CHAPTER 2

Nutrition Needs During Preconception

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Chapter Outline

Preconception Period

The Physiology of Reproduction

Infertility, Subfertility, and Assisted Reproductive Technology

Common Health Conditions

Nutrition Recommendations During Preconception

Lifestyle Habits During Preconception

Learning Objectives

1. Describe the preconception periods for men and women.
2. Summarize the reproductive process, including critical hormones and their roles.
3. Explain subfertility and infertility.
4. List preexisting diseases and conditions that may contribute to infertility or a poor pregnancy outcome.
5. List the common nutrients, including their recommended intake levels, for the preconception period.
6. Describe the role of body weight and lifestyle habits in preconception health.
7. List resources to promote a healthy preconception period.
8. List suggested steps of the Nutrition Care Process.

Case Study

Meet Suzanne, a 35-year-old woman who married 2 years ago. Suzanne works at a busy law firm, and her husband is an engineer. They enjoy outdoor activities as well as spending quiet time at home. Suzanne and her husband have been talking a lot about the right time to start a family.

Do you know someone who is trying to become pregnant? Perhaps you have noticed that, compared to your mother's and her mother's generations, many women are getting pregnant at a later age. Healthy habits used to begin once a woman discovered she was pregnant. Preconception health and lifestyle for women and their partners is a topic being discussed now more than ever before, as more women and men delay having babies or are struggling to conceive. New evidence points to the preconception period as being increasingly important in contributing to a healthy pregnancy outcome for both the woman and child.

Conception outcomes have a wide range, from women struggling to conceive, to women having twins, triplets, and multiples. **Assisted reproductive technology (ART)**, such as the use of fertility medication, artificial insemination, in vitro fertilization, and surrogacy, has been successful at assisting women who are otherwise unable to become pregnant. The health status and lifestyle of both the mother and her partner prior to conception are key factors in a healthy pregnancy and delivering a healthy baby. Pregnancy for a woman with various health conditions or for women older than age 35 years can often bring multiple health challenges for both the mother and the baby, not to mention a deal of ethical considerations.

The preconception period is a critical, and often overlooked, stage of the reproductive cycle. In this chapter, we will explore the journey to conception, identifying important steps a couple should take to ensure the healthiest pregnancy possible. An unhealthy lifestyle prior to conception may result in infertility and poor outcomes during the pregnancy and may result in persistent health issues that impact the baby for his or her entire life. We will review the physiology of reproduction and discuss the topics of infertility, subfertility, and assisted reproductive technology. Preexisting diseases, such as diabetes, celiac disease, and high blood pressure, as possible contributors to infertility and poor pregnancy outcomes will be discussed. Nutrition recommendations that both men and women should follow during the preconception period are outlined, along with recommendations for supplements. How body weight and lifestyle habits during pregnancy help to determine the health of a pregnancy and pregnancy outcomes are described. Finally, resources that exist to promote a healthy preconception period will be reviewed.

Preconception Period

Preview The **preconception period** is the time prior to or between pregnancies, and it is an important time for women of childbearing age to be in good health.

Today, many women of childbearing age spend the preconception period in less than optimal health, and therefore they start pregnancies as such. For example, about 31% of pregnant women are obese, about 69% do not take folic acid, and an estimated 3% take medications that are known to cause birth defects.[1] If conception occurs during a time of poor maternal nutrition or health status, the health of the expecting mother, the growth and development of the fetus, and the future health of the offspring may all be compromised. In extreme cases, suboptimal health prior to pregnancy can lead to pregnancy-related complications, such as gestational diabetes and high blood pressure, and may result in infant death or premature birth, with associated birth defects and disability.[2]

The Importance of Having a Plan

The importance of preconception nutrition is validated by the fact that the U.S. Department of Health and Human Services (HHS) has included recommendations on this topic in the Healthy People 2020 goals. One recommendation is that all men and women of reproductive age be encouraged to develop a reproductive life plan. Individuals and couples are encouraged to analyze their overall health, their health habits, their social support, and their mental health prior to making the decision to conceive. The eight main recommendations for a healthy pregnancy are presented in TABLE 2.1. The overarching goal among these recommendations is to improve the woman's and child's health. Men should also be included in the preconception plan and receive care, because they too are integral to ensuring a healthy pregnancy.

Preconception Care

Within about 8 to 10 days after an ovum is fertilized, it implants into the uterine wall and embryo development begins. The time prior to conception represents an important and critical period when nutrition and other exposures can affect conception, maintenance of the pregnancy, and development, growth, and future health of the offspring.[4] The Centers for Disease Control and Prevention (CDC) identifies **preconception health care** as the medical care a woman or man receives from the doctor or other health professionals that focuses on the parts

Table 2.1

Recommendations to Improve Preconception Health[3]

1. Individual Responsibility Across the Life Span	Adult men and women should have a reproductive life plan.
2. Consumer Awareness	Increase public awareness of the importance of preconception health behaviors and preconception care services available.
3. Preventive Visits	Provide risk assessment and health promotion education to all women of childbearing age.
4. Interconception Care	Use the time between pregnancies to provide additional interventions and education to women who have had a previous pregnancy that ended in an adverse outcome.
5. Prepregnancy Checkup	Offer, as a component of maternity care, one prepregnancy visit for couples and persons planning pregnancy.
6. Health Insurance Coverage for Women with Low Income	Increase health insurance coverage for women with low incomes to improve access to preventive women's health and preconception and interconception care.
7. Public Health Programs and Strategies	Integrate components of preconception health into existing local public health and related programs.
8. Monitoring Improvements	Maximize research mechanisms to monitor preconception health.

Modified from Healthy People 2020 Recommendations to Improve Preconception Health

of health that have been shown to increase the chance of having a healthy baby. This care encompasses the biomedical, behavioral, and social health interventions provided to women and couples prior to conception. Because of individual and unique needs, preconception health care differs for every person. A doctor or other healthcare professional should suggest a course of treatment or follow-up care as needed. Research shows that women who receive care prior to pregnancy have improvements in many significant areas, including increased folic acid intake, being current on important vaccinations, less weight gain at the beginning of their pregnancy, and fewer complications for both mother and baby.[5]

In the past, nutrition during preconception and interconception periods has been overlooked. However, today healthcare professionals use a framework that has been developed to counsel, provide care, and monitor the mother so that the health of the mother and the child in the short and long terms will be improved. Research suggests that if medical, behavioral, and social health issues are addressed prior to conception, all of society will feel the benefits. Ideally, preconception care should begin at least 3 months before a woman becomes pregnant. Such care can help individuals be in the best health possible prior to pregnancy. Optimal health before pregnancy results in fewer pregnancy complications and fewer babies born preterm or with low birth weight.

The Academy of Nutrition and Dietetics asserts "Women of childbearing age should adopt a lifestyle optimizing health and reducing risk of birth defects, suboptimal fetal development and chronic health problems in both mother and child."*

* Kaiser LL, Campbell CG; Academy Positions Committee Workgroup. Practice paper of the Academy of Nutrition and Dietetics abstract: nutrition and lifestyle for a healthy pregnancy outcome. S J Acad Nutr Diet. 2014 Sep;114(9):1447.

Let's Discuss

Research on general practitioners reveals that they face multiple barriers to providing preconception care. Some are time constraints, lack of preconception visits, competing priorities when women and couples do come in for a visit, cost of care, and lack of resources. How could practitioners encourage more women and couples to attend preconception visits?

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Case Study

Suzanne and her husband have decided that they want to start a family as soon as possible. She is aware that with older age comes increased risk of complications in pregnancy. Additionally, Suzanne really wants to have at least three children.

Questions

1. Would you recommend Suzanne visit her doctor for a preconception appointment?
2. List at least five different areas her health practitioner should assess as part of Suzanne's preconception care.

Recap Women and men of childbearing age should have a reproductive plan to ensure their health and the health of their babies are optimal. Entering pregnancy in optimal health has been shown to reduce poor pregnancy outcomes for both woman and child. Practitioners should be thorough in their assessment of men and women of childbearing age, as the benefits of improved maternal and infant health benefit all of society.

1. List two reasons preconception care is recommended for women who are of childbearing age.
2. Describe the three components of preconception care.

The Physiology of Reproduction

Preview Female and male reproductive systems differ greatly. A woman is born with all the eggs she will ever have—between 1 and 2 million eggs—and she will release about 500 during her reproductive life. Males, on the other hand, can generate millions of new sperm daily. Hormones that play roles in reproduction differ between the sexes as well.

Female Reproductive System and Hormones

The main components of female reproductive anatomy include ovaries, fallopian tubes, cervix, uterus, and vagina. Ovaries are the two small reproductive glands on either side of the uterus that produce hormones that regulate female secondary sex characteristics as well as house the ova (eggs). The fallopian tubes are a pair of long, slender ducts in the female abdomen that transport ova from the ovary to the uterus and, in fertilization, transport sperm cells from the uterus to the released ova. The cervix is the lower part of the uterus that is connected to the vagina. The uterus is the organ where a fetus develops; the upper part is called the corpus and the lower part, the cervix. The vagina is the canal that connects the cervix to the outside of the body and is the site for the delivery of the baby. See FIGURE 2.1 for an image of the female reproductive system.

The menstrual cycle, which typically lasts about 28 days, is divided into two distinct phases. The first half is called the follicular stage, and the second is the luteal stage. Four major hormones are involved in the female menstrual cycle: follicle-stimulating hormone (FSH), luteinizing hormone (LH), estrogen, and progesterone. How the hormones vary during the cycle is presented in FIGURE 2.2.

During the follicular phase, the brain releases FSH and LH, which travel to the ovaries. In the ovaries, they stimulate 15 to 20 eggs to grow, each in its own follicle. Estrogen levels also rise in response to the increase in FSH and LH, and once enough estrogen is released, FSH

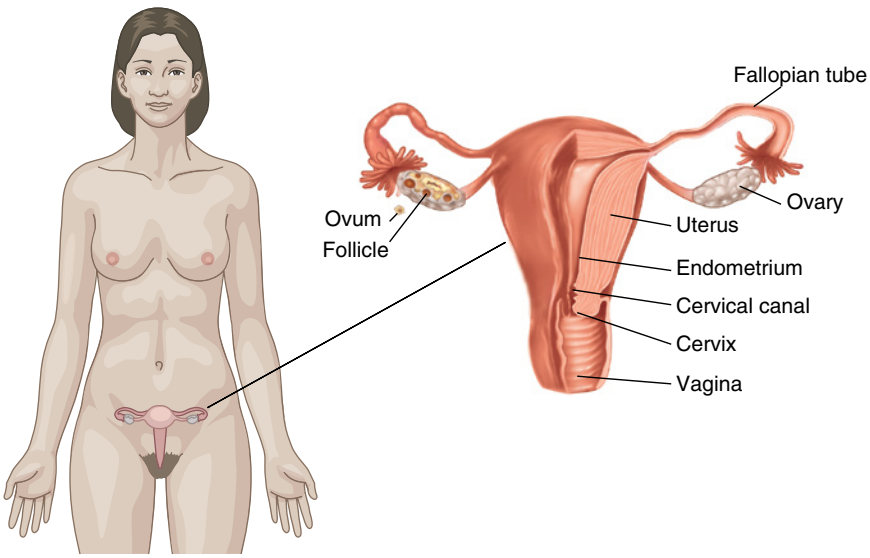


Figure 2.1
The female reproductive system.

