hematocrit levels above 45% during the second or third trimester may indicate inadequate blood volume expansion, and have been associated with lower infant birth-weight.^{1,5}

TABLE 1
Cutoff Values for
Anemia in Pregnancy

Trimester	Hemoglobin (g/dL)	Hematocrit (%)
First	11.0	33.0
Second	10.5	32.0
Third	11.0	33.0

Altitude above 3,000 feet raises the cutpoint for anemia because of lower oxygen partial pressure, a reduction in oxygen saturation of blood and an increase in red cell production.

Altitude (feet)	Hemoglobin (g/dL)	Hematocrit (%)
3,000 – 4,000	+0.2	+0.5
4,000 – 5,000	+0.3	+1.0
5,000 – 6,000	+0.5	+1.5
6,000 – 7,000	+0.7	+2.0
7,000 – 8,000	+1.0	+3.0
8,000 – 9,000	+1.3	+4.0

Cigarette smoking also raises the cutpoint for anemia since carboxyhemoglobin formed from carbon monoxide during cigarette smoking has no oxygen carrying capacity. The effect of cigarette smoking and altitude on anemia cutpoints is additive.

Number of Cigarettes/day	Hemoglobin (g/dL)	Hematocrit (%)
10 – 19	+0.3	+1.0
20 – 39	+0.5	+1.5
40 +	+0.7	+2.0

Source: Centers for Disease Control and Prevention. Recommendations to prevent and control iron deficiency in the United States. MMWR 1998;47:1-29.

Increased Iron Demands

- The total iron requirement of a singleton pregnancy is approximately 840 mg.⁵ This estimate is based on placental and fetal iron content, fetal hemoglobin synthesis, maternal basal losses, and the expansion and contraction of maternal red cell mass during pregnancy and the postpartum period (Table 2).

TABLE 2
Iron Requirements in Pregnancy (mg)

Fetal, placental iron needs	350
Maternal red cell expansion	450
Maternal excretion	240
Maternal blood loss at delivery (vaginal birth)	250
Postpartum maternal contraction of red cell mass	- 450
Total	840

- Iron needs increase throughout pregnancy and are estimated to be 5.6 mg of absorbed iron per day during the second and third trimesters.⁶

Low or Absent Iron Stores

Many adolescents are likely to begin pregnancy with depleted iron stores, as a result of low dietary iron intakes and/or the iron demands of recent growth.⁷ Heavy or lengthy menstrual periods, substance abuse, or a previous pregnancy, particularly if multiparous or closely-spaced, may further contribute to a negative iron balance.

Marginal Iron Intakes

Dietary iron absorption increases by about 50% during the second and third trimesters of pregnancy.⁶ The diets of pregnant adolescents, however, are frequently low in iron. Discomforts such as nausea, vomiting or heart-burn may result in even lower dietary iron intakes.

CONSEQUENCES

- Iron deficiency anemia in pregnancy may increase perinatal morbidity and occurrence of maternal complications as summarized in Table 3.^{3,6}
- Iron deficiency anemia in the first and second trimesters has been associated with a two-to-three fold increased risk of prematurity and low birthweight.⁸

- Postpartum hemorrhage, as well as decreased tolerance of normal blood loss at delivery, may increase the need for transfusion therapy.
- The adolescent with anemia may experience fatigue, irritability, dizziness, headache, more frequent infections and shortness of breath.
- Maternal anemia and low iron stores have been associated with decreased infant iron stores, particularly at 4-6 months of age. Infants of anemic mothers are more likely to develop anemia by 12 months of age, despite controlling for confounding variables.^{3,6}

- Prevention of iron deficiency anemia
- Protection of maternal iron stores
- Improvement of postpartum iron status
- Promotion of adequate fetal iron stores and infant iron status

This recommendation appears to be especially appropriate for adolescents since they have been found to be at an increased risk for gestational anemia.⁷ Adolescents who begin pregnancy with inadequate iron stores and/or have low dietary iron intakes will become progressively more iron deficient without iron supplementation. Selective iron supplementation, based on depleted iron reserves (serum ferritin less than 20 ug/L during the first or second trimesters), may be less practical for adolescents since they are more likely to receive late or inconsistent prenatal care. In addition, adequate iron status in later pregnancy may not be assured by a normal ferritin in early pregnancy.^{1,3}

Examples of iron supplements and their elemental iron content are listed in Table 4. Chewable or liquid iron products are available for adolescents who have difficulty swallowing tablets.

TABLE 3
Potential Consequences of Iron Deficiency Anemia in Pregnancy

- Prematurity
- Low birthweight
- Lower gestational weight gain
- Depressed maternal immune status
- Decreased maternal well-being
- Maternal cardiovascular stress
- Increased risk of maternal urinary tract infections/pyelonephritis
- Postpartum hemorrhage/decreased tolerance of blood loss at delivery
- Slower wound healing
- Delayed recovery of postpartum iron status
- Decreased infant iron stores at birth
- Decreased maternal interaction with infant

Sources: Allen LH. Pregnancy and iron deficiency: unresolved issues. *Nutr Rev* 1997;55(4):91-101; Viteri FE. The consequences of iron deficiency and anemia in pregnancy. *Adv Exp Med Biol* 1994;352:127-139.

PREVENTION

The Centers for Disease Control and Prevention recommends universal supplementation of all pregnant women with 30 mg of elemental iron at the first prenatal visit.¹ Advantages of routine iron supplementation include:^{1,4}

TABLE 4
Examples of Iron Supplements in Pregnancy

Supplement	Strength (mg)	Elemental Iron (mg)
Fergon	240	27
Ferrous Gluconate	325	36
Ferrous Fumarate	200	66
Ferrous Sulfate	324	66
Feostat	200	65
Feostat Chewable	100	33
Feostat Liquid	100	33/5 mL
Ferrous Sulfate Elixer	220	44/5 mL
Slow FE	160	50
FE 50 extended release	160	50
Ferro-Sequels timed release	50	50
Feosol caplets	50	50

Source: Drug Facts and Comparisons. St Louis, MO: Facts & Comparisons, 1998.

Dietary strategies will also improve the adolescent's iron status and help prevent iron deficiency anemia.⁹

- Daily intake of lean meat, fish or poultry can provide heme, an effectively absorbed form of iron. In addition, these foods increase the absorption of iron from nonmeat sources in the meal (e.g., dried beans or peas, grain products, etc.).
- Eating foods that contain ascorbic acid increases the absorption of nonheme sources of iron by maintaining the iron in its more soluble form (e.g., citrus or fortified fruit juices, citrus fruits, strawberries, green peppers, broccoli, cabbage, cantaloupe, etc.).
- Regular intake of highly fortified breakfast cereals (e.g., Total®, Special K Plus®, Product 19®, Smart Start®, Multigrain Cheerios Plus®) can provide a good source of iron.

SCREENING/DIAGNOSIS

A hemoglobin or hematocrit determination at the first prenatal visit and at least once during each trimester at subsequent visits will identify anemia.

- Iron deficiency is the most common cause of anemia in pregnancy. The presence of any of the following risk conditions¹⁰ in adolescents with a low hemoglobin or hematocrit level reinforces a presumptive diagnosis of iron deficiency anemia:
 - History of iron deficiency anemia
 - Conception within one year of a previous delivery
 - Multiple pregnancy
 - Low dietary iron intakes
 - Strict vegetarian diet
 - Nausea and vomiting
 - History of heavy or lengthy menstrual periods
 - Frequent blood donations
 - History of regular aspirin, nonsteroidal anti-inflammatory drugs (NSAIDS), or corticosteroid use
 - Ulcerative colitis
 - Gastrointestinal bleeding

Responsiveness to iron therapy further indicates iron deficiency. If the anemia does not improve after four weeks of iron therapy, which the adolescent has complied with, (>1 g/dL increase in hemoglobin or 3% increase in hematocrit), further assessment is indicated.¹

Serum Ferritin Determination

Serum ferritin, an intracellular iron storage protein, indicates iron reserves.

