



Understanding PCOS

By Carol Brannon, MS, RD, LD

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Level 2

See Continuing Education credit information on page 14

Learning Objectives

Upon completion of this module the student will be able to:

1. Define and describe polycystic ovary syndrome.
2. Identify the physical (visible) and clinical signs of PCOS.
3. Describe the role of insulin and androgens in PCOS.
4. List the environmental factors that contribute to insulin resistance.
5. Explain the relationship of insulin resistance to infertility and central obesity.
6. Understand and describe the relationship of PCOS to dyslipidemia and cardiovascular disease.
7. Explain and understand the role of diet modification and therapy, especially recommendations regarding dietary carbohydrate intake, in treating PCOS.
8. Describe the potential protective and therapeutic role of supplemental doses omega-3 fatty acids in PCOS.
9. Identify and understand the role of medications (oral contraceptive pills, insulin-sensitizing drugs, fertility drugs) frequently prescribed to treat or manage PCOS.
10. List the dietary recommendations for a woman with PCOS.

***I**t was evident that the emotional stress of infertility was taking its toll on her. At the age of 33, she had been trying to get pregnant with her husband for the past two years. At 5'7" and 180 lb, she knew weight loss was essential to overcoming her infertility. My client was battling infertility secondary to polycystic ovary syndrome (PCOS).*

Polycystic Ovary Syndrome (PCOS), once thought extremely rare, takes an emotional toll on thousands of women (1). An estimated 5 to 10 percent of US women, about 10 million, have PCOS. Originally named the Stein-Leventhal Syndrome after the researchers who first reported on it in 1935 (2, 3), PCOS is a leading cause of infertility in women (4).

Many health professionals do not understand the complexities of PCOS, the link between infertility and insulin resistance and the role nutrition plays in the etiology and treatment. The mission of practitioners should be to educate, encourage, and empower women with PCOS to make the necessary dietary and lifestyle changes for successful weight loss, resulting in decreased insulin resistance (IR), and an increased opportunity to conceive for those seeking pregnancy. This article will provide the basics.

Description/Definition

PCOS is the most common female endocrine disorder. Monika Woosley, RD, a leading nutrition expert on PCOS and eating disorders has termed PCOS “the perfect endocrine storm” (1). PCOS is gaining the attention of healthcare professionals as studies reveal that it affects more than a woman’s fertility. Initially, it was considered just an obscure reproductive disorder, but today it appears to be a precursor to “metabolic syndrome” or insulin-resistance syndrome (IRS), and type 2 diabetes. In addition, PCOS contributes to hyperlipidemia and hypertension, and increases a woman’s risk of cardiovascular disease (CVD) and possibly estrogen-related cancers later in life (3, 5).

The clinical definition of PCOS, as proposed by the National Institute of Health in 1990, is *oligomenorrhea*, irregular menstrual flow and cycles, associated with ovarian hyperandrogenism — high levels of circulating androgens, as well as an increase in nitrogen and water retention. Androgen hormones are a class of sex hormones that include testosterone, responsible for the development and maintenance of secondary male sexual characteristics.

Although this definition sounds simple and straightforward, in reality PCOS is a complex, heterogeneous metabolic disorder with many manifestations. Besides oligomenorrhea and hyperandrogenism, other PCOS characteristics include (3, 5):

- amenorrhea (absence or abnormal menstrual flow);
- anovulation (absence of ovulation);
- infertility;
- acanthosis nigricans (dark velvety patches on skin);
- hirsutism (excessive facial and bodily hair growth);
- androgenic alopecia (male-patterned baldness);
- pelvic pain;
- acne;
- central obesity; and/or
- hyperinsulinemia.

There is some debate about the diagnosis criteria for PCOS, but generally a woman with PCOS exhibits at least two of the features described in the chart on the following page.

Defining Features of PCOS	
Feature	Description/Manifestations
Polycystic ovaries (PCO)	Enlarged ovaries with ≥ 10 small peripheral cysts Amenorrhea
Hyperandrogenism	↑ Ovarian androgen production Hirsutism Androgenic alopecia Acne
Anovulation	Absence of ovulation Infertility
Hyperinsulinemia/ Insulin Resistance	↑ Circulating insulin levels due to insulin resistance Acanthosis nigricans Central obesity Anovulation

Reference: (1)

PCOS is usually, but not always, associated with enlarged ovaries that have at least 10 small bilateral ovarian cysts (fluid filled sacs). An estimated 70 to 80 percent of women with PCOS have polycystic ovaries (PCO), which result from incomplete ovarian follicle development. In normal ovulation, ovarian follicles mature and release a secondary oocyte that divides into a mature egg or ovum. In many women with PCOS ovarian follicles do not mature and ovulation cannot occur (2, 6, 7).