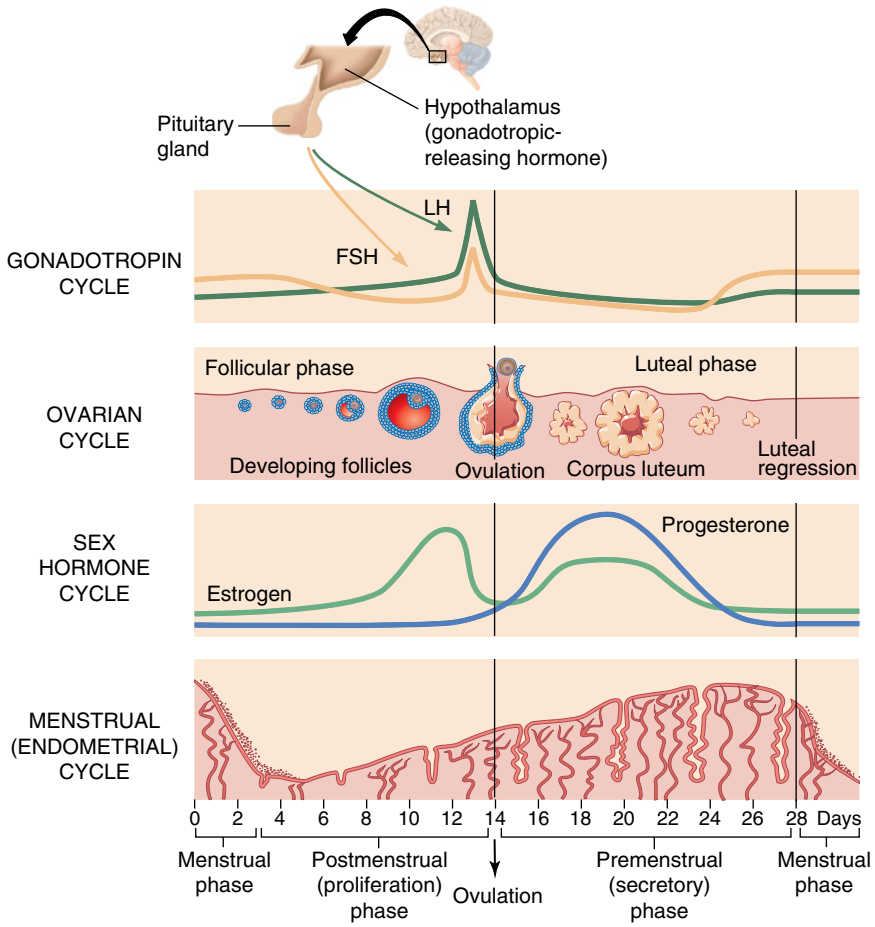


Figure 2.2
Female menstrual cycle hormones.

is turned off, limiting the number of follicles that mature. One follicle becomes dominant and continues to mature, and eventually the others die.

The luteal phase typically begins halfway through the 28-day cycle, or 14 days after the follicular phase began. Estrogen from the dominant follicle stimulates the release of LH by the brain, which causes the follicle to release its egg from the ovary. The egg is captured by the fallopian tubes in the process known as **ovulation**. The empty follicle becomes the corpus luteum, which secretes progesterone. The progesterone readies the uterus for a fertilized egg if one has been fertilized by sperm. If the egg is not fertilized, the egg passes through the uterus, and the lining of the uterus breaks down and is released, a process known as menstruation.

Male Reproductive System and Hormones

The male reproductive system differs in many ways from the female system. To begin with, the main structures, including the penis, scrotum, and testes, are outside of the body. The penis is the organ used in intercourse and is the site of the release of semen. The scrotum is a small sack behind the penis that houses the testes. The testes have two roles: to produce testosterone and to create sperm. The sperm move into the epididymis, where they remain until they mature. Millions of sperm can be generated each day, but they take roughly 70 days to reach maturity. Once sperm mature, they move into the vas deferens until they are released into the urethra via the ejaculatory ducts. The urethra also carries urine from the bladder; however, when a man ejaculates, only sperm is secreted. Other important structures include the seminal vesicles, which attach to the vas deferens and provide fructose and fluid to feed and make the sperm mobile, and the prostate gland, which also provides a source of fluid to help the sperm move. FIGURE 2.3 presents a diagram of the male reproductive system.

Three major hormones are involved in the male reproductive system: follicle-stimulating hormone (FSH), luteinizing hormone (LH), and testosterone. FSH makes sperm in a process called spermatogenesis. LH is responsible for making testosterone, which is also necessary for forming sperm. Finally, testosterone is necessary for the development of male characteristics.

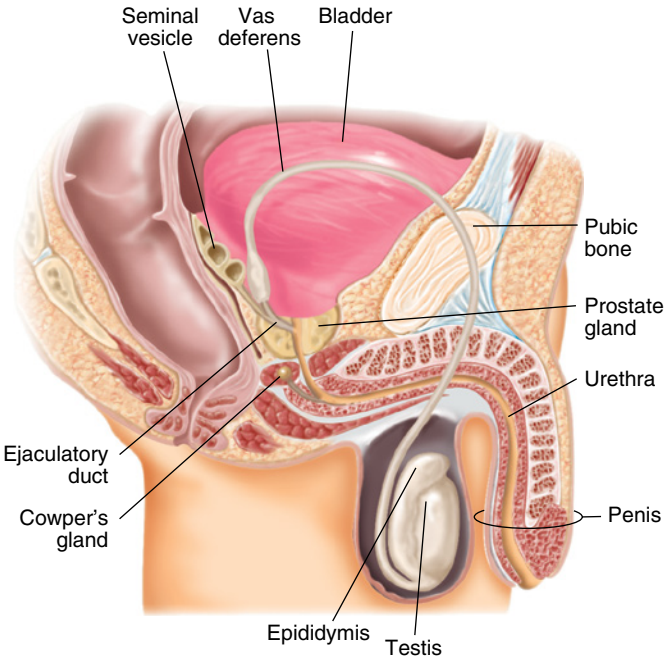


Figure 2.3
The male reproductive system.

Recap In human reproduction, two kinds of sex cells are involved: the egg in females, and the sperm in males. Various hormones control aspects of reproduction in men and women.

1. How do male and female reproductive systems differ?
2. Taking into account how long it takes for sperm to mature, if a man was trying to get healthy prior to conceiving, how many months should he wait to conceive to ensure the healthiest sperm?

Infertility, Subfertility, and Assisted Reproductive Technology

Preview According to the American Society of Reproductive Medicine, infertility in the United States affects about 10–15% of couples. Although couples cannot control all of the causes of infertility, causes related to preconception nutrition can be minimized or avoided. With emphasis on maintaining a healthy weight and choosing foods that create a safe and supportive environment in which a baby can develop and grow, couples may improve their chances of conception.

Antioxidants

Antioxidants protect the cells of the reproductive system from oxidative stress and therefore play an important role in the fertility of both men and women. Oxidative stress occurs when free radicals outnumber the body's antioxidant defenses. In relation to fertility, when this occurs in the testicular environment, for example, oxidative stress may lead to sperm DNA damage, resulting in a decrease in sperm mobility and cell abnormalities.[6]

A diet rich in antioxidants, such as one that includes blueberries, raspberries, nuts, and dark green vegetables, during the preconception period is critical to help ward off cellular damage resulting from oxidative stress.

Age

Age at onset of pregnancy can also have an effect on fertility and pregnancy outcomes. In our society, instead of having children in their late teens and early 20s, many women and couples decide to finish their education, begin working, and try to achieve some type of financial security before having children. Along with waiting, however, comes the possibility of difficulty getting pregnant and an increase in potential adverse outcomes for mother and baby if pregnancy is achieved.

In 1970, the average age of women having their first child was 21 years, whereas in 2013, it was 26 years. [7] In 1970, only about 1 in 100 women older than the age of 30 had their first child. Currently, about 20% of women older than the age of 35 conceive their first child. [8]

Though there are advantages to delaying conception, one consideration is the risk of **infertility** or **subfertility** and possibly fewer offspring than desired. Infertility is defined as the inability to get pregnant after 12 or more months of regular unprotected sexual intercourse. Subfertility is any period of reduced fertility when conception is desired. Delaying childbearing increases the risk of conception problems such as fewer and lower-quality eggs, eggs not released, increase in health conditions that affect female fertility, and increased risk of miscarriage.[9]

There are a variety of non-nutrition-related ways to increase fertility. Using medication to improve the quality of ovulation and therefore pregnancy rate is one popular choice.

A very sophisticated response to the challenges of infertility has been the increased use of assisted reproductive technology (ART). FIGURE 2.4 describes ART. ART is any treatment or procedure that uses in vitro technology with oocytes (immature ova or egg cells from the female), sperm, or embryos.

In ART, the ovaries are stimulated through medications to produce multiple eggs, then the eggs are surgically removed and fertilized in a lab, and, finally, the embryo is transferred back into the woman. Since 1978, when the first baby was born through in vitro fertilization, the use of ART has risen dramatically. Babies born through ART comprise 1.5% of all babies born in the United States.[10] Although this technology is miraculous for couples who otherwise would not be able to conceive, there is concern

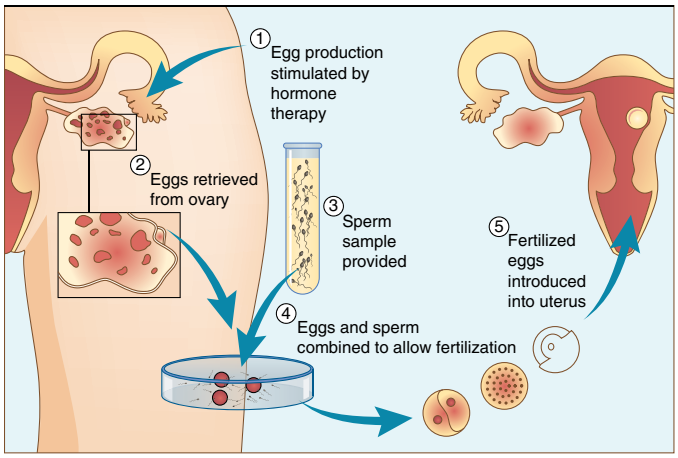


Figure 2.4
Assisted reproductive technology (ART) as seen in in vitro fertilization.

that ART pregnancies that result in twin and multiple fetuses put the woman and offspring at greater risk of adverse outcomes.[11]

Let's Discuss

Many women and couples are waiting longer to conceive. As we've discussed, this puts the woman and baby at increased risk of health problems during the pregnancy, and even after the birth. One solution that has been identified is harvesting a woman's eggs when she is younger and freezing them for later fertilization and implantation. The process is costly and there is no guarantee of the quality of the eggs after the freezing process. A couple of questions to consider: do you think women who are approaching 35 years of age, the age at which the risks to the woman and baby drastically increase in pregnancy, should be encouraged to get pregnant sooner to reduce potential health problems? Or should they be encouraged to freeze their eggs if they are not yet ready to conceive?

Recap Women today are conceiving later in life, which contributes to lower fertility rates. As a response, ART is one solution. ART works for many women but may put women and babies at risk for adverse outcomes.

1. Give one example of how oxidative stress can contribute to infertility.
2. Describe three ways being older affects a woman's ability to become pregnant.
3. What is the definition of infertility?

Common Health Conditions

Preview A variety of preexisting health conditions and environmental issues may impair fertility in both males and females. These conditions may also cause issues once a woman becomes pregnant. It is advisable for women and men with prior health conditions to be under a physician's care when trying to become pregnant. Fortunately, for many conditions, helpful interventions have been found.

Endometriosis

Endometriosis is a condition found in 5–10% of women. This condition occurs when the lining of the uterus, called the endometrium, grows outside of the uterine cavity. The tissue often grows on the ovaries and fallopian tubes. It can be painful for some women, and others are unaware that they even have the condition. When a woman menstruates, the endometrial tissues grows and bleeds but is unable to be released, which often results in the formation of scar tissue and development of cysts. Endometriosis can only be diagnosed through laparoscopy. Treatment for this condition varies but generally includes pain medication, hormones such as those found in contraceptives, removal of the endometrial tissues through surgery, or, in severe cases, a hysterectomy. It is likely that endometriosis leads to infertility because the endometrium may block the egg or not allow the egg and sperm to unite.