- Although serum ferritin levels decrease in pregnancy and are subject to normal variation, values <15 ug/L with a low hemoglobin or hematocrit confirm the diagnosis of iron deficiency anemia.¹
- A ferritin level above 15 ug/L is suggestive of another cause of the anemia. Since ferritin is an acute phase reactant, serum ferritin levels increase with acute and chronic inflammation, which can mask depleted iron stores.¹ In the presence of infection, a higher serum ferritin level (e.g., <50 ug/L) is indicative of iron deficiency.

Serum Transferrin Receptor Concentration

Serum transferrin receptor concentration, reflecting tissue iron need, increases in iron deficiency.

- This test is the most sensitive indicator of iron deficiency in pregnancy since it is unaffected by hemodilution, chronic disease, infection or inflammation.
- Values >8.5 mg/L indicate iron deficiency.³

Additional Screening

Screening for sickle cell trait and Thalessemia is indicated in adolescents who are African American, Southeast Asian or of Mediterranean descent if they have anemia which is nonresponsive to iron therapy.¹ Screening for parasitic infections may also need to be considered in some newly arrived immigrants. Folate deficiency or megaloblastic anemia may also need to be ruled out.

MANAGEMENT

Iron therapy in combination with dietary strategies effectively raises the hemoglobin level, replenishes iron stores and prevents reoccurrence of anemia.

Iron Therapy

- 60 to 120 mg of elemental iron per day, in divided doses, is recommended to correct anemia and minimize side effects. When the hemoglobin is normalized, reduce the dosage to 30 mg of elemental iron per day.
- The iron contained in multivitamins should not be considered when calculating the iron dosage since the calcium, phosphorus and magnesium content of these supplements interferes with iron absorption.⁹
- A multivitamin containing 15 mg of zinc and 2 mg of copper is recommended when therapeutic dosages of iron are used, to prevent impaired absorption or utilization of these nutrients.⁹

EDUCATION AND COUNSELING

- To increase compliance with iron supplementation, inform the adolescent of its importance, the possibility of side effects (which will subside with continued use) and that iron may darken her stools. Providing iron supplements to low income adolescents may also be helpful. In addition, it may be necessary to dispel myths, such as that iron will increase the size of the baby and make her delivery more difficult. If she has difficulty remembering to take supplements, problem-solve with the adolescent (e.g., carry in purse, set beeper or watch as reminder).
- To protect the potency and maximize the absorption of iron supplements, recommend that they be stored away from heat and humidity, take them with liquids other than coffee, tea, carbonated beverages and milk, and avoid taking them within one hour of multivitamin or calcium supplements, dairy products or antacids.
- To prevent accidental poisoning, caution the adolescent to store vitamins and iron supplements away from the reach of children.
- A gradual increase in the iron dosage will minimize side effects (e.g., constipation, diarrhea, nausea, heartburn, headache, dizziness).
- If side effects persist, decrease the iron dosage, recommend taking supplements with meals or at bedtime or try a delayed release form of iron.

Dietary Strategies

- Increase the intake of meat, fish and poultry.
- Include an ascorbic acid source at meal.
- Limit the intake of dairy products to 4 servings per day.
- Consume minimal amounts of coffee, tea and carbonated beverages.

FOLATE DEFICIENCY OR MEGALOBLASTIC ANEMIA

Persistent anemia may also be caused by folate deficiency, particularly during the last trimester of pregnancy when folate needs are highest. Adolescents at risk for folate deficiency (megaloblastic) anemia include those with:¹¹

- Short interval between pregnancies
- Multiple pregnancy
- Long term anticonvulsant therapy or alcohol abuse
- Uncontrolled infections
- Hyperemesis
- Malabsorption syndrome
- Low dietary folate intakes
- Non-use of a multivitamin supplement

A peripheral blood smear indicating macrocytosis and hypersegmented neutrophils is suggestive of folate deficiency anemia. A red blood cell folate level, which reflects tissue stores, confirms the diagnosis of folate deficiency if below 150 ng/mL. Folate deficiency anemia is managed with 1 mg of folic acid per day.¹²

DIABETES MELLITUS

Adolescent pregnancy may be complicated by pregnancy-related or diagnosed gestational diabetes (GDM) as well as pre-existing Type 1 or Type 2 diabetes mellitus (DM).¹³

CHARACTERISTICS

Type 1 DM

- Insulin deficiency related to pancreatic beta cell destruction
- Dependency on insulin therapy
- Progressively increased insulin needs during pregnancy in response to increased nutrient demands, weight gain and insulin resistance
- Proneness to ketoacidosis
- Increased risk of spontaneous abortion or congenital anomalies if blood glucose levels are not well controlled (hyperglycemia) during the periconceptual period

Type 2 DM

- Increasing prevalence among adolescents in conjunction with increasing rates of overweight
- Insulin resistance, rather than deficiency, which intensifies during pregnancy
- Insulin therapy needed in pregnancy
- Not ketosis prone
- Increased risk of spontaneous abortion or congenital anomalies if hyperglycemia occurs during the periconceptual period

Gestational DM

- Carbohydrate intolerance occurs or is first recognized during current pregnancy
- Carbohydrate intolerance may range from mild to severe
- Carbohydrate intolerance may be pregnancy-related and resolve after delivery or may have occurred prior to pregnancy as undiagnosed or latent Type 2 DM and may persist after delivery
- Insulin therapy may be needed (oral hypoglycemic agents are contraindicated in pregnancy)

PREVALENCE

Gestational diabetes occurs in 1% to 12% of pregnancies in the United States. The highest rates occur among members of certain ethnic groups (African American, Native American, Hispanic, South or East Asian, Pacific Islands or Indigenous Australian).¹⁴

- Anti-insulin hormones produced by the placenta to maintain a constant glucose supply to the fetus (estrogens, progesterones, prolactin, cortisol, human placental lactogen) peak at 26-32 weeks gestation. This causes a progressive increase in insulin resistance and decreased glucose tolerance, which is compensated for by increased insulin production in normal pregnancies.¹³
- Carbohydrate intolerance develops during the second and third trimesters of pregnancy in some individuals when enough insulin cannot be produced by the pancreas in response to increasing insulin resistance.¹³

CONSEQUENCES

If intensively managed, the risk of intrauterine fetal death is similar to that in normal pregnancies.¹³⁻¹⁵ Complications are less severe and occur less frequently than when GDM is not well controlled. Uncontrolled gestational diabetes is a major cause of perinatal mortality and morbidity. Potential complications associated with GDM are listed in Table 5. The severity of risk is associated with the degree of maternal hyperglycemia. Even mild blood glucose elevations, however, may cause fetal macrosomia (excessive size).

- While maternal glucose readily crosses the placenta, insulin does not. Elevated maternal blood glucose levels produce fetal hyperglycemia which results in hyperinsulinemia, lipogenesis, glycogen and protein synthesis, and subsequent macrosomia.¹³
- More than 50% of women with GDM will eventually develop Type 2 DM.¹⁶ Obesity increases the risk of developing this condition. Even young, nulliparous women who develop GDM are at increased risk of developing future diabetes.^{16, 17}

- Gestational diabetes and even mild maternal impaired glucose tolerance increase the risk of insulin resistance, diabetes and obesity in the offspring in later life and possibly in future generations.¹⁸ Children of mothers who had GDM have been found to have a 19% prevalence of impaired glucose tolerance by 10-16 years of age.¹⁸

TABLE 5
Potential Complications
Associated with GDM

Perinatal

Spontaneous abortion

Preeclampsia

Polyhydramnios

Prematurity

Macrosomia, birth trauma, shoulder dystocia, operative delivery

Asphyxia

Neonatal metabolic abnormalities:

- Hypoglycemia
- Hypocalcemia
- Jaundice
- Polycythemia

Respiratory distress

Long Term

Maternal Type 2 DM

Diabetes or obesity in offspring

SCREENING/DIAGNOSIS

Techniques to screen and diagnose GDM:¹⁴

Determine Risk for GDM at the First Prenatal Visit:

Low Risk: (if all characteristics are present)

- Not a member of an ethnic group with a higher prevalence of GDM (see prevalence section, this chapter)
- No known diabetes in first degree relatives (parents, siblings)
- Normal prepregnant weight
- No previous history of abnormal glucose tolerance
- No history of adverse pregnancy outcome associated with GDM (e.g., unexplained pregnancy loss, excessive sized infant)

Average Risk: (if any characteristic is present)

- Member of an ethnic group with a higher prevalence of GDM
- Family history of diabetes
- High prepregnant weight

High Risk: (if any characteristic is present)

- Significant obesity
- Strong family history of Type 2 DM
- GDM in previous pregnancy
- History of glucose intolerance
- Glucosuria
- History of adverse pregnancy outcome associated with GDM

Screen for GDM According to Risk Status:

Low Risk: Screening not routinely required.