The presence of polycystic ovaries in the absence of oligomenorrhea or hyperandrogenism does not constitute a diagnosis of PCOS, according to the 1990 NIH issued definition. In 2003, a broader, more inclusive definition was proposed at a consensus workshop in Rotterdam. However, expanding the criteria is controversial and more research is needed.

Thus, the presence of polycystic ovaries is not currently considered a defining feature of PCOS. In fact, the incidence of polycystic ovaries without any other defining PCOS symptoms may be more common than PCOS. A survey of women in the United Kingdom and New Zealand found an estimated 20 to 25 percent of women had polycystic ovaries, but not PCOS (8,9).

Polycystic ovaries commonly develop during the early stages of puberty and are often found in women with bulimia or recovering from anorexia nervosa (2,10). Monica Woosley has observed that many of her clients with PCOS also have a history of an eating disorder, usually beginning during adolescence. It could be that the symptoms of PCOS (hirsutism, central adiposity) negatively affects the body image and self-esteem of young girls, resulting in to the development of distorted eating habits and eating disorders (1).

Women with PCOS exhibit masculine traits of excessive facial and body hair (hirsutism) and female scalp hair loss similar to male pattern baldness (androgenic alopecia) secondary to elevated androgen levels (3, 6).

Etiology and Pathogenesis

The precise etiology of PCOS is unknown. Researchers believe the link between PCOS and its symptoms is hyperinsulinemia, an excessive production of insulin. The etiology of the hyperinsulinemia is unknown. However environmental and lifestyle factors such as obesity and inactivity, are major culprits in the development of PCOS (7). Family history is a strong predictor of PCOS leading researchers to investigate the role of genetics in the disease (7).

• **Insulin Resistance and Hyperinsulinemia:** Insulin resistance (IR) appears to be at the center of the hormonal imbalances and metabolic changes of PCOS. The majority of women with PCOS, regardless of their body weight or body mass index (BMI), exhibit some degree of insulin resistance.

The primary role of insulin is glucose regulation. The pancreas secretes insulin in response to a rise in blood glucose levels. Insulin binds to insulin receptors on the cells, allowing glucose to enter the cell. When insulin receptors become insulin resistant, the pancreas compensates by producing more insulin in an effort to maintain normal blood sugar levels, resulting in very high levels of insulin. It is this hyperinsulinemia that may cause the increase in the production of androgens resulting in an increase in abdominal fat, menstrual irregularities, anovulation, an increase in androgen production, accompanied by acne and hirsutism, and dyslipidemia (2,8,11).

The exact etiology of insulin resistance is unknown, but genetics, lifestyle, and environmental factors are known contributors. It is suggested that insulin resistance is caused by a genetic trait that produces abnormal insulin receptors. Obesity and inactivity are lifestyle factors that cause a down-regulation of insulin receptors, making them less sensitive to insulin (11). As fat cells become larger, it takes more insulin to have the same metabolic effect. The factors contributing to insulin resistance are shown in the following chart.

Factors Contributing to Insulin Resistance
<ul style="list-style-type: none"> • Genetic predisposition • Aging • Sedentary lifestyle • Smoking • Centralized obesity • Pregnancy • Medications (Corticosteroids, thiazide diuretics)
Reference: (11)

There may prove to be ethnic differences in the prevalence and severity of insulin resistance as a component of PCOS, just as there are ethnic differences in the incidence of obesity. One retrospective study of 102 women with PCOS found that insulin resistance is more prevalent and more severe in Mexican American women compared to white American women. Larger studies are needed before any conclusions can be made (3).

• **Adiposity:** Upper body or abdominal body fat, called central obesity, is a defining feature of PCOS and occurs secondary to insulin resistance. Even women with PCOS that have a healthy BMI of less than 27 have a tendency toward central adiposity and have a higher waist-to-hip ratio (ratio greater than 0.8) compared to weight-matched women without PCOS (12). Studies using ultrasound measurements found that lean women with PCOS have a higher proportion of visceral adiposity compared to weight-matched control subjects (13). As body fat increases so does the severity of insulin resistance, making weight loss extremely difficult (2).

An estimated 50 percent of women with PCOS are overweight (BMI greater than 27) or obese (BMI greater than 30). Studies indicate obese women with PCOS have more severe insulin resistance, higher levels of testosterone, and lower levels of luteinizing hormone (LH) than weight matched controls (14). PCOS and obesity appear to each have a separate and synergistic impact on insulin resistance. The long-term health consequences are more serious in obese females with PCOS. Many US and European studies indicate that obese women with PCOS progress from normal glucose tolerance to impaired glucose intolerance or to type 2 diabetes more rapidly than weight-matched controls without PCOS (15).