Body Weight and Fertility

There is wide agreement that body weight affects fertility and health. Epidemiological data confirm that both obesity and low body weight each accounts for 6% of primary infertility; that is, 12% of primary infertility results from deviations in body weight (either high or low body weight) from established norms.[12] Infertility caused by weight extremes is generally a result of altered hormone levels that negatively affect ovulation.

Overweight

Given the detrimental influence of maternal overweight and obesity on reproductive and pregnancy outcomes for the mother and child, the position of the Academy of Nutrition and Dietetics is that all overweight and obese women of reproductive age should receive counseling on the roles of diet and physical activity in reproductive health prior to pregnancy, during pregnancy, and in between pregnancies.[13] Weight is often measured and defined as body mass index, or BMI. BMI is a mathematical formula determined by dividing a person's weight in kilograms by his or her height in meters squared. There are four main categories of BMI: underweight, normal weight, overweight, and obese (see TABLE 2.2).

Table 2.2

BMI Categories

BMI	Weight Status
Below 18.5	Underweight
18.5 – 24.9	Normal or Healthy Weight
25.0 – 29.9	Overweight
30.0 and Above	Obese

Reproduced from CDC. About Adult BMI. Retrieved from: https://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/. Accessed on 9/27/16.

Although, in some instances, being overweight or obese has no negative effects on fertility, it is associated with contributing to a variety of fertility issues and can have a negative impact on the baby once conception is achieved.

BMI in the obese range may lead to irregular menstrual cycles and irregular ovulation, causing conception to be difficult or delayed.[14] There also seems to be a strong association between obesity and insulin resistance, which is thought to reduce fertility.[15] Obesity is a strong risk factor for polycystic ovary syndrome, which results in menstrual irregularities and chronic **anovulation**,[16] or failure of the ovary to release an egg over time, usually 3 months or longer. The central distribution of fat, as measured by waist-to-hip ratio, is also related to reproductive functioning, with higher rates of infertility associated with higher waist-to-hip ratios.[17] In addition, obese women have a higher chance of delivering by cesarean section, increased risk of some birth defects, and higher chance of having a high-birth weight baby.[18]

There is some evidence of an association between maternal overweight or obesity and decreased rates of breastfeeding. Specifically, a high BMI before conception has been shown to be inversely related to the successful initiation of breastfeeding, the duration of lactation, and the amount of milk produced.[19] Such results show the importance of encouraging women to start pregnancy with a healthy BMI in an effort to increase the chances of successful breastfeeding.[20]

Obesity affects male fertility as well. Evidence suggests that obesity reduces sperm quality, in particular, altering the physical and molecular structure of germ cells in the testes and ultimately mature sperm.[21] Also concerning is evidence that shows that male obesity impairs offspring metabolic and reproductive health, suggesting that paternal health cues are transmitted to the next generation with sperm as the mediator.[21] The good news is that studies also show that simple diet and exercise interventions can be used to reverse the damaging effects of obesity on sperm function.

How much weight loss is necessary to improve the possibility of conception? Studies suggest that even a modest loss of 5–10% of body weight can restore ovulation, and therefore increase fertility.[22] Fertility issues are generally complex, and no single reason may be the cause of trouble; however, for both men and women, if overweight or obesity is the reason for difficulties with conception, it can likely be corrected by restoring body weight to within normal established limits.

Underweight

Just as being overweight is associated with difficulty getting pregnant, being underweight also has its downsides. A certain percentage of body fat is required to produce the hormones necessary to conceive. Women who are underweight may develop amenorrhea, and men who are underweight may not be able to produce viable sperm. Generally, women with BMI less than 19 should be encouraged to gain weight, and this alone often increases fertility or makes hormone therapy more successful.

Let's Discuss

The rates of obesity among men and women have been discussed. Being obese makes it harder to get pregnant, and research suggests even small amounts of weight loss can help increase the odds of becoming pregnant. Should a woman or couple seeking fertility treatment through a clinic be asked first to try to lose weight rather than beginning more invasive and costly treatments?

Eating Disorders

Bulimia nervosa, anorexia nervosa, and binge eating disorder are common eating disorders that can affect many women during their childbearing years. One side effect of eating disorders, particularly of anorexia nervosa, is fertility problems. TABLE 2.3 reviews common eating disorders and their characteristics. Some studies indicate a higher prevalence of eating disorders in women undergoing fertility treatment.[23]

Amenorrhea as a consequence of an eating disorder may lead to the belief that pregnancy is not possible, therefore increasing risk for unplanned pregnancy. Women with a past or current eating disorder are more likely to report having unplanned pregnancies.

Women with an active eating disorder or a history of eating disorders would likely benefit from psychological counseling prior to becoming pregnant. Counseling may also help address possible depression and feelings about how the body will change as a result of being pregnant.

Polycystic Ovary Syndrome

Polycystic ovary syndrome (PCOS) is a hormonal imbalance that affects women, making it difficult for them to become pregnant. PCOS is the most common endocrine

Table 2.3

Comparing Characteristics of Eating Disorders

	Body weight	Eating tendency	View of body image	Physical indications	Emotional expression	Interactions with others
Anorexia	Underweight with BMI < 17.5	Limited calorie intake, may have unusual food rituals and limit variety of foods eaten	Obsessed with weight and appearance, viewing the body as overweight	Extreme weight loss, low blood pressure, heart problems, kidney problems, hair loss, fine and thin hair over parts of the body, weakness, fatigue, nutritional deficiencies, cessation of menstruation	Depression, anxiety, obsessive-compulsive behaviors, denial of a problem, fear of gaining weight	Withdrawn, may refuse to eat in front of others
Bulimia	Generally normal weight or overweight	Eats a large amount of food in a short period of time, followed by purging by vomiting and/or using laxatives	Obsessed with weight and appearance	Changes in weight, ulcers, sores in the mouth, core throat, dehydration, dental problems, weakness, fatigue	Depression, anxiety, feeling of guilt, self-destructive behavior	May be withdrawn, but able to develop relationships with others
Binge Eating Disorder	Usually overweight	Eats a large amount of food in a short period of time. Does not purge, however, may restrict food in between binges	Generally is overly focused on weight and appearance	Excessive weight gain, high blood pressure, diabetes, joint pain, fatigue	Depression, feeling of guilt or self-hatred	May be withdrawn, may seem overly sensitive

disorder in women: nearly 1 in 8 women worldwide suffers from it.[24] PCOS is also the number one reason a woman may have trouble achieving conception. When a woman with PCOS does become pregnant, she is at higher risk for gestational diabetes, high blood pressure during her pregnancy, and babies born smaller than typical for their gestational age.[25]

Why a woman gets PCOS is not fully understood, but almost all women with the condition have cysts on their ovaries. In addition, women with PCOS begin to produce the male sex hormones, called androgens. The result is anovulation, facial hair growth, and acne. TABLE 2.4 shows the common symptoms of PCOS. Insulin is also affected, with the body producing increased amounts of insulin that it may not be able to use. Over time, this increase in insulin can cause diabetes. Because it is a syndrome, and not a disease, women do not need to have all the symptoms of PCOS to be diagnosed. Diagnosis involves having **amenorrhea**, or the abnormal absence of menstruation, having high levels of androgens, and having cysts on the ovaries.

Taking a medication commonly prescribed for diabetes treatment called metformin (also known as Glucophage) appears to help women with PCOS, especially obese women, to become pregnant; however, use of metformin has been related to the risk of malabsorption of vitamin B_{12}, which may result in anemia. One suggested dietary treatment of PCOS, which also addresses a factor of obesity, is a decrease in consumption of foods that cause insulin to increase, such as carbohydrates, including dairy. However, whether changing diet to reduce carbohydrates and other foods that cause insulin spikes increases fertility rates has not yet been determined.

Table 2.4

Common Symptoms of Polycystic Ovary Syndrome

Menstrual problems	Hair loss from the scalp	Fertility problems or repeat miscarriages	Depression or mood swings
Acne, oily skin, or dandruff	Hair growth on the face, chest, back, stomach, thumbs, or toes	Insulin resistance and too much insulin, which can contribute to obesity	Breathing problems while sleeping
Cysts on the ovaries	Weight gain or obesity, especially around the waist	Skin tags	Pelvic pain

Reproduced from Office on Women's Health, U.S. Department of Health and Human Services. Polycystic ovary syndrome (PCOS). Retrieved from: http://www.womenshealth.gov/publications/our-publications/fact-sheet/polycystic-ovary-syndrome.html#d. Accessed: January 12, 2016.

Case Study

When she was a teenager, Suzanne was told that she had polycystic ovary syndrome and may have trouble getting pregnant. Sure enough, after trying for a year, Suzanne is disappointed that she is unable to conceive. She is contemplating using assisted reproductive therapy (ART) but knows that it is expensive and doesn't guarantee she will get pregnant.

Questions

1. Why might she have trouble getting pregnant?
2. What medications may be helpful to her in getting pregnant?
3. What lifestyle modifications may be helpful to her?

Diabetes

Diabetes rates have increased dramatically in the United States and in women of childbearing age. There are two types of diabetes, type 1 and type 2. TABLE 2.5 describes the types of diabetes; elsewhere in the text, gestational diabetes, which can occur during pregnancy, is discussed. Diabetes that is poorly controlled can contribute to a host of health problems, including infertility, in both men and women. Glucose control is important for successful fertility because chronic high blood glucose levels affect hormone levels, including levels of estrogen, progesterone, and testosterone.

Studies suggest that men with diabetes are twice as likely to suffer from low testosterone than are men without diabetes. Less testosterone means fewer healthy sperm. Men with diabetes benefit from having their blood sugar under control prior to attempting to conceive.

Table 2.5

Comparison of Type 1 and Type 2 Diabetes Mellitus

Feature	Type 1 Diabetes	Type 2 Diabetes
Onset	Sudden	Gradual
Age at onset	Any age, but mostly in young children up to teenage years	Most common in adults
Body type	Generally thin or normal	Often obese
Presence of endogenous insulin	Low or absent	Normal, decreased, or increased
Prevalence	~10% of all individuals with diabetes in the United States	~90–95% of all individuals with diabetes in the United States

Data from American Diabetes Association. Retrieved from: http://www.diabetes.org

Following dietary recommendations is key to diabetes management for both men and women. The type of diabetes dictates the best diet prescription. However, carbohydrate counting tends to be a generally effective strategy regardless of diabetes type. Carbohydrate counting is a menu-planning strategy for which a person is allotted a specific number of grams of carbohydrates per day, which are divided into meals and snacks. Proteins and healthy fats are encouraged, and consumption of specific rates of the three macronutrients is designed to keep blood sugar within a healthy range.

Individuals with existing diabetes who are trying to conceive should be made aware that tightly regulating their blood sugar is critically important in assisting with becoming pregnant and for their future health and the health of their baby. Seeing a registered dietitian to help formulate a diet during the preconception period is highly recommended.

Celiac Disease

Celiac disease is an autoimmune disorder that occurs when the body is unable to absorb the protein gluten, which is found in wheat, barley, rye, and sometimes oats. If wheat, barley, and rye are consumed, damage is done to the intestinal lining, putting a person at risk for many issues, including anemia, bone problems, and cancer. Because of the damaged small intestine, a number of critical nutrients may not be well absorbed. Celiac disease has also been linked to infertility.[26] In addition, some studies indicate that in celiac patients, the risk of miscarriage, low birth weight, and preterm delivery is significantly higher compared with that in nonceliac patients.[27]

It is hypothesized that fertility may be affected among men and women with celiac disease because of poor absorption of key nutrients, but the exact mechanism is not known. In addition, women with celiac often suffer increased spontaneous abortion and premature delivery.[28] Successful treatment for a person with celiac disease, or any gluten sensitivity, is to eliminate foods that contain gluten. FIGURE 2.5 shows how the U.S. Department of Agriculture's (USDA) MyPlate can be used for those who choose to eliminate gluten from their diet.