Average Risk: Screen at 24-28 weeks gestation.

High Risk: Screen as soon as possible. If negative, repeat screening at 24-28 weeks gestation and again at 32 weeks or at any time symptoms or signs suggestive of hyperglycemia are present (e.g., polyhydramnios, estimated fetal weight large-for-gestational-age, failure to gain weight).

PREVENTION

There is no known way to prevent gestational diabetes. However, since the insulin resistance associated with adipose tissue may further stress carbohydrate tolerance, it may be advisable to avoid excessive weight gain, particularly if the adolescent is obese. In those with a previous pregnancy complicated by GDM, lower dietary fat and carbohydrate intakes after delivery may reduce the risk of developing GDM in a subsequent pregnancy.¹⁹

TABLE 6
Glucose Tests

1. Glucose Challenge Test

- Preparation: NONE (time of day or food intake prior to the test are not regarded)
- 50 g oral glucose load in at least 200 mL water
- Foods and beverages other than water, as well as cigarette smoking are avoided during the test
- Venous plasma glucose determination one hour after began drinking glucose solution
- Abnormal glucose screen = venous plasma glucose at or above 130 mg/dL

2. Glucose Tolerance Test

- Preparation: Carbohydrate intake of at least 150 g per day for 3 days prior to the test to avoid false positive results (e.g., grain products and fruits = 15 g/serving; milk = 12 g/serving)
- Overnight fast of 8-14 hours
- Morning fasting venous plasma glucose determination
- 100 g glucose load in at least 400 mL water
- Food and beverages other than water as well as cigarette smoking and physical activity are avoided during the test
- Venous plasma glucose determination at one, two and three hours after began drinking glucose solution
- Abnormal OGTT = two or more of the following venous plasma glucose values:
 - Fasting \geq 95 mg/dL
 - One hour \geq 180 mg/dL
 - Two hour \geq 155 mg/dL
 - Three hour \geq 140 mg/dL
- One abnormal value on the OGTT as well as significantly elevated (>185 mg/dL) glucose screens despite normal OGTT results have been associated with fetal macrosomia, and may warrant management.

Source: Metzger BE, Coustan DR. Summary and recommendations of the Fourth International Workshop-Conference on Gestational Diabetes Mellitus. The Organizing Committee. *Diabetes Care* 1998;21 Suppl 2:B161-167.

Procedures for Screening

- A 50 g glucose challenge test (GCT) followed by an oral glucose tolerance test (OGTT), if plasma glucose above 130 mg/dL (see Table 6); or
- Defer GCT and immediately perform OGTT; or
- A random plasma glucose at or above 200 mg/dL or fasting plasma glucose at or above 126 mg/dL.

MANAGEMENT

Nutrition management is a primary component of diabetes care in pregnancy. In many GDM cases, nutrition therapy can effectively achieve normal blood glucose ranges and prevent or delay the need for insulin.

Regardless of the type of diabetes, the goals of medical nutrition therapy are similar:¹⁴

- To maintain blood glucose levels as close to normal as possible (avoiding hyper- and hypoglycemia)
- To provide optimal maternal and fetal nutrition
- To promote appropriate maternal weight gain and weight gain patterns
- To prevent maternal ketosis

Nutrition management strategies to achieve these goals are listed in Table 7.

- Meal plans that are individualized, culturally appropriate, economically feasible and are consistent with the Daily Food Guide for pregnancy adolescents will provide required nutrients and be acceptable to the adolescent.
- An adequate energy intake is needed to prevent hunger and ketosis, and support recommended weight gain based on prepregnant body mass index (BMI) (see Table 8). Energy needs must be individualized according to age, growth status, stage of pregnancy, activity, current level of intake and weight gain pattern. Average recommended intakes are based on current body weight.
- Since carbohydrate is the main macronutrient affecting blood glucose levels, total carbohydrate must be limited to 35-45% of total calories to prevent hyperglycemia. This makes it necessary to increase the proportion of protein to 20-25% and fat to 35-40%

TABLE 7
Nutrition Management Strategies for Diabetes in Pregnancy

- Adequate intake of macro- and micronutrients and energy
- Limited total carbohydrate intake
- Avoidance of foods containing sugar and concentrated sweets
- Limited fruit, fruit juice, milk and refined grain products
- Emphasis on complex, unrefined carbohydrates
- Limited convenience foods
- Consistency in energy and carbohydrate intake
- An eating pattern of 3 regular meals and 3 light snacks
- Limited carbohydrates at breakfast
- Distribution of remaining carbohydrates throughout the day
- Increased dietary fiber
- Alternative sweetener use in moderation (if used)
- Moderate physical activity appropriate to pregnancy

TABLE 8
Recommended Weight Gain and Energy Intake

Prepregnant	BMI	Total lbs	Lb/wk*	Kcal/kg
Normal	(19.8-25)	25-35	1.0	30
Low (Underweight)	(<19.8)	28-40	1.5	40
High (Overweight)	(>25-29)	15-25	0.75	24
Very high (Obese)	(>29)	~15**	0.5	~12***

* during second and third trimester

** minimum

*** more kilocalories may be needed to avoid intakes <1800 kcal/day

Source: Adapted from Jovanovic L. American Diabetes Association's Fourth International Workshop-Conference on Gestational Diabetes Mellitus: summary and discussion. Therapeutic interventions. Diabetes Care 1998;21 Suppl 2:B131-137.

of total energy intake.¹⁸ The higher end of the range is recommended for those with pre-existing DM.²⁰ (There is some evidence that protein needs may be increased in pregnancies complicated by diabetes).¹³ A meal plan based on carbohydrate counting will give the adolescent greater flexibility in achieving these goals.

- Pre-existing DM in pregnancy and GDM are associated with increased carbohydrate sensitivity, making it necessary to restrict concentrated sweets (e.g., sugar, honey, molasses, corn syrup, candy, sweetened beverages) and limit intake of fruit, fruit juice, milk and refined grains and convenience foods such as white bread, rice, instant noodles and packaged stuffing. Complex carbohydrate sources (e.g., whole wheat bread, oatmeal, bran cereal, legumes) and protein sources are emphasized.¹⁶
- Regularly spaced meals and snacks (breakfast, lunch, dinner and 3 light snacks 2-3 hours after meals) distribute energy and carbohydrates throughout the day, and prevent hyperglycemia and starvation ketosis. An evening snack containing approximately 7 g protein and 30 g carbohydrate (e.g., 1 oz meat or cheese and 2 slices of bread) will prevent early morning ketonuria, and, if insulin is used, hypoglycemia.²¹ An example of energy and carbohydrate distributions associated with normal blood glucose ranges is shown in Table 9. Individualization is necessary, based on the adolescent's blood glucose response.
- Carbohydrate tolerance is often lowest in the morning because of higher plasma cortisol and glucagon levels. Post-breakfast hyperglycemia can be prevented by limiting total carbohydrate to less than 30 g and minimizing or avoiding intake of fruit, fruit juice and refined grain products.²¹