• **Menstrual Cycle Irregularities:** Hyperinsulinemia stimulates specific cells called “theca” cells in the ovaries to increase androgen production, particularly testosterone. Paradoxically in PCOS, the theca cells are overly sensitive to insulin, while muscle and liver cells are insulin-resistant. The insulin hypersensitivity of ovarian cells may be due to a single gene or multiple genes (16,17). It is unclear whether hyperinsulinemia precedes hyperandrogenism or vice versa. More research is needed (17).

Excessive production of ovarian testosterone results in increased conversion of testosterone to estrone, a potent, disease-promoting form of estrogen. Estrone levels are high in women with PCOS, while estradiol levels are within the normal range. Estradiol is considered the “good” form of estrogen because it appears to protect against cancer development (17,18,19,20). High estrogen levels prevent regular endometrial shedding, which in turn increases the risk for endometrial overgrowth and possibly cancer (21).

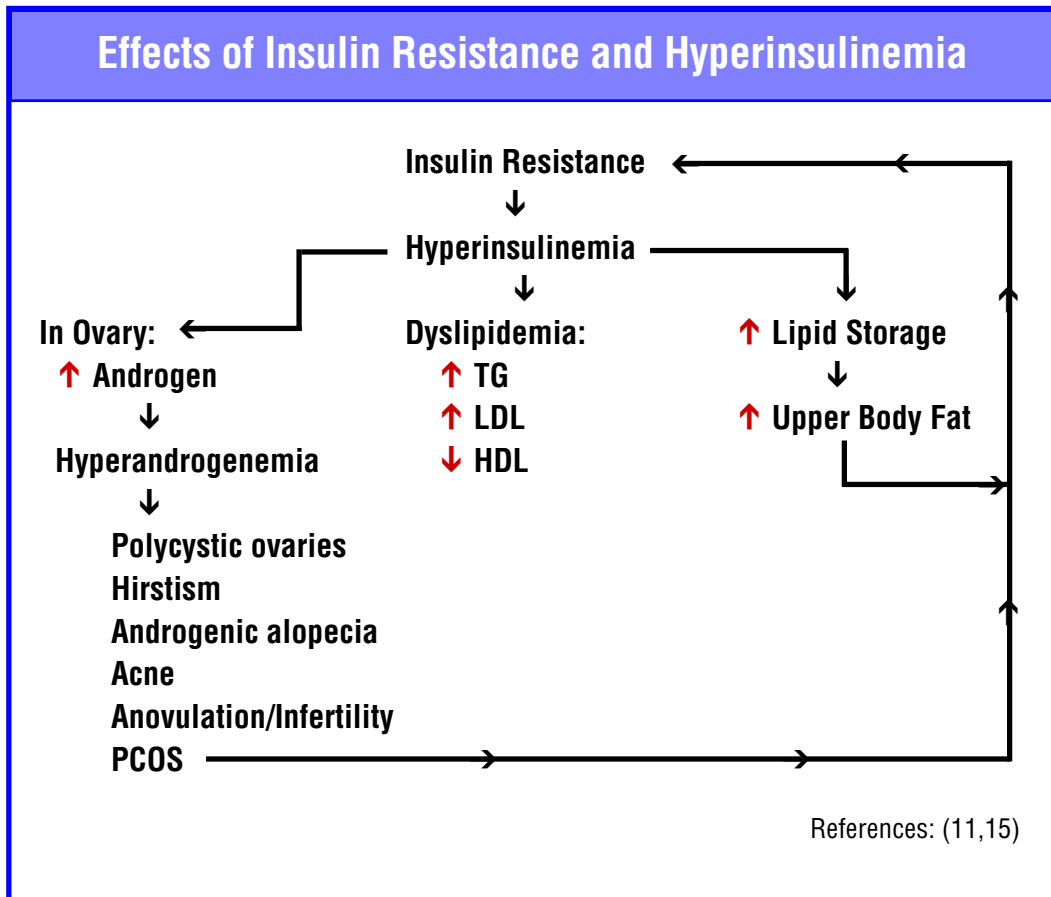
Hyperandrogenemia prevents ovulation by blocking follicle development and causes oligomenorrhea (2). Menstrual cycles are generally shorter than 21 days or longer than 35 days. PCOS is also associated with abnormal uterine bleeding, miscarriage, and other complications of pregnancy, such as gestational diabetes and pregnancy induced hypertension (17).

• **Skin and Hair Changes:** Acanthosis nigricans — dark, velvety patches on skin, particularly on the back of the neck and underarms — are physical signs of hyperinsulinemia (2,6).