Treatment with a gluten-free diet in those with celiac disease reduces the risks of infertility and all other negative outcomes to the same level as seen in individuals without celiac disease.[27] Because women with celiac disease may not absorb a number of critical nutrients well, it is important that prior to becoming pregnant, blood levels of vitamins and minerals be tested and supplementation began if necessary. Some physicians also believe that in women who suffer from infertility, checking for undiagnosed celiac disease is a reasonable strategy.

Hypertension

Along with obesity rates, the rates of high blood pressure, or hypertension, have also increased. In the United States, an estimated 7.3% of women of childbearing age have high blood pressure.[29] If a woman enters a

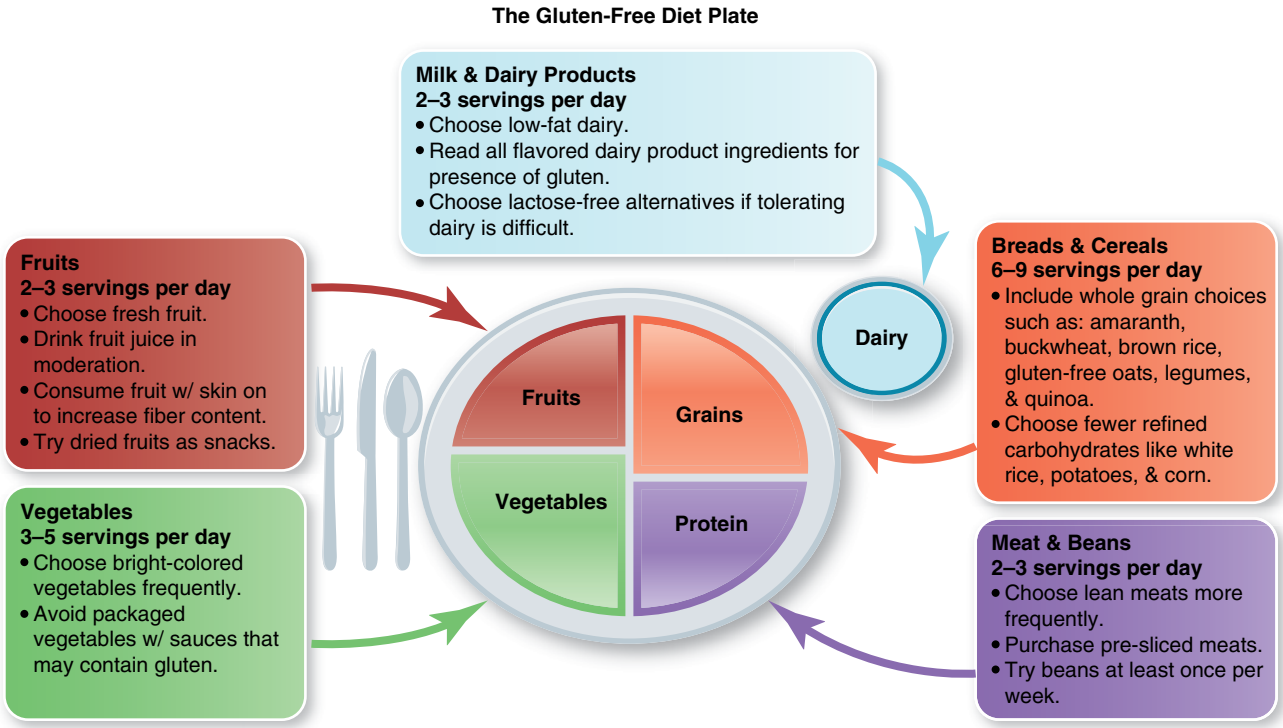


Figure 2.5
MyPlate gluten-free diet plate.

Reproduced from ChooseMyPlate.gov.

News You Can Use

Many people today are eliminating gluten from their diets for a variety of reasons. Some have celiac disease, and gluten must be eliminated or else they will suffer from a variety of health issues. People are also experimenting with eliminating gluten for other reasons, including suspected gluten intolerance. For those who are trying to see whether they have issues with gluten, removing it from their diet may be a good idea. For people who have caught on to the gluten-free craze as a way to be healthier, removing gluten from the diet actually may backfire. Research suggests that for the majority of people, eating gluten free can mean a less healthy overall diet with lower amounts of vitamins, minerals, and fiber than is ideal. Gluten-free products can also cost more. It is important not to get swept up with current nutrition trends and to, instead, check websites that offer unbiased information to ensure a healthy approach to eating.

pregnancy with hypertension, her frequency of experiencing **preeclampsia** is 17% to 25% while she is pregnant compared with a rate of 3% to 5% in women without prior high blood pressure.[30] Preeclampsia is a condition in which high blood pressure and protein in the urine occur and can lead to fetal growth restriction. This will be discussed in more detail in Chapter 3.

Fortunately, if a woman adopts a healthy diet with lower sodium and ample fruits and vegetables following the recommended DASH diet (Dietary Approaches to Stop Hypertension), her blood pressure can be lowered and the likelihood of future problems reduced. TABLE 2.6 shows the DASH diet foods and recommended amounts that are helpful in reducing blood pressure.

Table 2.6

Daily and Weekly DASH Eating Plan Goals for a 2,000-Calorie-a-Day Diet

Food Group	Daily Servings
Grains	6–8
Meats, poultry, and fish	6 or less
Vegetables	4–5
Fruit	4–5
Low-fat or fat-free dairy products	2–3
Fats and oils	2–3
Sodium	2,300 mg*
	Weekly Servings
Nuts, seeds, dry beans, and peas	4–5
Sweets	5 or less

*1,500 milligrams (mg) sodium lowers blood pressure even further than 2,300 mg sodium daily.

Reproduced from National Heart, Lung, and Blood Institute. Description of the DASH eating plan. Retrieved from: https://www.nhlbi.nih.gov/health/health-topics/topics/dash. Accessed January 12, 2016.

Sexually Transmitted Infections

A woman who has a current or history of sexually transmitted infections (STIs) may need additional care during preconception time. Having an STI can cause complications during pregnancy and even affect the baby for many years. Some STIs can be treated and cured successfully during pregnancy with medications that are safe for the baby. Others cannot be cured, but medications may reduce the risk of transmission to the baby. Every woman considering pregnancy should be tested for STIs.

Human Immunodeficiency Virus

A woman with human immunodeficiency virus (HIV) may want to have children. Many options are available today to protect her and her child. It is critical she discuss the options with a healthcare practitioner prior to conceiving. For women with HIV who are thinking of becoming pregnant, preconception counseling can assist with: (1) optimizing maternal health prior to conceiving, (2) ensuring medications taken to treat HIV are appropriate for pregnancy, and (3) alerting the woman to other precautions she will need to take, including avoiding breastfeeding and choosing mode of delivery.[31] Preconception care can also be utilized to prevent unplanned pregnancies. HIV testing should be recommended to all women as part of preconception care.

Recap A wide variety of health conditions can make it harder for a woman to get pregnant and have a healthy pregnancy. Some of these chronic conditions can also affect men. What is most important to remember is that having a chronic condition does not mean that pregnancy is not achievable or that the outcome will be poor. However, people may need to take steps before trying to conceive to decrease the risks that may result from specific conditions.

1. How do body weight extremes such as being underweight or obese generally affect fertility?
2. How common is celiac disease? How does having celiac impair fertility and cause trouble during pregnancy?
3. What steps should a man or woman with an STI or HIV take prior to becoming pregnant?

Nutrition Recommendations During Preconception

Preview The nutrition recommendations for women and men trying to conceive are similar in many ways to the Dietary Guidelines for Americans for healthy adults, with a few notable exceptions. In general, women need extra folate, iron, and DHA (an omega-3 fatty acid), and, for men, zinc and antioxidants are important micronutrients to focus on during the preconception period.

Overall Nutrition Plan

Although no one diet can ensure successful conception, general dietary recommendations help both men and women enter pregnancy in the healthiest environment possible.

Nutrition for Men

We do know that for men, a healthy body and healthy sperm rely on good nutrition choices, including a balanced diet. As previously discussed, some of the most common causes of sperm-related infertility result from health conditions that contribute to low sperm count, slow-moving sperm, abnormal shape and size of sperm, and problems with semen.

Unfavorable environmental conditions can also affect the quality of sperm. The environment alone can cause oxidative stress on sperm. Oxidation creates free radicals (atoms with an unpaired number of electrons) that can damage DNA and cause other problems. **Antioxidants**, which are molecules that inhibit the oxidation of other molecules, interfere with this oxidative chain reaction before damage can be done. FIGURE 2.6 demonstrates how antioxidants scavenge free radicals. Antioxidants in the diet, such as vitamin E, vitamin C, glutathione, and coenzyme Q10, can boost fertility.[32]

In addition, identifying any environmental and occupational factors that are harming sperm is warranted. Studies suggest that exposure to heavy metals, pesticides, heat, and radiation can damage and diminish sperm production. The mineral zinc is an important component of sperm development and number. Men with infertility have been found to have reduced amounts of zinc compared with those men free of infertility issues.[33] Zinc is a powerful antioxidant, and taken in supplement form, not to exceed the U.S. Department of Agriculture (USDA) Tolerable Upper Intake Level (UL), appears to be safe and may support increasing fertility in men.

Folate status may affect male fertility as well, and higher levels of dietary folate intake are related to fewer chromosomally abnormal sperm compared with the sperm of men with lower intakes of folate.[34] Another interesting but controversial nutrient for men is soy. Soy contains

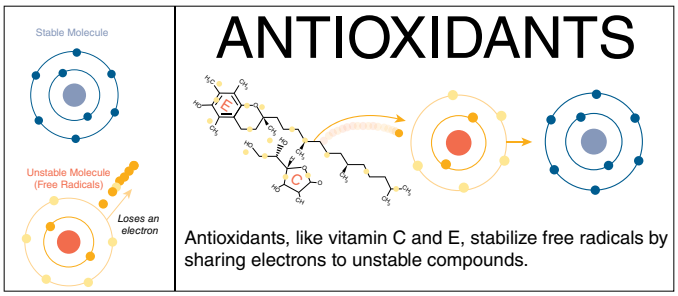


Figure 2.6
Antioxidants can help scavenge free radicals.

isoflavones, which are similar in structure and function to estrogens and may disrupt the body's natural hormonal balance. More research needs to be conducted before advising men to avoid soy products; however, like for all foods, a moderate soy intake appears to be a good strategy. In addition, alcohol consumption in males prior to pregnancy may cause infertility by affecting male reproductive hormones and impairing sperm.[35] In men, smoking can cause impotence and erectile dysfunction in addition to harming sperm.[36]

See TABLE 2.7 for nutrition and lifestyle guidelines for males to ensure optimal sperm health.

For a number of years, research has focused on how age and lifestyle can affect molecules that control gene function in women, which ultimately can affect pregnancy outcomes; however, research also links some of these same effects with males. For instance, there is evidence that advanced paternal age permanently changes the socialization patterns of offspring in an animal study; [37] this association has been seen among older men resulting in higher risk of their children being born with schizophrenia and autism. Paternal obesity has been associated with enlarged fat cells, diabetes, and obesity among offspring.[38] In addition, fathers' alcohol use is also linked to lower birth weight and brain size and reduced cognitive function, all of which are symptoms of fetal alcohol spectrum disorder (FASD).[39] More research must be conducted before the link between fathers and birth defects can be translated into practical advice; however, it seems reasonable that personal choices of males can affect offspring just as those of females do.