TABLE 9
Energy and Carbohydrate Distribution to Achieve Normoglycemia

Meal	Kilocalories(%)	CHO(%)	CHO(g)
Breakfast	10-15	10-15	15-30
Snack	5-10	10	15-30
Lunch	20-30	20-25	30-60
Snack	5-10	15	15-45
Dinner	30-40	25	45-60
Snack	5-10	15	30

- There is some evidence that dietary fiber may lower blood glucose levels by slowing the intestinal absorption of simple carbohydrates and increasing insulin sensitivity. Whole grain products, oatmeal, bran, dried beans and peas and fresh vegetables can be encouraged.¹⁶
- Non-nutritive sweeteners are considered to be safe in pregnancy.¹⁶ Although no specific recommendations have been made regarding their use during pregnancy, moderation may be appropriate.
 - Saccharin (Sweet'n Low[®]) and Acesulfame-K (Sweet One[®], Sunette[®]) cross the placenta but have not been shown to be harmful to the fetus.
 - Aspartame (Equal[®] or Nutrasweet[®]) does not cross the placenta when consumed in usual amounts. It is useful in uncooked foods but unstable when heated. Since the amino acid phenylalanine is one of the metabolites of Aspartame, it should be avoided or considered as a phenylalanine source by adolescents with phenylketonuria.
 - Sucralose (Splenda[®]) derived from sucrose, crosses the placenta in small amounts but has been shown in animal studies to be nontoxic and nonteratogenic. It is heat-stable and can be used in a wide range of cooked and uncooked food. It is biochemically inert, absorbed in limited amounts and rapidly excreted.
 - Sorbitol[®], Mannitol[®] and Xylitol[®] are sugar alcohols supplying 4 kcal/g. They have less influence on blood glucose or insulin levels than sugar since they are absorbed more slowly from the gastrointestinal tract. Since the slow, passive absorption of sugar alcohols can produce osmotic diarrhea, malabsorption and abdominal discomfort, they should be avoided or used in limited amounts.
- Moderate exercise can be an important adjunctive therapy in the management of diabetes in pregnancy, particularly in GDM. Physical activity improves blood glucose control by increasing insulin sensitivity and peripheral use of glucose. In combination with dietary management, exercise for 20-30 minutes, 3 or more times per week may prevent or delay the need for insulin therapy (see Chapter 12).²²
 - Exercise that utilizes the upper body muscles and places minimal stress on the trunk region (e.g., swimming, upper arm exercises, walking) is the least likely to cause fetal distress or uterine contractions.¹⁴
 - Exercise is not recommended if blood glucose levels are poorly controlled.²⁰
 - Exercise 30-60 minutes prior to meals and before a premeal insulin injection will improve postprandial (PP) blood glucose levels without inducing hypoglycemia. In adolescents with GDM not requiring insulin, exercise after meals can also lower blood glucose levels.²⁰
 - To prevent hypoglycemia, exercise should be avoided in the fasting state and during periods of peak insulin activity. Energy and carbohydrate intake should be adequate prior to exercise and a rapidly absorbed form of carbohydrate readily available during exercise.
 - If insulin is used, injection into muscles which will be heavily exercised within 60-90 minutes will accelerate insulin absorption. An alternative site (e.g., abdomen) is recommended.²⁰
 - Blood glucose should be monitored before and after exercise.

MONITORING

Ongoing monitoring of the adolescent with DM or GDM with the following parameters will evaluate the effectiveness of nutritional therapy and provide the basis for adjustments in management strategies:^{14,18,20}

- Self-monitoring of blood glucose with a memory reflectance meter is recommended for all adolescents with preexisting or gestational diabetes. Whole-blood capillary glucose values prior to breakfast, one hour after the beginning of meals and in some individuals, at bedtime and/or in the middle of the night provide the following advantages:
 - The adolescent is an active participant in her care.
 - She becomes aware of her individual blood glucose response to particular types and amounts of foods.
 - The practitioner is able to evaluate the level of glycemic control and the need for changes in the meal plan as well as identify the need for and adjustments in insulin therapy.
- Goals for blood glucose control (whole-blood capillary values) which have been associated with the prevention of macrosomia:^{16,18}

Fasting: 60-90 mg/dL

1 hour PP: 100-120 mg/dL

Bedtime: 90-120 mg/dL

3:00 AM: 60-120 mg/dL

- Insulin therapy is recommended if blood glucose values cannot consistently be maintained below the upper level of the fasting and 1 hour PP ranges with nutrition management (i.e., >90 mg/dL fasting; >120 mg/dL 1 hour PP).
- A record of types, amounts and timing of foods eaten at meals and snacks as well as type, time and duration of physical activity, and, if used, insulin dosages and times will help the adolescent and practitioner evaluate the interrelationships of these factors as they affect blood glucose control. Food intake records will also indicate the adolescent's level of understanding and compliance with the prescribed meal pattern.
- Urinary ketone testing done on the first morning voided specimen is recommended to evaluate the adequacy of energy and carbohydrate intake.
- Periodic glycosylated hemoglobin determinations evaluate glycemic control over the previous 4-6 weeks since the attachment of glucose to hemoglobin occurs in relation to the concentration of plasma glucose over the lifespan of the red blood cells. Levels >7% (varies with individual laboratory) indicate sub-optimal blood glucose control.
- A weight gain grid in the medical record and a personal copy for the adolescent are useful to evaluate weight gain progress and assure that energy intake is adequate. Inadequate weight gain may be related to restriction of food intake to avoid the need for insulin therapy.

EDUCATION AND COUNSELING

The pregnant adolescent with preexisting or gestational diabetes needs extensive education, counseling and support to make the lifestyle changes necessary to achieve strict blood glucose control. The diagnosis of GDM may be especially difficult for an adolescent who is asked to make significant and immediate changes in her eating patterns and food choices, begin self monitoring of her blood glucose levels and, if needed, give herself insulin injections. The following approaches are suggested:

- Use a multidisciplinary health care team, including psychosocial support.
- Refer to a Registered Dietitian/nutritionist, particularly when insulin is used.
- Use a public health nurse for home follow-up and education.
- Schedule frequent visits and include nutrition education and counseling.
- Discuss in simple, concrete terms the implications of diabetes for her pregnancy and the importance of good blood glucose control.
- Avoid the term "diet;" use "meal plan" or "eating plan."
- Involve the adolescent in her care as much as possible.
- Include the adolescent's partner and family in nutrition education sessions.
- Teach the adolescent to read food labels, estimate portion sizes and make appropriate snack and fast food choices.
- Use concrete educational approaches such as test tubes filled with sugar to demonstrate the amount of sugar in various foods (e.g., 11 tsp of sugar per 12 oz can of soft drink- 4 g is equal to 1 tsp).
- Consider an education and support group such as a breakfast club on clinic days.
- Encourage breastfeeding, which has been associated with higher HDL and lower blood glucose levels in the mother and a lower risk of obesity and diabetes in the infant.²³

POSTPARTUM FOLLOW-UP

After delivery, a reevaluation of glucose tolerance will determine if the adolescent with GDM had pre-existing or pregnancy related DM. Providing education and counseling at family planning visits also offers the opportunity to influence modifiable risk factors for the development of DM.¹⁷

- Reassess glucose tolerance in adolescents with GDM 6 weeks after delivery with a 2 hour, 75 g glucose tolerance test (follow same procedure as for 3 hour OGTT).
- Fasting plasma glucose (FPG)

- FPG ≥ 126 mg/dL is diagnostic of diabetes if confirmed on another day.
 - FPG < 126 mg/dL but 2 hour value on OGTT ≥ 200 mg/dL is diagnostic of diabetes.
 - FPG 110-125 mg/dL is designated as impaired fasting glucose.
 - If the FPG is normal (< 110 mg/dL) and the 2 hour value on the OGTT is < 200 mg/dL, a FPG should be repeated annually.
- Encourage the adolescent to achieve and maintain a healthy body weight.
 - Recommend a lower fat and carbohydrate eating plan.
 - Encourage regular physical activity.
 - Discourage cigarette smoking.
 - Counsel the adolescent to prevent obesity in her infant.
 - Inform the adolescent that further pregnancies may increase her risk of developing Type 2 DM.
 - Encourage the adolescent to begin prenatal care early and be screened for glucose intolerance at her first prenatal visit if she has a subsequent pregnancy.