Table 2.7

Eating and Lifestyle Recommendations to Improve the Health of Sperm

Eating	Lifestyle Choices
Consume 2½ cups of vegetables and 2 cups of fruit each day.	If you drink alcohol, do so in moderation—no more than two drinks per day.
Eat at least half of all grains as whole grains each day (choose whole wheat bread, oatmeal).	Avoid cigarettes and marijuana.
Consume at least 3 servings of low-fat dairy each day.	Obtain or maintain a healthy weight.
Evaluate your red meat intake and cut back as able. Choose leaner protein sources: fish, turkey, chicken, pork. Include vegetable proteins such as beans, nuts, seeds, and tofu.	Exercise 5 days a week for at 30 minutes—extreme exercise has been shown to decrease testosterone, which can lower sperm count.
Limit saturated fats from meats, full-fat dairy products, and fried foods. Replace these with healthy fats such as almonds and avocado.	

Data from Sharol Denny, Academy of Nutrition and Dietetics. How a Man's Diet Affects Fertility Too. November 19, 2014. http://www.eatright.org/resource/health/pregnancy/fertility-and-reproduction/how-a-mans-diet-affects-fertility-too..

Nutrition for Women

Even though one way of eating may not work for everyone, some dietary practices in general can help or harm a woman's chances of becoming pregnant. An interesting study using data from nurses found that certain dietary practices, such as eating a high-carbohydrate diet, eating foods with high glycemic index, or eating a diet high in saturated fat, were associated with difficulty getting pregnant. Women in this study who consumed a multivitamin and iron supplement and plant protein rather than animal protein had a lower risk of ovulatory infertility.[40]

Folic Acid

One of the most important nutrients for a woman to consume prior to becoming pregnant is folic acid. Folic acid, which is also called folate, is a B vitamin that helps to produce and maintain each cell in the body, including red blood cells. Folate also supports DNA synthesis. Folate is necessary for the neural tube to develop into the brain and spinal cord. The critical time for this development is from days 17 to 30 after conception, a time when many women may not even be aware that they are pregnant. Furthermore, nearly half of pregnancies in the United States are unplanned, leaving these women at greater risk of adverse effects related to low folic acid intake. Each year, about 3,000 women deliver babies with neural tube defects. The two most common include anencephaly, which occurs when the upper end of the neural tube does not close, so no brain develops, and spina bifida, which occurs when the spinal cord fails to close.

Fortunately, ample folic acid intake in the early days of pregnancy and during the first trimester can prevent many neural tube defects. Folic acid is so important that, in 1998, the U.S. government mandated folate be added to commonly consumed grain foods, such as breakfast cereals, grits, noodles, and breads. Fortification has resulted in an overall decline in the percentage of children born with neural tube defects; however, a recent U.S.-based study indicates that the previous prediction of a 28% decline in neural tube defects since fortification began may actually be more modest.[41]

How much folic acid is enough? The folic acid that is found in foods is referred to as folate. See TABLE 2.8 for a list of foods that contain folate.

How can a woman ensure she is getting enough folic acid? All women should be advised to maintain a folate-rich diet. Women can generally meet 100% of estimated folic acid needs by consuming a basic diet that includes foods fortified with folate, such as breakfast cereal, and by eating 6 to 8 servings of refined grain products each day. However, even if a woman consumes a healthy diet, all women of reproductive age in whom pregnancy is

Table 2.8

Food Sources of Folic Acid

Fortified cereal	Broccoli	Enriched pasta and bread
Cooked lentils and beans	Great Northern beans	Cantaloupe
Spinach	Asparagus	Eggs
Lettuce (cos, or romaine)	Avocado	Tropical fruits

possible should be advised of folic acid/multivitamin supplementation benefits and should supplement at least 2 to 3 months before conception with 0.4–1.0 mg of folic acid daily as part of a multivitamin.[42]

Supplementation should continue throughout pregnancy and during breastfeeding. This guideline applies to all women who may become pregnant because so many pregnancies are unplanned. Folic acid/multivitamin supplementation is needed to achieve the red blood cell folate levels associated with maximal protection against neural tube defects. If a woman has had a child with a neural tube defect in a prior pregnancy, she should talk to her doctor because her recommended intake of folic acid will likely be higher.

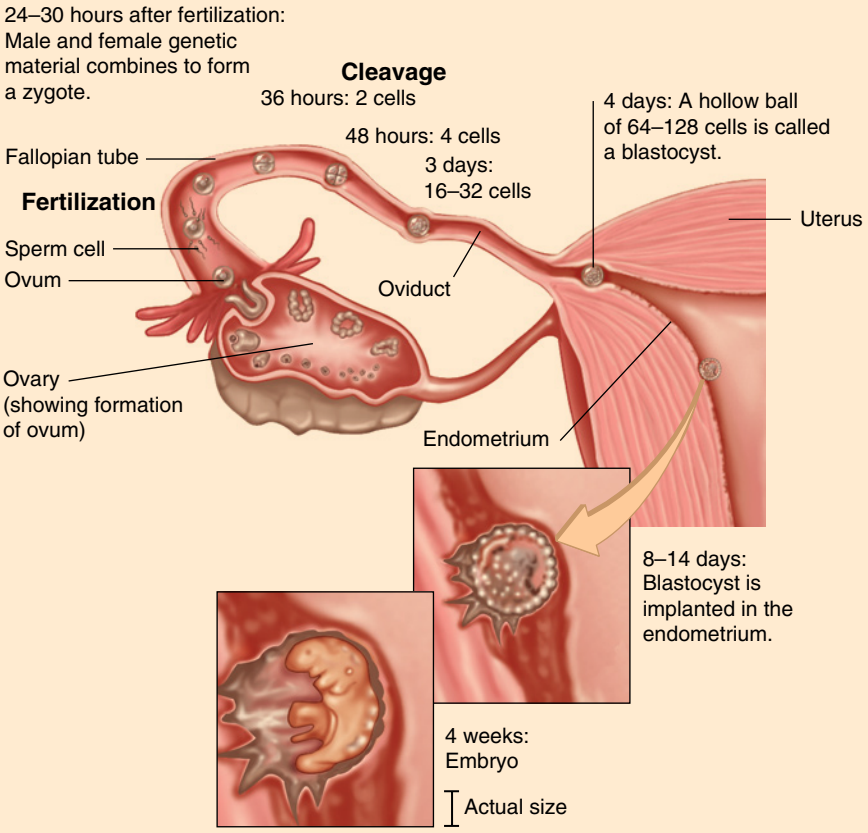
Iron

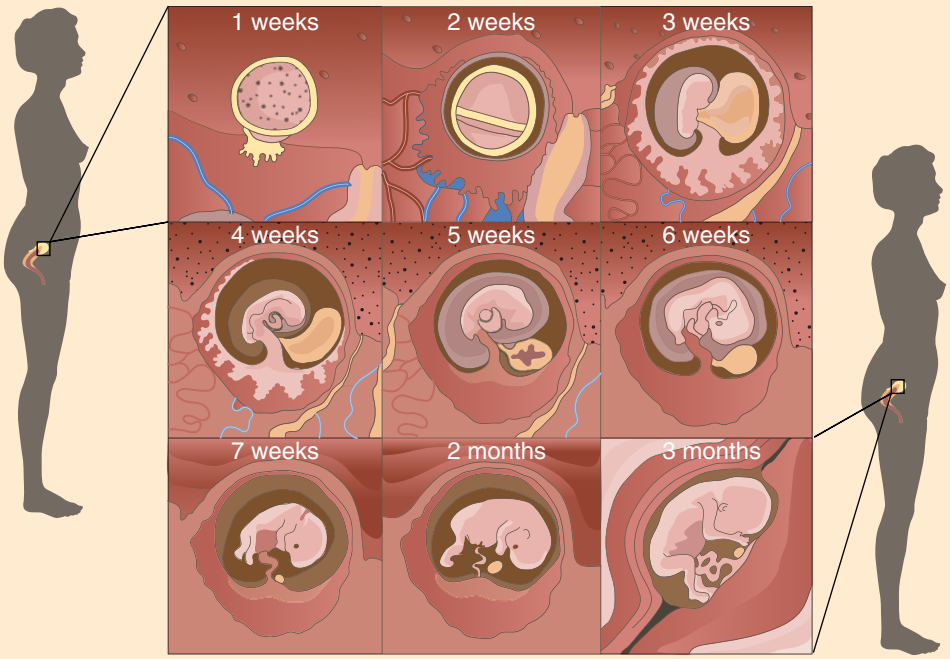
An iron-rich diet may lower the risk of ovulatory infertility, which is when a woman ovulates rarely or not at all, a cause of infertility that affects 25% of infertile couples.[43] Iron deficiency is a very common nutritional

The Big Picture

Adequate folate intake is crucial during specific stages of embryonic development, including the following:

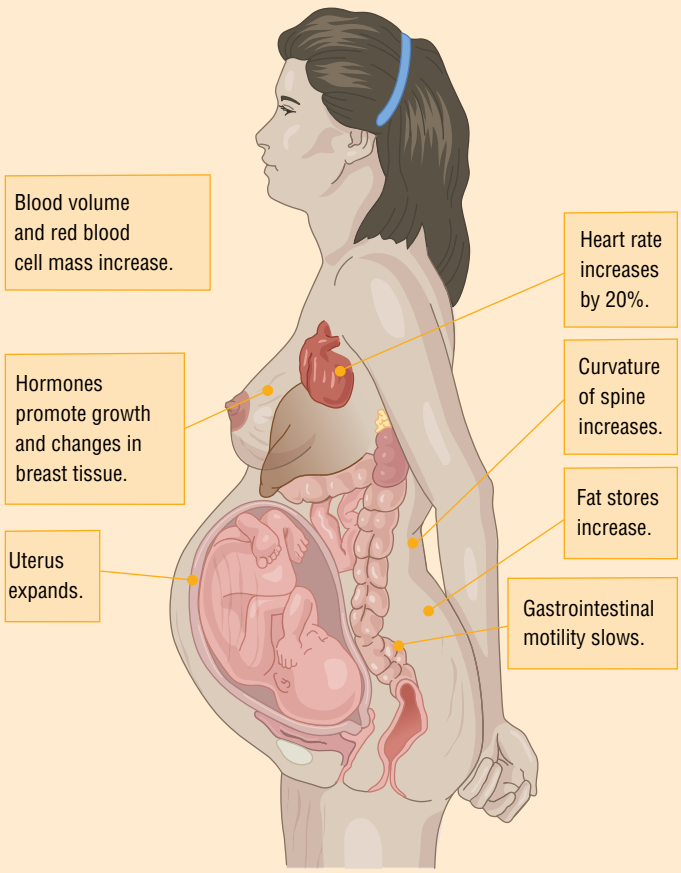
1. Fertilization of an egg (ovum) with sperm creates a zygote, whose cells divide rapidly. The zygote enters and attaches to the uterus (implantation), becoming a hollow ball of cells called a blastocyst.
2. After implantation, the blastocyst starts to develop the placenta and the amniotic sac that will house the embryo. This stage of embryo development is when most internal organs and external body structures are formed. Within about 16 days of fertilization, the heart and the major blood vessels begin to develop. Most other organs begin to form about 3 weeks after fertilization. The embryo elongates, and the area that will become the brain and spinal cord (neural tube) begin to develop.





Most birth defects occur during the period when organs are forming. At this time the embryo is most vulnerable to the effects of too little nutrients, such as folic acid, which is essential for spinal cord and brain development. The effects of drugs, radiation, and viruses can also be detrimental during this stage.

3. By the 8th week after fertilization, the embryo is considered a fetus. Structures that have formed grow and develop. By week 12, the fetus fills the entire uterus; by week 14, the sex can be identified; by weeks 16–20, the pregnant woman can feel the fetus move; and by week 24, the fetus has a chance of survival outside of the uterus.



©Steven Blandin/Shutterstock

problem in the United States and worldwide. Iron is a mineral that plays a critical role in creating the protein hemoglobin, which attaches to red blood cells and delivers oxygen throughout the body. In individuals with anemia, fewer red blood cells exist. Although different types of anemia exist, the most common type occurs from a deficiency of iron. Whereas the degree of deficiency is important, it has recently been established that the timing of deficiency is even more important. Women who are anemic during their first trimester of pregnancy have babies who show more delays in development and have behavioral and learning issues.[44] Ensuring that a woman begins pregnancy with adequate iron stores is critical.

The recommended intake of iron during the preconception period is the same amount that is recommended during pregnancy, which is 27 mg per day. If a woman is found to have low iron stores or is already anemic, she may need more supplemental iron. Although iron is found in many foods, especially in animal proteins, it is still recommended that women begin taking iron supplements prior to becoming pregnant and continue throughout pregnancy. Adding vitamin C such as from citrus fruits, bell peppers, or berries to meals enhances iron absorption. FIGURE 2.7 identifies iron-rich foods.

Iodine

It is widely known that thyroid dysfunction may result in subfertility. One out of every nine women (11%) has thyroid function tests consistent with hypothyroidism,[45] making thyroid dysfunction prevalent among women of reproductive age.

The trace mineral iodine is necessary for proper thyroid function. The thyroid gland needs iodine to manufacture the hormones thyroxine (T_4) and triiodothyronine (T_3). Every cell in the body depends on thyroid hormones for proper regulation of metabolism, blood calcium levels, energy production, fat metabolism, oxygen utilization, balance among hormones, and weight maintenance. During the time of preconception, proper function of the thyroid gland is necessary for body functions such as proper cell division, cell metabolism, growth, development, and repair of the body and for ovulation. When the thyroid does not have enough iodine owing to iodine deficiency, thyroid functions are compromised.

Hypothyroidism, a condition in which the thyroid gland does not produce enough hormones to keep the body running normally, can affect fertility by inhibiting ovulation. Hypothyroidism can also result in luteal phase problems, such as short second half of the menstrual cycle and implantation problems. When a fertilized egg cannot implant securely, it leaves the body at the same time that menstruation would normally occur, and this passage of menstrual fluid is sometimes mistaken as normal menstruation. Hypothyroidism can also result in high prolactin levels because of elevated levels of thyroid-releasing hormone (TRH) and low levels of thyroxine (T_4), and this results in irregular ovulation or no ovulation. Other hormonal imbalances can result from hypothyroidism, including reduced sex hormone binding globulin (SHBG), estrogen dominance, and progesterone deficiency, all of which interfere with proper reproduction hormone balance.

Iodine may be obtained from drinking water and from foods. In the United States and Canada, seafood and iodized salt are good sources of iodine. Depending on the iodine content of soil, vegetables and fruits also contain iodine. In the United States and Canada, iodine content in the soil is low, and therefore adding iodine to salt and bread is common, making iodine intake generally adequate.

Certain foods can interfere with the production of thyroid hormone. Individuals with hypothyroidism should limit intake of broccoli, Brussels sprouts, cabbage, cauliflower, kale, turnips, and bok choy because these vegetables can block the thyroid's ability to absorb iodine.

Stress management is imperative. Stress results in elevated levels of cortisol, the main hormone released by the adrenal glands. Increased cortisol inhibits the conversion of T_4 to the active T_3. Exercise is beneficial because it stimulates thyroid hormone secretion and increases tissue sensitivity to thyroid hormones.

Once thyroid issues are improved, in some women fertility issues are resolved and successful pregnancy is achieved.

Figure 2.7
Iron-rich foods.
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Multivitamins

In addition to eating foods rich in nutrients, women who are considering pregnancy are encouraged to check with a healthcare provider to assess their need for a prenatal vitamin and mineral supplement. The prenatal period is a critical window for the future health and functioning of both mother and child. A multivitamin, specifically a prenatal vitamin, is designed to provide all of the additional

vitamins and minerals a developing baby may need. In general, prenatal vitamins contain many of the same micronutrients found in daily multivitamins, but they usually contain higher levels of folic acid and iron. Many vital organs of a developing fetus are formed by week 10 of pregnancy, so it is important to have all of the essential vitamins and minerals available in advance of conception.

Recap No one eating plan is recommended for all individuals who want to conceive. Women of childbearing age should consider taking supplemental folic acid and iron. Men benefit from a healthy diet and supplementing with zinc and other antioxidants while eliminating environmental exposures that could damage their fertility.

1. What two nutrients may be important for optimal male fertility?
2. Why is it important for women of childbearing age to take a folic acid supplement?
3. Describe the importance of iron in pregnancy and why it is important to start out a pregnancy with adequate iron stores.

Lifestyle Habits During Preconception

Preview During the preconception period, it is important for both men and women to avoid certain lifestyle choices. Caffeine consumption, alcohol and recreational drug use, smoking, and use of birth control are all factors that can possibly delay fertility.

Coffee

Coffee and other caffeinated beverages are a common part of many people's daily routines. It was believed that caffeine contributed to miscarriages and low birth weight, but data remain mixed. Today, recommendations on caffeine are for no more than 200 mg per day for women who are pregnant, and this is believed to be a safe recommendation for women who are trying to get pregnant.[46] FIGURE 2.8 reviews the amount of caffeine in common beverages; it is easy to bypass the 200-mg daily recommendation.

Alcohol and Other Recreational Drugs

Alcohol is a commonly consumed beverage in the United States. In a study, women of childbearing age were asked whether they had consumed alcohol in the 3 months prior to getting pregnant and 50.1% reported that they had.[47] Women who were older than 35 years of age and Caucasian were the most likely to consume alcohol before becoming pregnant.

Alcohol is a known **teratogen** during pregnancy and intake can cause stillbirth, preterm birth, and miscarriage. No amount of alcohol is recommended during pregnancy. For women, no definitive association has been found between moderate drinking and fertility, but there appears to be some evidence to suggest binge or excessive drinking affects fertility. The danger is that many women get pregnant unexpectedly and often are 4–6 weeks into their pregnancy before they realize they are pregnant.

Other recreational drugs, including marijuana, have been found to be teratogenic during pregnancy. It is advised, therefore, for women who are actively trying to conceive to stop using alcohol and other recreational drugs.

Case Study

Suzanne works full time, and at the end of the day she often doesn't feel like cooking. She and her husband eat fast food 3–4 times a week, they hike about 60 minutes once during the weekend, both drink wine 4–5 times a week (Suzanne limits herself to 1 glass, but her husband often consumes up to 3 glasses per occasion), and both consume 2–3 large cups of coffee a day.

Medications: None currently
Supplements: None currently
Biochemical values: Glucose: 105 (high); cholesterol: 210 (high); LDL: 155 (high); HDL: 39 (low); triglycerides: 155 (high)
Blood pressure: 125/80 mm Hg (high)
Anthropometrics: Height: 167.64 cm/66 inches; weight: 90.7 kg/200 lb
Body mass index: 32.3

Questions

1. What diagnoses can be made based on Suzanne's labs?
2. What lifestyle modifications would you recommend for Suzanne prior to her becoming pregnant?
3. What medications may be helpful to her in getting pregnant?
4. Would you recommend a supplement to Suzanne, and if so, what should she make sure it contains?
5. Would you recommend her husband make any modifications to his lifestyle? If yes, which?
6. Should they consider waiting for a while before trying to conceive? If yes, why and for how long?

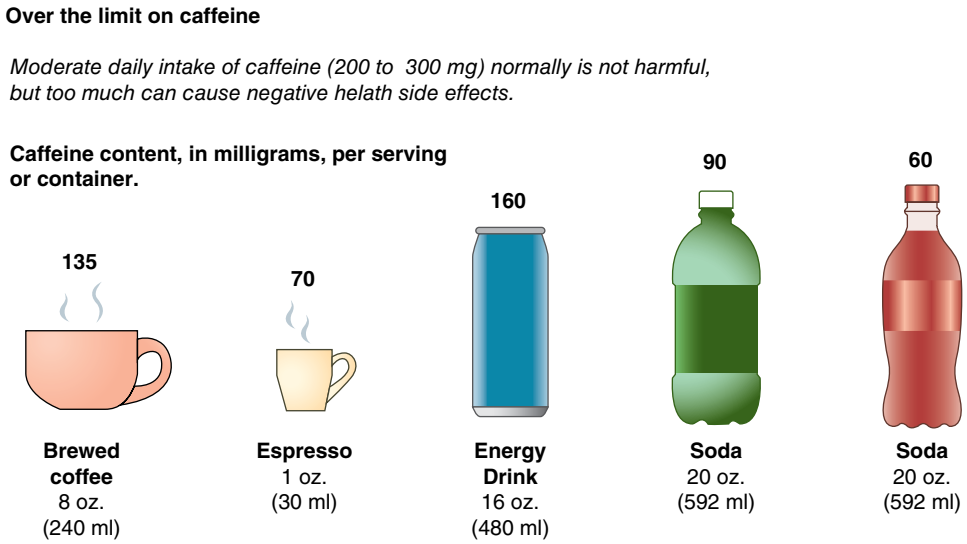

Figure 2.8
Caffeine content of common beverages.

Smoking

A surprising 23.3% of women reported smoking in the 3 months prior to pregnancy.[48] Those who smoked were typically younger than 20 years of age, Caucasian, and their pregnancy was unintended. Smoking is known to be dangerous when a woman is pregnant, because it limits the amount of oxygen available to the baby and can cause tissue damage. This can lead to fewer nutrients being delivered and less waste being removed, an outcome that may eventually lead to birth complications and low birth weight. Smoking can also make it harder for a woman to get pregnant.[49] It is advisable that women stop smoking when they are trying to get pregnant.

Birth Control

About 62% of women of childbearing age use hormonal contraceptives, with the birth control pill the most common method.[50] There is some concern and debate about whether birth control pills and other hormones used to prevent pregnancy impair or delay fertility. Although there is no consensus, birth control pills can cause other issues such as increased cholesterol levels, higher blood pressure, and higher triglycerides, depending on the type of contraceptive used. Birth control is a central component of preconception care and discussion about its use and possible side effects should be included in a preconception visit.

Recap A number of different lifestyle habits, or choices, during the preconception period for both men and women can hinder chances for successful conception. Caution should be used and guidelines followed to ensure that the health of both baby and mother are protected prior to conception.

1. What are the recommendations for caffeine intake for those trying to become pregnant?
2. Describe possible consequences of alcohol use prior to pregnancy.
3. How does smoking negatively affect preconception in both men and women?

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Learning Portfolio

Visual Chapter Summary

Preconception Period

- The preconception period is the time prior to when a woman becomes pregnant.
- Addressing her and her partner's health prior to conception can reduce risks for the mother and child.
- All women and couples should have a reproductive life plan.
- Preconception care encompasses the biomedical, behavioral, and social health interventions provided to women and couples prior to conception.

Table 2.1

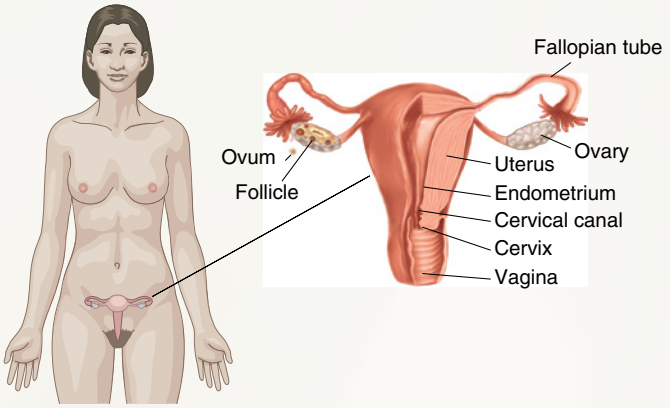
Recommendations to Improve Preconception Health[3]

1. Individual Responsibility Across the Life Span	Adult men and women should have a reproductive life plan.
2. Consumer Awareness	Increase public awareness of the importance of preconception health behaviors and preconception care services available.
3. Preventive Visits	Provide risk assessment and health promotion education to all women of childbearing age.
4. Interconception Care	Use the time between pregnancies to provide additional interventions and education to women who have had a previous pregnancy that ended in an adverse outcome.
5. Prepregnancy Checkup	Offer, as a component of maternity care, one prepregnancy visit for couples and persons planning pregnancy.
6. Health Insurance Coverage for Women with Low Income	Increase health insurance coverage for women with low incomes to improve access to preventive women's health and preconception and interconception care.
7. Public Health Programs and Strategies	Integrate components of preconception health into existing local public health and related programs.
8. Monitoring Improvements	Maximize research mechanisms to monitor preconception health.