HYPERTENSIVE DISORDERS

Chronic, pre-existing hypertension, pregnancy-induced hypertension (PIH), as well as PIH superimposed on chronic hypertension may occur in adolescent pregnancy. Hypertensive disorders of pregnancy are classified in Table 10.²⁴

CHARACTERISTICS

Chronic Hypertension

- Increasing prevalence in young people, which may be related to higher rates of obesity and low calcium intakes
- Hypertension prior to 20 weeks gestation and persistence for more than 6 weeks postpartum
- At risk for rapidly developing superimposed PIH,

- associated with significant proteinuria and generalized edema
- Severity and early onset makes it particularly hazardous

TABLE 10

Classification of Hypertensive Disorders in Pregnancy

Pregnancy-induced hypertension (PIH)

Gestational hypertension

- Preeclampsia
- Mild
- Severe
- Complicated by eclampsia or HELLP syndrome

Chronic hypertension preceding pregnancy

Chronic hypertension with superimposed PIH

- Preeclampsia
- Eclampsia

Source: Perloff D. Hypertension and pregnancy-related hypertension. *Cardiol Clin* 1998;16(1):79-101.

Gestational Hypertension

- The most common of the hypertensive disorders of pregnancy
- Elevation of blood pressure developing after 20 weeks gestation without proteinuria
- Disease process which can progress to preeclampsia, and finally eclampsia

Preeclampsia

- Previously referred to as “toxemia”
- Hypertension after 20 weeks gestation accompanied by proteinuria and edema
- Most common in young primiparas
- Additional risk factors include multiple gestation, diabetes mellitus (preexisting or gestational), chronic renal disease, obesity or daughter of woman who had preeclampsia
- Can rapidly progress to eclampsia

Eclampsia

- Rare, life-threatening condition involving seizures
- Marked hypertension and/or coagulation abnormalities may be present

HELLP Syndrome

Gestational hypertension complicated by:

- Hemolysis
- Hepatic dysfunction (Elevated Liver enzymes)
- Thrombocytopenia (Low Platelet count)

PREVALENCE

U.S. birth certificate data indicate that adolescents under age 20 have higher rates of pregnancy related hypertension than women in their twenties. In a meta analysis by Scholl et al., half of the studies showed some increase in the risk of PIH in adolescents compared to older pregnant women.²⁵

PATHOPHYSIOLOGY

Pregnancy-induced hypertension is associated with an inadequate expansion of plasma volume, an increase in vascular tone, lower serum-ionized calcium and increased intracellular calcium levels.^{24,26} The sequel of these events and their causes, however, are unclear.

- Plasma volume may be 30-50% of normal. A similar reduction in placental blood flow compromises oxygen and nutrient transfer and subsequently, fetal growth and well being. The greatest reduction in plasma volume and placental perfusion occurs in PIH superimposed on chronic hypertension.
- Increased sensitivity to vasoactive hormones results in intense vasospasms of peripheral arterioles and hypertension. With acute vasospasms, ischemia and lesions of target organs (renal, hepatic, cerebral, cardiac, uteroplacental) may occur.
- Abnormalities in calcium metabolism are similar to those associated with essential hypertension.

CONTRIBUTING FACTORS

- The etiology of PIH is unknown, despite several theories involving genetic, hormonal, immunologic and nutrition factors. It is clearly recognized that neither excess weight gain nor excess dietary sodium are predisposing factors for the development of PIH. Of the nutrient excesses or deficiencies implicated in the pathogenesis of PIH (which include protein, sodium, magnesium, zinc and linoleic acid), calcium has received the most attention.
- The importance of an adequate calcium intake in the prevention and management of hypertension is recognized in the nonpregnant state, but is controversial in pregnancy.²⁷
- It has been hypothesized that calcium reduces parathyroid hormone, which lowers intracellular free calcium levels and results in smooth muscle relaxation. It has also been suggested that an adequate calcium intake may promote vasodilation and improve blood pressure and placental blood flow through effects on nitric oxide.^{27,28}
- Pooled analysis of 14 clinical randomized trials using 1.5 to 2.0 g supplemental calcium per day showed a 5.4 mm Hg decrease in systolic and a 3.4 mm Hg decrease in diastolic blood pressure and an inverse relationship between calcium and PIH.²⁹
- The Calcium for Preeclampsia Prevention trial did not show a beneficial effect of calcium in the prevention of preeclampsia or gestational hypertension in adolescents or adults.³⁰ It is possible, however, that a protective effect of calcium is most evident in calcium deficient populations.²⁸
- In a recent clinical trial of adolescents with low dietary calcium intakes (approximately 600 mg/day), daily supplementation with 2 g calcium resulted in a 12.5% risk reduction in preeclampsia compared to those receiving a placebo. In addition, a 9.1 mm Hg reduction in systolic and a 6.0 mm Hg reduction in diastolic blood pressure were demonstrated.²⁸

CONSEQUENCES

Hypertensive disorders in pregnancy are a major cause of perinatal mortality and morbidity in adolescent pregnancy. Perinatal mortality rates may be five times higher and neonatal morbidity may be increased by as much as 50%. Fetal morbidity and mortality rates are highest in pregnancies with eclampsia, the HELLP syndrome, and preeclampsia developing prior to 34 weeks gestation. Risks associated with hypertensive disorders in pregnancy are summarized in Table 11.^{24, 26}

TABLE 11
Risks Associated with
Hypertensive Disorders of Pregnancy

Fetal

Spontaneous abortion
Fetal death in utero
Prematurity
Low birthweight
Intrauterine growth retardation

Maternal

Placental abruption
Cerebral hemorrhage and edema
Pulmonary edema
Seizures
Renal, hepatic or cardiac failure
Disseminated intravascular coagulation
Generalized bleeding

intakes who are at increased risk for the development of PIH, including those with:³¹

- Multiple gestation
- Preexisting hypertension
- History of preeclampsia
- Preexisting or gestational diabetes

Attempts to manipulate sodium and water retention through the use of sodium restriction or diuretics will not prevent PIH.²⁴

- The retention of 950 mmol of sodium and 6-9 liters of extracellular and intracellular water is a normal physiological adjustment of pregnancy to accommodate maternal and fetal tissue gain, expanded maternal blood volume and increased renal and cardiac circulation.³²
- Although sodium needs are increased in pregnancy, an increase in the glomerular filtration rate and levels of several natriuretic hormones promote sodium loss. Sodium balance is maintained by the sodium conserving mechanism, the renin angiotensin-aldosterone system (RAAS).³²
- Clinical edema, related to increased capillary permeability and decreased venous return from the lower extremities (from mechanical pressure on iliac and pelvic veins by the enlarging uterus) occurs in 80% of normal pregnancies.³²
- Edema has been associated with higher birthweights, a lower incidence of low birthweight infants and reduced perinatal mortality rates.³²
- Sodium restriction, and/or the use of diuretics are contraindicated in pregnancy since they may limit normal plasma volume expansion, decrease placental perfusion and over-stimulate and stress the RAAS.³²
- Although obesity increases the risk of developing PIH, restriction of weight gain, even in severely obese adolescents, will not prevent PIH.²⁴

PREVENTION

Although there is no known way to prevent PIH, the following recommendations may be beneficial:

- Encourage the adolescent to follow the recommended pregnancy diet, including an adequate dietary calcium intake (1300 mg/day). Consider 2000 mg elemental supplemental calcium carbonate per day for adolescents with low dietary calcium

DIAGNOSIS

Blood pressure levels normally fall 7-10 mm Hg during the first trimester of pregnancy, reflecting decreased peripheral resistance resulting from increased cardiac

output. An increase in blood pressure to prepregnancy levels occurs during the third trimester, coinciding with blood volume expansion and increased peripheral vascular resistance.^{24,33-35}

Chronic Hypertension

- Normal decreases in blood pressure in early pregnancy or late entry into prenatal care may cause the diagnosis of hypertension to be missed.
- If the adolescent is under 18 years of age, the American Academy of Pediatrics guidelines are used to define hypertension. Blood pressure levels diagnostic of hypertension are lower than those in adults (e.g., systolic pressures 125-132 mm Hg, diastolic pressures 83-86 mm Hg, from the shortest to tallest girls 16 years of age).

Pregnancy Induced Hypertension

- Increase in blood pressure of at least 30 mm Hg systolic or 15 mm Hg diastolic
- Blood pressure of $\geq 140/90$ mm Hg
- One diastolic blood pressure ≥ 110 mm Hg

Any of these criteria must be met on two or more occasions, 4 hours apart, in adolescents normotensive prior to 20 weeks gestation.

Preeclampsia

- Hypertension as defined above
- Proteinuria, 1+ or more on dipstick
- Generalized edema or more than 1 pound of weight gain per week

Severe preeclampsia

- Systolic blood pressure above 160 or diastolic blood pressure above 110 mm Hg
- Proteinuria 3+ or more on dipstick

Eclampsia

- Convulsions up to 48 hours after delivery

Superimposed preeclampsia

- Blood pressure increases 30 mm Hg systolic or 15 mm Hg diastolic, or 20 mm Hg mean pressure, above reading before 20 weeks gestation
- Edema or proteinuria develops

MANAGEMENT

- Management of hypertensive disorders includes bedrest on the left lateral side, which increases uterine and renal blood flow, mobilization of interstitial fluid and blunting of the sympathetic nervous system.^{24, 32, 35, 36}
- Diuretics and sodium restriction are no longer used in the management of pregnancy-induced hypertension. These approaches are not only ineffective but potentially disadvantageous:
 - Edema is associated with a pathological redistribution of extracellular fluid. Despite marked fluid retention, plasma volume is contracted and placental perfusion is compromised.
 - Potential risks of sodium restriction and/or diuretics include further depletion of plasma volume, cardiac output and placental perfusion, electrolyte imbalance and pancreatitis as well as decreased nutrient intake and weight gain.
 - Reduced plasma volume is associated with poor pregnancy outcome and low birthweight.
- Significant proteinuria may require additional dietary protein to replace protein losses (e.g., 0.5 g/kg/day).

EDUCATION AND COUNSELING

Nutrition guidelines for the management of hypertensive disorders in pregnancy should be reviewed with the adolescent, and her mother or other caregiver. The adolescent should be encouraged to:

- Consume a nutritionally balanced diet, following the Food Guide Pyramid (Appendix B) for pregnant adolescents.
- Avoid sodium restriction and salt food to taste using iodized salt.
- Drink fluids liberally.
- Gain weight according to recommendations for normal pregnancy (see Chapter 9).

- Continue to eat well if on bed-rest:⁹
 - Eat small amounts of food often throughout the day.
 - Choose nutritious foods that are easy to eat and require minimal preparation (e.g., sandwiches, cheese or peanut butter and crackers, granola/cereal bars, hard boiled eggs, small cans of juice, raw vegetables, nuts, fresh fruit, oatmeal cookies).
 - Keep a cooler nearby containing milk, cheese, yogurt, juices, etc.
 - Request healthy take-out foods (e.g., pizza, hamburger, grilled or roasted chicken, taco, sub sandwiches).
 - Keep a pitcher of water nearby to encourage adequate fluid intake.
 - Include foods high in fiber to help prevent constipation (e.g., whole grain bread and cereals, raw fruits and vegetables, salads, dried fruits).
 - Limit low nutrient snacks such as soft drinks, chips and candy.

- Craved pica substances are obtained despite considerable effort and inconvenience.³⁹
- Some substances, such as styrofoam cups, may be chewed but not swallowed.³⁹
- The smelling of selected substances in response to cravings has also been reported (olfactory craving) and may occur in conjunction with or independently from pica.³⁹

PREVALENCE

The reported prevalence of pica has ranged from zero in urban whites to 68% in a rural black population.³⁸ Although the consumption of clay, dirt, laundry starch and cornstarch has frequently been cited among African Americans, pica may occur in pregnant women of any age, race, culture, geographic area or socioeconomic status.³⁸ Feelings of shame, embarrassment and guilt often result in secrecy and under-reporting of pica practices, making it difficult to know the true prevalence of pica in pregnancy.

PICA

Pica is an abnormal craving resulting in regular, compulsive ingestion of inappropriate substances. It is most frequently reported in children and during pregnancy.

- Items consumed by those practicing pica vary according to individual preference and may range from food products (e.g., cornstarch) to highly toxic substances such as mothballs (see Table 12).
- Ice, freezer frost, laundry and cornstarch appear to be consumed most frequently. In a recent survey of 281 WIC participants 16-30 years-of-age, 54% practiced ice pica.³⁷ The ingestion of multiple substances may be common.^{38, 39}
- Frequency of pica may range from weekly to several times per day.³⁸
- Amounts of substances ingested may be significant. Daily intakes of up to 32 pounds of ice, 2-3 boxes of cornstarch, 2 cans of baking powder and one large can of powdered cleanser have been reported in individuals practicing pica.³⁹

CONTRIBUTING FACTORS

Despite theories based on nutritional, psychosocial, physiological, or cultural factors, the etiology of pica remains unknown. The cause of pica appears to be complex and multifactorial.^{38, 40, 41}

- Nutritional theories suggest that appetite-regulating brain enzymes are altered by iron or zinc deficiencies, causing an individual to experience specific cravings.⁴⁰ However, the pica substances that are craved and ingested do not usually supply these minerals.
- Psychosocial theories describe pica as an eating disorder created by emotional stress.
- Iron deficiency anemia is frequently associated with pica, particularly pagophagia (ice eating),³⁷ and often resolves with iron therapy prior to an increase in hemoglobin level.⁴² In addition, lower serum ferritin levels have been observed in ice eaters.³⁷ However, other studies have observed no differences in anemia rates.³⁸ If related, it is unknown whether pica is a cause or consequence of iron deficiency anemia.

TABLE 12
Examples of Pica Substances

Ingested		Chewed	Smelled	
Baking powder	Ice	Aspirin	Air freshener	Powdered detergent
Baking soda	Lemons	Concrete chips	Freezer air	Wet dirt
Chalk	Laundry starch	Foam rubber	Air conditioner emissions	Automobile exhaust
Cigarette ashes	Burnt match tips	Plastic	Rubbing alcohol	Gasoline
Baked clay	Newspaper	Sponge	Ammonia (scented)	Nail polish remover
Powdered cleanser	Paper	Styrofoam	Bleach	Marking pens
Cornstarch	Dried paint	Tissues	Carpet deodorizer	Powder
Coffee grounds	Baby powder	Toilet paper	Pine scented cleaner	Room disinfectant
Powdered detergent	Raw potatoes	Wax	Powdered cleanser	
Dirt	Salt			
Flour	Tobacco			
Freezer frost	Vanilla			

Sources: Smulian JC, Motiwala S, Sigman RK. Pica in a rural obstetric population. *South Med J* 1995;88(12):1236-1240; Cooksey NR. Pica and olfactory craving of pregnancy: how deep are the secrets? *Birth* 1995;22(3):129-137.