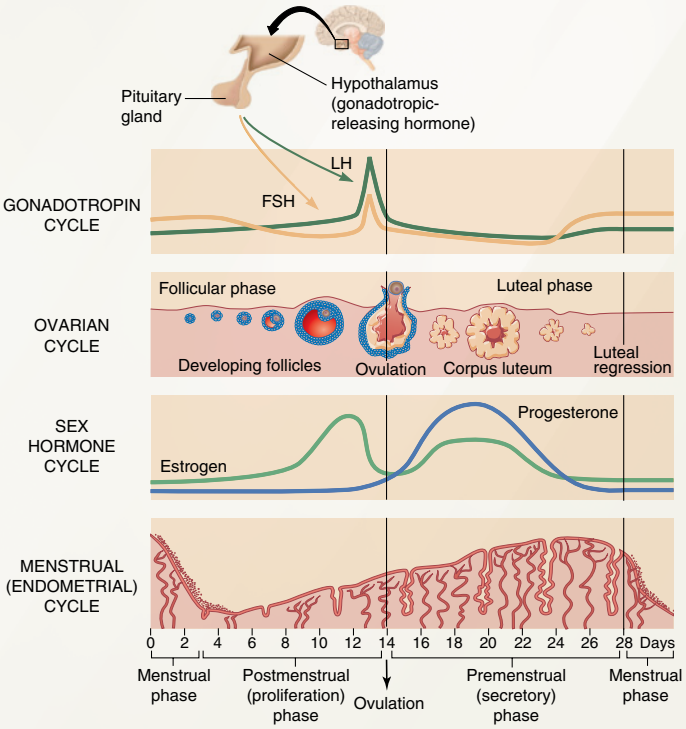
Modified from Healthy People 2020 Recommendations to Improve Preconception Health

The Physiology of Reproduction

- Preconception care can improve healthy habits and decrease adverse health problems for the mother, child, and society.
- A woman is born with 1 to 2 million eggs and releases about 500 in her lifetime.
- Males can generate millions of new sperm daily.
- The female reproductive system is made up of the ovaries, uterus, fallopian tubes, cervix, and vagina.
- Four main hormones are responsible for the monthly menstrual cycle: FSH, LH, estrogen, and progesterone.
- Men have many structures in their reproductive system, including the penis, scrotum, testes, epididymis, vas deferens, urethra, seminal vesicles, and prostate gland.
- Sperm are produced in the scrotum and move to the epididymis to mature; they are released via the urethra with fluid from the seminal vesicles and prostate gland.

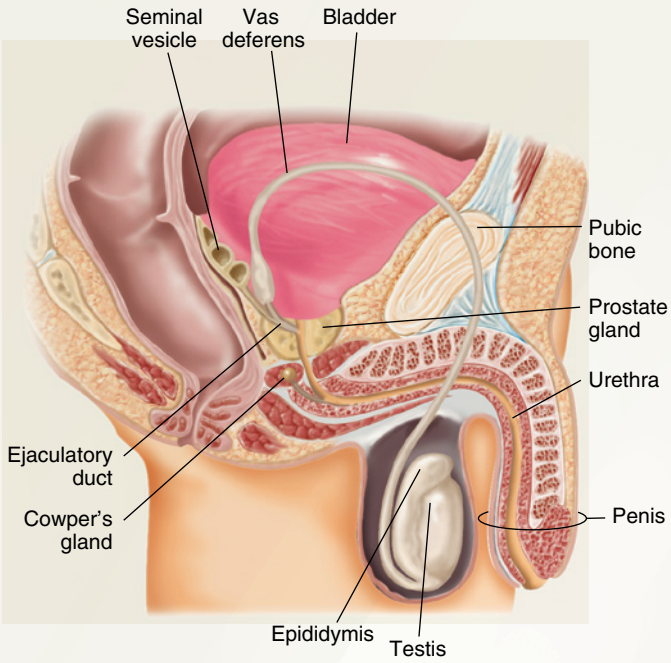


The female reproductive system.



Female menstrual cycle hormones.

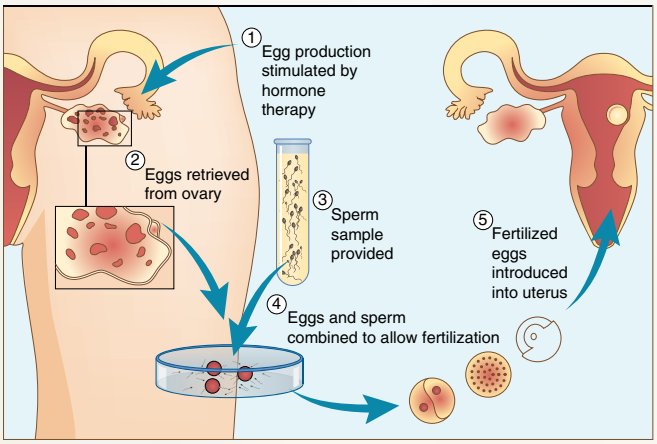
Learning Portfolio (continued)



The male reproductive system.

Infertility, Subfertility, and Assisted Reproductive Technology

- The average age for women to conceive has increased.
- Many women and couples delay starting their families until they are 30 years or older.
- Infertility is the inability to achieve conception after 12 or more months of unprotected sex.
- Delaying childbearing can cause reproductive delays owing to egg or sperm issues.



- ART is one strategy for assisting conception and is gaining popularity.
- ART contributes to a higher number of high-risk birth outcomes because of increased chances of twins and higher-order multiples.

Common Health Conditions

- PCOS is a common condition that affects fertility and is characterized by cysts on the ovaries, high androgen levels, and possibly amenorrhea and anovulation.
- PCOS can be treated with medications and potentially a low-carbohydrate diet.
- Many women are at risk of diabetes.
- Type 1 and type 2 diabetes are different, and women with uncontrolled blood sugar from either type are at risk of poor pregnancy outcomes for themselves and the baby.
- Men with diabetes have lower testosterone levels, which can lead to less healthy sperm.
- Carbohydrate counting is a promising meal-planning strategy that may be helpful prior to pregnancy.
- Many women enter pregnancy with hypertension, which puts them at risk of preeclampsia.
- The DASH diet can help improve outcomes.
- Celiac disease is an autoimmune disease in which people are unable to consume wheat, barley, and rye without damaging their intestines and causing other adverse health outcomes.

Table 2.4

Common Symptoms of Polycystic Ovary Syndrome

Menstrual problems	Hair loss from the scalp	Fertility problems or repeat miscarriages	Depression or mood swings
Acne, oily skin, or dandruff	Hair growth on the face, chest, back, stomach, thumbs, or toes	Insulin resistance and too much insulin, which can contribute to obesity	Breathing problems while sleeping
Cysts on the ovaries	Weight gain or obesity, especially around the waist	Skin tags	Pelvic pain

Reproduced from Office on Women's Health, U.S. Department of Health and Human Services. Polycystic ovary syndrome (PCOS). Retrieved from: http://www.womenshealth.gov/publications/our-publications/fact-sheet/polycystic-ovary-syndrome.html#d. Accessed: January 12, 2016.

Table 2.5

Comparison of Type 1 and Type 2 Diabetes Mellitus

Feature	Type 1 Diabetes	Type 2 Diabetes
Onset	Sudden	Gradual
Age at onset	Any age, but mostly in young children up to teenage years	Most common in adults
Body type	Generally thin or normal	Often obese
Presence of endogenous insulin	Low or absent	Normal, decreased, or increased
Prevalence	~10% of all individuals with diabetes in the United States	~90–95% of all individuals with diabetes in the United States

Data from American Diabetes Association. Retrieved from: http://www.diabetes.org

Table 2.6

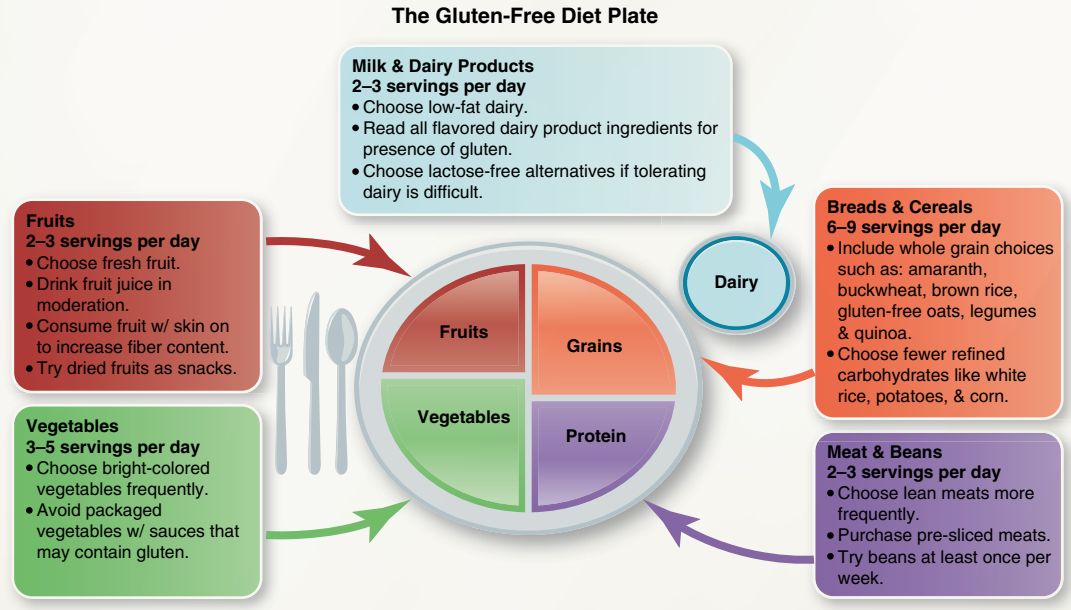
Daily and Weekly DASH Eating Plan Goals for a 2,000-Calorie-a-Day Diet

Food Group	Daily Servings
Grains	6–8
Meats, poultry, and fish	6 or less
Vegetables	4–5
Fruit	4–5
Low-fat or fat-free dairy products	2–3
Fats and oils	2–3
Sodium	2,300 mg*
	Weekly Servings
Nuts, seeds, dry beans, and peas	4–5
Sweets	5 or less

*1,500 milligrams (mg) sodium lowers blood pressure even further than 2,300 mg sodium daily.

Reproduced from National Heart, Lung, and Blood Institute. Description of the DASH eating plan. Retrieved from: https://www.nhlbi.nih.gov/health/health-topics/topics/dash. Accessed January 12, 2016.

- Celiac disease can lead to infertility and poor pregnancy outcomes.
- Getting a proper diagnosis and avoiding wheat, barley, rye, and oats have been shown to improve outcomes.
- Individuals with a history of STIs or a current STI should see a healthcare practitioner for treatment; many STIs can be treated prior to pregnancy.
- Women and couples with HIV may have options for conception; alerting their healthcare provider prior to conceiving is critically important.



MyPlate gluten-free diet plate.

Reproduced from ChooseMyPlate.gov.