- In some individuals, pica may begin in an attempt to relieve discomforts of pregnancy. For example, baking soda or baking powder have been reported to be used as remedies for heartburn and gas and continued throughout the pregnancy. A teenager consuming 2 cans of baking powder per day began using it for indigestion, and liked the way it foamed in her mouth.³⁹
- Pica has been practiced for generations in many families and is culturally accepted.^{38, 42} Its roots may include the relief of nausea or hunger or a decrease in excess saliva production. Beliefs of beneficial effects of pica have also been described (e.g., clay-eating will make the baby stronger, free of birthmarks and a suitable color).³⁸
- Some individuals have described beginning the practice of pica in childhood, then increasing it in pregnancy. They also report pica among other family and household members, who are frequently authority figures.³⁸
- Other individuals have felt alone in the practice of pica, and have been relieved to learn of pica in others.³⁹

CONSEQUENCES

The potential risks associated with pica in pregnancy, which include fetal and maternal toxicity and medical complications, are dependent on the type, quantity and frequency of substance ingested. Examples of pica substances and associated risks are listed in Table 13.^{38-40, 43}

- Constipation or fecal impaction, as well as gastric or intestinal obstruction and peritonitis can result from ingestion of pica substances. Maternal death associated with bowel obstruction and perforation from clay ingestion has been reported.⁴³
- Low intakes of iron, zinc, energy and other nutrients may occur as pica substances displace nutritious foods in the diet. Nutrient deficiencies or inadequate weight gain may result. Appetite depression, particularly with ice eaten before and instead of meals has been reported.³⁹
- Malabsorption of minerals caused by binding from pica substances may further contribute to nutrient deficiencies. Clay eating has been associated with iron malabsorption, while starch does not appear to cause intestinal binding of iron.⁴²

TABLE 13
Pica Substances and Associated Risks in Pregnancy

Pica Substance	Content	Potential Effects
Baking soda, baking powder	Sodium, alkali	Excess sodium load, alkalosis, hypokalemia, elevated liver function tests
Chalk	Calcium, alkali	Hypercalcemia, alkalosis
Cigarettes	Nicotine	Nicotine toxicity
Clay, dirt	Bacteria, parasites, mercury, lead	Bacterial/parasitic infections, mercury/lead toxicity, maternal bowel obstruction, hypo/hyperkalemia
Lead paint, colored paper	Lead, mercury	Lead/mercury toxicity
Coffee grounds	Caffeine	Caffeine toxicity
Matches	Phosphorus	Phosphorus toxicity
Moth balls, toilet bowl freshener	Naphthalene, paradichlorobenzene	Maternal, fetal hemolytic anemia, toxicity

- Ice, freezer frost and starch eating have been associated with lower serum ferritin levels and the delivery of infants who were irritable, cried often and had smaller head circumferences.⁴²
- The energy content of ingested clay, laundry starch, flour or cornstarch may result in excessive weight gain. For example, a one pound box of cornstarch contains 1,590 kilocalories.
- Tooth fractures may occur from chewing hard substances¹ while the citric acid content of lemons can cause permanent erosion of dental enamel.³ Ice eating may contribute to tooth decay by contracting metal fillings which can then allow entry of bacteria.
- Congenital lead poisoning in infants whose mothers ingested lead-containing substances, as well as transplacental toxicity and hemolytic anemia resulting from maternal intake of paradichlorobenzene have been observed.

ASSESSMENT

The adolescent may be reluctant to admit to pica practices because of embarrassment or shame. However, the ingestion of pica substances, including frequency and amounts, should be assessed in all pregnant adolescents at the initial visit and periodically throughout pregnancy, particularly if iron deficiency anemia develops.

- Use a sensitive and non-judgmental manner.
- The adolescent's partner, friends or family members may be more willing to share information about her pica practices.³⁹
- If one pica substance is identified, probe for additional substances.³⁸ Questions related to pica may most easily follow those related to the adolescent's usual food intake. For example:
 - What foods do you especially like and eat a lot of since becoming pregnant?

- Some people eat things when they are pregnant that are not usually considered food. Do you know anyone who eats things like ice, lemons with salt, cornstarch, baking soda, etc.?
- How often do you crave things like this?
- Do you crave to smell anything special since becoming pregnant?³⁹

EDUCATION AND COUNSELING

Some forms of pica may not be considered abnormal behavior within the adolescent's family. Conversely, those practicing pica have described inability to stop the behavior in spite of pressure and blocking efforts from relatives or friends.³⁹ Promoting behavioral change in the adolescent admitting to pica may thus be challenging.

- Encourage the adolescent to discuss her behavior.
- Explain concerns about pica in simple, concrete terms.
- Advise avoidance of inappropriate substances.
- Encourage healthful alternatives and a nutritionally balanced diet.
- Suggest substitutes, when appropriate, such as sour pickles, sugarless gum, a cinnamon stick to chew on, etc.
- Refer for psychosocial counseling, if indicated.

Food Cravings and Aversions

Food cravings, or an intensive and compulsive desire to eat particular foods, as well as aversions, or a repulsion of foods not previously disliked have been described in pregnant adults and adolescents. Although highly individual, food cravings and aversions which have been most frequently described⁴⁴ are listed in Table 14.

- Pregnant adolescents may be told by family members or friends that food cravings should be ignored as they may alter pregnancy outcome or the appearance of the infant (see Chapter 7). This myth should be dispelled. In fact many foods that may be craved, such as dairy products or fruit, contribute necessary nutrients to the diet.
- Adolescents should be encouraged to satisfy cravings for foods within the framework of a balanced and healthy diet.

TABLE 14
Food Cravings and Aversions

Cravings	Aversions
Sweets	Meats, especially red meats
Dairy products	Coffee
Fruits	Alcohol
Fruit juices	Fried foods
Salty snacks	
Chocolate	
Pickles	
High protein main dishes	
Ice cream	

Source: Pope JF, Skinner JD, Carruth BR. Cravings and aversions of pregnant adolescents. *J Am Diet Assoc* 1992;92(12):1479-1482.

- Food aversions are common during pregnancy and are often related to nausea and vomiting. Many young women find that food aversions peak during the early part of pregnancy when nausea and vomiting are more likely to occur. However, food aversions may continue throughout pregnancy.
- Adolescents can be counseled on how to replace offensive foods with other more tolerable food choices from the same food group. A dietitian or nutritionist can make suggestions for replacing any nutrients lost by avoiding foods.

EATING DISORDERS

Eating disorders are a group of abnormal, maladaptive eating-related behaviors that cause negative mental, emotional and physical consequences among adolescents. Eating disorders, as well as a wide range of disordered eating behaviors, may occur in adolescents prior to or during pregnancy. Adolescents who have previously been diagnosed with an eating disorder and who have completed a treatment program may experience a relapse during pregnancy due to changes in body shape and weight. Poor pregnancy outcomes are

common among adolescents who experience eating disorders during pregnancy. The risk of pregnancy complications and poor outcomes, however, can be significantly reduced when the adolescent receives appropriate treatment.

DEFINITION OF EATING DISORDERS

The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) criteria for eating disorders⁴⁵ are listed in Table 15. These criteria define the three diagnosable types of eating disorders: Anorexia Nervosa (AN), Bulimia Nervosa (BN) and Eating Disorders Not Otherwise Specified (EDNOS).

Subclinical Eating Disorders and Eating Disordered Behaviors

A wide range of disordered eating behaviors are characteristic of subclinical eating disorders:⁴⁶⁻⁴⁸

- Restrictive or chronic dieting
- Meal skipping
- Fasting
- Chaotic or irregular eating
- Excessive use of fat-free foods or sugar or fat substitutes
- Vomiting
- Use of laxatives, diet pills or diuretics
- Preoccupation with weight, shape and body size
- Excessive exercise

PREVALENCE

- Eating disorders are increasing among adolescent females of all ethnic backgrounds and social classes.^{49, 50}
- Anorexia nervosa affects approximately 1%, and bulimia nervosa, up to 5% of adolescent females in the U.S.^{51, 52}
- Disordered eating behaviors are more common, occurring in 10-20% of adolescent girls.^{49, 53}
- More than one half of junior and senior high school females consider themselves overweight and have attempted to diet.⁵³
- Amenorrhea that is associated with eating disorders,

particularly with AN, may decrease fertility; however pregnancy can still occur.

- Pregnancy may occur after partial recovery from an eating disorder or in adolescents with subclinical eating disorders who have not received treatment. In addition, eating disorders may develop during pregnancy.^{51, 54}
- The course of eating disorders and associated symptoms varies widely during pregnancy:
 - Some individuals are able to decrease their behaviors in an effort to improve pregnancy outcome.
 - Others experience an increase of symptoms, especially during the third trimester when body image and weight issues peak.
 - Most demonstrate a moderate improvement in eating disordered behaviors without stopping them. A decrease in binge eating is often noted during the third trimester of pregnancy when the growing fetus makes stomach expansion more difficult.
 - In those who improve during pregnancy, many relapse and may intensify their behaviors after delivery.⁵⁵

CONTRIBUTING FACTORS

- Societal emphasis on thinness
- Stressful life events, including unintended pregnancy
- Fear of growing up and becoming independent
- Family dysfunction including parental abuse or neglect and substance abuse
- Low self esteem / Poor body image
- Sense of loss of control over one's body and life
- Fear of weight gain, including gestational weight gain

CONSEQUENCES

Restricted eating and purging behaviors may compromise maternal and fetal health.⁵⁶ Potential risks associated with eating disorders in the prepregnancy period, during gestation, and after delivery include:^{49, 54-56}

- Low prepregnant weight
- Inadequate gestational weight gain
- Excessive weight gain (binge eating)
- Decreased nutrient stores
- Decreased bone density
- Higher rates of substance use

TABLE 15
Diagnostic Criteria for Eating Disorders

ANOREXIA NERVOSA (AN)

- Refusal to maintain a minimally normal weight for age and height (15% below that expected)
- Intense fear of gaining weight or becoming fat, even though underweight.
- Disturbance in the way in which one's body weight or shape is experienced; undue influence of body weight or shape on self-evaluation, or denial of the seriousness of current low body weight.
- Amenorrhea in postmenarcheal females (i.e., the absence of at least 3 consecutive menstrual cycles).

BULIMIA NERVOSA (BN)

- Recurrent episodes of binge eating, characterized by both:
 Eating within a discrete period of time (e.g., within a two hour period) an amount of food definitely larger than most people would eat during a similar period of time and under similar circumstances.
 A sense of lack of control over eating during the episode (e.g., a feeling that the person cannot stop or control what or how much they are eating).
- Recurrent inappropriate compensatory behavior in order to prevent weight gain (e.g., self-induced vomiting, misuse of laxatives, diuretics, or other medications; fasting or excessive exercise).
- Binge eating and inappropriate compensatory behavior occurs, on average, at least twice a week for three months.
- Self-evaluation is unduly influenced by body shape and weight.
- The disturbance does not occur exclusively during episodes of AN.

EATING DISORDERS NOT OTHERWISE SPECIFIED (EDNOS)

Binge Eating Disorder

- Recurrent episodes of binge eating. Binge eating episodes are characterized by both of the following:
 Eating within a discrete period of time (e.g., within a two-hour period) an amount of food definitely larger than most people would eat during a similar period of time and under similar circumstances.
 A sense of lack of control over eating during the episode (e.g., a feeling that the person cannot stop or control what or how much they are eating).
- Binge-eating episodes are associated with 3 or more of the following:
 Eating much more rapidly than normal.
 Eating until feeling uncomfortably full.
 Eating large amounts of food when not feeling physically hungry.
 Eating alone because of being embarrassed by the amount that one is eating.
 Feeling disgusted with oneself, depressed or very guilty after overeating.
- Marked distress regarding binge eating is present.
- Binge eating occurs, on average, at least 2 days a week for 6 months.
- Binge eating is not associated with regular use of inappropriate compensatory behaviors (e.g., purging, fasting, excessive exercise) and does not occur exclusively during the course of AN or BN.

Other examples of EDNOS

- All of the criteria for AN are met except the individual continues to have regular menses.
- All of the criteria for AN are met except, despite significant weight loss, the individual's current weight is in the normal range.
- All of the criteria for BN are met except binges or inappropriate compensatory behaviors occur at a frequency of less than twice a week for a duration of less than three months.
- Regular use of inappropriate compensatory behaviors by individuals of normal body weight after eating small amounts of food (e.g., self-induced vomiting after eating 2 cookies).
- The individual repeatedly chews and spits out, but does not swallow, large amounts of food.

- Esophagitis
- Constipation
- Decreased iron stores
- Hyperemesis
- Dehydration
- Electrolyte disturbances (e.g., alkalosis, hypokalemia)
- Hypertension
- Adverse infant outcome
 - Higher incidence of miscarriage or stillbirth
 - Delivery of a low birthweight infant
 - Premature delivery
- Postpartum depression
- Inappropriate feeding of infant

SCREENING

Adolescents may not readily disclose their eating disorders to health care providers because of shame, secrecy or denial.⁵⁴ To help identify the presence of clinical or subclinical eating problems, the following conditions should be evaluated in all pregnant adolescents:^{53-55, 57, 58}

History

- History of or treatment for eating disorders
- Menstrual history (e.g., irregular/missed/light periods)
- Irregular or infrequent eating

Weight/Body Image

- Weight fluctuations (highest and lowest weight in the past year)
- Participation in appearance-related activities (e.g., dance line, studio dance, modeling, figure skating, gymnastics)
- Body image dissatisfaction
- Attitudes and fears related to gestational weight gain
- Significant underweight status
- Excessive or inadequate weight gain

Eating/Weight Control

- History of dieting, fasting, meal-skipping
- Time spent thinking/worrying about food, eating and weight

- Use of vomiting, laxatives, syrup of ipecac, diuretics, diet pills
- Binge eating
- Appetite dysregulation
- Food hoarding, night time eating, secretive eating
- Attitudes about eating (e.g., “safe” and “unsafe” or “good” and “bad” food beliefs)
- Excessive or compulsive exercise to purge calories
- Fluid intake (excessive or inadequate)
- Use of fat free/reduced foods and sugar and fat substitutes

Medical

- Prolonged hyperemesis
- Enlarged salivary glands
- Calluses on dorsum of hand (from inducing vomiting)
- Dental enamel erosion/excessive caries.

MANAGEMENT, EDUCATION AND COUNSELING

The management of eating disorders in pregnancy requires an interdisciplinary team and an empathetic, supportive and nonjudgmental approach.^{59, 60} The nutrition educator is a vital member of the eating disorders management team.

General

- Refer to a therapist associated with an eating disorder treatment program when an eating disorder is suspected or confirmed.
- Make the fetus as real as possible through use of pictures of fetal development, ultrasound and fetal heart tones.
- Inform the adolescent that symptoms associated with eating disorders may increase or decrease during pregnancy, especially during the third trimester of pregnancy and the postpartum period and arrange for postnatal follow-up or treatment.
- Discuss potential adverse effects on the fetus of over-the-counter or prescription medications that the adolescent may use (such as diuretics or diet pills).

Eating Behaviors

- Provide frequent monitoring of eating patterns, including types, amounts and frequency of food intake.
- Frequently assess purging behaviors (vomiting, laxative or diuretic use, exercise).
- Discuss fetal growth and development and corresponding maternal nutrition needs.
- Without invoking guilt, discuss the potential adverse effects of restrictive eating, purging, excessive exercise or inadequate weight gain on pregnancy outcome. Discuss the relationship of healthy eating to the adolescent's physical and emotional well being.
- Provide an individualized meal plan that includes 3 small meals and 2-3 snacks per day.
- Encourage specific, realistic incremental changes in eating behaviors.
- Recommend that nonnutritive sweeteners, fat-free products and fat substitutes be limited or avoided.
- Monitor after delivery for relapse, unhealthy weight loss strategies and inappropriate infant feeding practices.

Weight Gain

- Closely monitor the amount and rate of weight gain (weigh with the adolescent facing away from the scale if she is distressed by the weight increase).
- Discuss the importance of gestational weight gain and emphasize that it is normal and temporary.
- Negotiate a goal range of weight gain.
- Provide an individual weight gain grid.
- Discuss normal fluid accumulation in pregnancy.
- Discuss the need for moderation in exercise.

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