Learning Portfolio (continued)

Nutrition Recommendations During Preconception

- There is no recommended preconception diet other than an overall healthy diet, such as the meal plan found on USDA's ChooseMyPlate.
- A diet high in carbohydrates (especially carbohydrates with a high glycemic index), saturated fat, and animal protein and low in multivitamins and iron may impair fertility.
- Folic acid is an important B vitamin needed to make DNA and produce and maintain cells.
- Insufficient folic acid at critical times of development can lead to neural tube defects.
- Women of childbearing age are recommended to consume 400–800 mcg of folic acid daily in the form of supplements, fortified food, and food.
- Iron is a critical mineral needed to make hemoglobin, which delivers oxygen in the body.
- Low iron and anemia contribute to delayed development and behavioral and learning issues.
- Women are recommended to consume 27 mg of supplemental iron during the preconception period but may need more if stores are low or women are anemic.
- Women should consume 300 mg of DHA in a supplemental form because it helps with brain and eye development and is associated with fewer low-birthweight and preterm deliveries.
- Multivitamins may be warranted during the preconception period.

Table 2.8

Food Sources of Folic Acid

Fortified cereal	Broccoli	Enriched pasta and bread
Cooked lentils and beans	Great Northern beans	Cantaloupe
Spinach	Asparagus	Eggs
Lettuce (cos, or romaine)	Avocado	Tropical fruits

Table 2.7

Eating and Lifestyle Recommendations to Improve the Health of Sperm

Eating	Lifestyle Choices
Consume 2½ cups of vegetables and 2 cups of fruit each day.	If you drink alcohol, do so in moderation—no more than two drinks per day.
Eat at least half of all grains as whole grains each day (choose whole wheat bread, oatmeal).	Avoid cigarettes and marijuana.
Consume at least 3 servings of low-fat dairy each day.	Obtain or maintain a healthy weight.
Evaluate your red meat intake and cut back as able. Choose leaner protein sources: fish, turkey, chicken, pork. Include vegetable proteins such as beans, nuts, seeds, and tofu.	Exercise 5 days a week for at 30 minutes—extreme exercise has been shown to decrease testosterone, which can lower sperm count.
Limit saturated fats from meats, full-fat dairy products, and fried foods. Replace these with healthy fats such as almonds and avocado.	

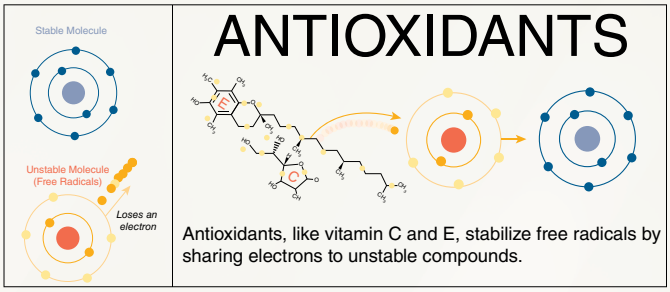
Data from Sharol Denny, Academy of Nutrition and Dietetics. How a Man's Diet Affects Fertility Too. November 19, 2014. http://www.eatright.org/resource/health/pregnancy/fertility-and-reproduction/how-a-mans-diet-affects-fertility-too..

Lifestyle Habits During Preconception

- For men, ensuring enough zinc and antioxidants in the daily diet can help produce healthier and larger supplies of sperm.
- For men, occupational and environmental factors such as exposure to heat, heavy metals, and pesticides should be addressed because they may impair sperm health.
- Overweight and obesity rates are at an all-time high in the United States.
- Many women begin pregnancy overweight or obese; a BMI over 25 puts a woman at risk for reduced fertility and pregnancy-related issues.
- Losing 10% of body weight can improve fertility rates among women.
- Bariatric surgery can improve fertility among men and women.
- A BMI of less than 19 can impair fertility.
- Being underweight among men and women disrupts reproductive capabilities.
- Eating disorders are common in the United States, with the most common being bulimia, anorexia nervosa, and binge eating disorder.

- Caffeine can harm the developing baby; recommended amounts are less than 200 mg per day.
- Alcohol and recreational drugs are known teratogens during pregnancy; their use may also reduce fertility and should be eliminated among women and couples actively trying to conceive.
- Smoking during pregnancy limits the oxygen available for the developing baby.
- Smoking can decrease fertility among women and men and should be decreased and ideally stopped prior to conception.
- Birth control has its benefits to prevent unwanted conception; however, the pill can cause increased cholesterol, triglycerides, and blood pressure among some women.

Iron-rich foods
©bitt24/Shutterstock



Antioxidants can help scavenge free radicals.

Key Terms

amenorrhea: The absence of menstruation.
anovulation: Failure of the ovary to release an egg over time, usually 3 months or longer.
antioxidant: A synthetic or natural substance that inhibits the oxidation of another molecule, especially one used to counteract the deterioration of stored food products.
assisted reproductive technology (ART): Any treatment or procedure that uses in vitro technology with oocytes (immature ova or egg cells from the female), sperm, or embryos.
hypothyroidism: A condition caused by an underactive thyroid or inadequate maternal iodine intake during pregnancy that is characterized by intellectual disabilities, growth impairment, and deafness in the infant.
infertility: Inability to get pregnant after 12 or more months of regular unprotected sexual intercourse.
ovulation: When the mature egg is released from the ovary into the fallopian tube and becomes available for fertilization.
preconception health care: A type of health care that identifies medical, behavioral, and social risks and modifies them prior to conception.
preconception period: The time prior to or between conceptions.
preeclampsia: Hypertension with onset following 20 weeks of pregnancy that is characterized by a sudden rise in blood pressure, excessive weight gain, generalized edema, proteinuria, severe headache, and visual disturbances and that may result in eclampsia if untreated. It can lead to fetal growth restriction.
subfertility: Diminished fertility but still able to become pregnant; hypofertility.
teratogen: Something in the environment of the embryo that can cause birth defects`.

Learning Portfolio (continued)

Discussion Questions

1. If a friend tells you she is having trouble getting pregnant and wants to try ART, what steps would you suggest she take prior to her first appointment?
2. What are the advantages and disadvantages of waiting to have children?
3. In 1998, the U.S. government made the decision to fortify all cereals and many grains with folic acid to prevent neural tube defects. It has worked, and rates of neural tube defects are down. However, research has begun to suggest that there is a surge in cancers that may be related to the increased amount of folic acid being consumed. What do you think? Should we be encouraging *all* members of society, including those at low risk (like men who are not of reproductive age and older adults), to consume folic acid?

Activities

1. Think about yourself right now. Do you have a preconception plan? What steps do you need to take to put a plan into action? What are you doing that is helpful or hurtful if you plan on conceiving in the future?
2. Visit the website http://www.mothertobaby.org/. Look on the Resources tab for fact sheets. Find at least one fact sheet that interests you or that you've never heard about before. Open it and see whether you agree with the information or whether it's what you've always believed. Write a paragraph about the fact sheet to share with the class.

Study Questions

1. What are components of preconception care that should be addressed to improve outcomes for the mother and child?
   a. Medical, behavioral, and social
   b. Social, financial, and medical
   c. Social, financial, and religious
   d. Medical, financial, and behavioral
2. What are the roles of FSH and LH in the follicular phase of the menstrual cycle?
   a. Stimulate estrogen and progesterone production.
   b. Stimulate eggs to grow in the ovaries.
   c. Release the eggs from the ovaries.
   d. FSH and LH are not released during the follicular phase.
3. Which of the following best describes the steps of ovulation?
   a. The follicular phase allows stimulation of egg growth into follicles, allowing one to mature, which is then released from the ovary during the luteal phase.
   b. The luteal phase allows a surge of LH, which stimulates the ovaries to release an egg from the ovary into the fallopian tubes.
   c. Ovulation is when the empty follicle becomes the corpus luteum.
   d. Ovulation is when the egg passes through the uterus and the lining breaks down.
4. How long does it take for sperm to mature?
   a. 30 days
   b. 50 days
   c. 70 days
   d. 90 days
5. What is the trend in age for women having children in the United States?
   a. More teens are having children than ever before.
   b. More women are waiting until they are 35 years and older to have children.
   c. Women are having children at the same age today as they were 40 years ago.
   d. Women older than 40 are not trying to have children.
6. What is the danger in delaying childbearing for women?
   a. There are no risks.
   b. The woman is financially more secure.
   c. There are fewer health risks for a woman and her baby if she is older.
   d. Infertility and increased health risks for her and her baby.

7. What is a possible reason that women with PCOS have trouble getting pregnant?
   a. They produce androgens that interfere with the monthly menstrual cycle because they cause anovulation.
   b. They have low circulating levels of insulin.
   c. They are overweight.
   d. They eat a high-carbohydrate diet.
8. What are the possible negative outcomes for the mother and baby when a woman enters a pregnancy with uncontrolled blood sugar?
   a. Low and high blood sugar
   b. Large babies
   c. Fetal death
   d. High blood pressure for the mother
   e. All of the above
9. What foods should a woman with celiac disease eliminate from her diet?
   a. Only wheat products
   b. All carbohydrates
   c. Wheat, barley, rye, and oats
   d. Lactose
10. Women who have had an STI should not have children because STIs are incurable and may hurt her baby.
   a. True
   b. False
11. In one study of thousands of nurses, certain dietary practices were found to be helpful for women with infertility. Which, from the following list, was *not* helpful?
   a. Low saturated fat
   b. Foods with a high glycemic index
   c. Low supplemental iron intake
   d. High plant protein
   e. Low animal protein
12. Why is folic acid intake so important and recommended to all women of childbearing age prior to conception?
   a. Many women do not know they are pregnant at the time when the folic acid is most needed to close the neural tube.
   b. Up to half of all pregnancies are unplanned.
   c. It is possible to get enough folic acid in food, but you would have to eat a lot of fruit.
   d. Folic acid is so important we fortify cereals and other grains with it.
13. _____ are caused by oxygen and can damage DNA, while _____ can stop the chain reaction.
   a. Antioxidants, free radicals
   b. Free radicals, antioxidants
   c. Free radicals, DHA
   d. Oxygenation, antioxidants
14. What BMI range is found to result in the best chances of getting pregnant?
   a. Lower than 19 and higher than 25
   b. Lower than 19 and higher than 30
   c. Higher than 19 and lower than 30
   d. Higher than 19 and lower than 25
15. Eating disorders can result in amenorrhea, contributing to impaired fertility.
   a. True
   b. False
16. What amount of alcohol has been found to be safe prior to conception?
   a. 1–2 servings a day
   b. 1–2 servings per week
   c. 3–5 servings per week
   d. The data are not clear, but alcohol should be avoided to increase fertility and decrease risks if a woman becomes pregnant accidentally.

Weblinks

- **Show Your Love**
  http://www.cdc.gov/preconception/showyourlove/
  Show Your Love is a national campaign set up through the CDC that is designed to improve the health of women and babies by promoting preconception health and health care.
- **Before, Between & Beyond Pregnancy**
  http://beforeandbeyond.org/toolkit/about-this-toolkit/
  The National Preconception Curriculum and Resources Guide for Clinicians from **Before, Between & Beyond Pregnancy** provides information and toolkits to help clinicians build care plans for women seeking pregnancy.
- **Midwifery Obstetrical Nursing**
  http://obgnursing.blogspot.com/2012/07/preconception-care-and-counseling.html

Learning Portfolio (continued)

A website designed for nursing students. Includes a comprehensive checklist of the different areas that should be assessed during a preconception visit.

- **March of Dimes**
  https://www.marchofdimes.org/catalog/category.aspx?categoryid=195&
  The March of Dimes has three research-based books for nurses that address a variety of topics related to preconception care. The books are: *Challenges and Management of Infertility, Including ART; Preconception Nursing Care*; and *Preconception Health Promotion*.

- **Best Start Preconception Health Resources**
  http://www.beststart.org/cgi-bin/commerce.cgi?search=action&category=F00E&advanced=yes&sortkey=sku&sortorder=descending
  Best Start is an education resource for preconception health developed by the charitable organization Health Nexus. The education provided focuses on the importance of women's and men's health before conception.

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