Elevated testosterone levels trigger acne, hirsutism, and androgenic alopecia. However, hirsutism and androgenic alopecia can occur in the absence of PCOS (6).

• **Dyslipidemia:** Insulin resistance causes blood lipid changes. About 70 percent of women with PCOS have at least one abnormal lipid level (14,22). Obese women with PCOS are likely to have dyslipidemia, specifically elevated triglycerides and decreased HDL cholesterol. Some studies, which controlled for insulin resistance, found that elevated triglyceride levels and decreased HDL cholesterol levels are linked to insulin resistance, not PCOS (2). High triglycerides and low HDL levels are strongly linked with cardiovascular disease. Elevated LDL cholesterol levels have not been consistently found in women with PCOS (2).

The diagram in the chart on the following page outlines the metabolic changes that occur secondary to insulin resistance and hyperinsulinemia.



PCOS affects women at all stages of their lives. Clinical onset usually occurs at puberty but may occur later. Puberty often occurs prematurely and is characterized by insulin resistance. Precocious puberty, onset of menstruation before the age of 8 years, is linked to PCOS. Teenagers experience hirsutism, acne, oligomenorrhea, and insulin resistance. Young women with PCOS have an increased risk of developing an eating disorder in an effort to lose weight (1,17,23).

Women in their reproductive years may experience infertility, a high rate of miscarriages, and/or gestational diabetes or impaired glucose tolerance during pregnancy (11). Later in life, women are likely to develop type 2 diabetes, heart disease, and possibly cancer. In addition, females with PCOS are at higher risk for developing clinical depression, which should not be overlooked by healthcare practitioners (1, 24). Many women are not diagnosed with PCOS until they try to get pregnant and fail, although they may have had the disease for many years.

PCOS and Metabolic Syndrome

PCOS strongly resembles and often precedes the Metabolic Syndrome (or insulin-resistance syndrome), a clustering of abnormalities that dramatically increase CVD risk. Each abnormality of insulin-resistant syndrome is linked to CVD, but when these abnormalities are clustered together the CVD risk increases dramatically (25).

There are multiple definitions for insulin-resistant syndrome. The World Health Organization (WHO) definition of insulin-resistant syndrome proposes that diabetes, impaired glucose tolerance, or insulin resistance must be present, as well as two or more of the following: hypertension, microalbuminuria, central obesity, elevated triglycerides, and decreased HDL cholesterol levels.

The National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) definition is more widely used and does not require the presence of insulin resistance, but mandates the presence of three or more of the following: elevated triglycerides and/or decreased HDL levels, central obesity, hypertension, and/or impaired glucose tolerance (25).

Both of these definitions resemble PCOS, with the exception of hypertension, which is uncommon in PCOS (14). However one retrospective study indicates PCOS may predispose a woman to develop hypertension later in life (26, 27).

Diagnosis

PCOS is often underdiagnosed because it manifests differently in each woman. There is no single, definitive diagnostic test, so a diagnosis is made based on physical examination, ultrasound, and laboratory tests and by ruling out other disorders (19).

The physical signs (acanthosis nigricans, hirsutism, androgenic alopecia and acne) are easily detected. Polycystic ovaries are diagnosed by ultrasound. A woman's BMI and waist-to-hip ratio should also be assessed (7, 19). As mentioned earlier, many women do not have easily recognizable symptoms as PCOS, so until they fail to become pregnant, the disorder is not diagnosed.

Laboratory measurements indicative of PCOS are: elevated total testosterone, free testosterone and luteinizing hormone (LH) levels; and normal thyroid stimulating hormone (TSH) and prolactin levels. It is important to rule out other potential causes of hyperandrogenism before a diagnosis is made. TSH and prolactin levels are drawn to rule out adrenal tumors and pituitary or thyroid conditions (17).

The glucose tolerance test (GTT) is widely used as a diagnostic tool. Measurements for both glucose and insulin should be obtained to screen for any abnormal levels (17). One clinical study found a fasting glucose to insulin ratio useful in the measurement of insulin resistance in obese non-Hispanic women (28).

Managing PCOS

Diet Therapy

All aspects of PCOS can be managed with a combination of diet, exercise, and medication. The primary treatment goal is weight reduction.

Diet therapy is without question the most important and effective treatment for PCOS. The typical western diet (high in fat and refined carbohydrates, low in fiber) contributes to insulin resistance and chronic disease development. Weight loss of just 5 percent, along with diet modification, can lower insulin levels, reduce hyperlipidemia, reduce androgen and luteinizing hormone (LH) levels, and restore regular menstruation and ovulation (11, 17).

There is strong agreement that a hypocaloric diet is beneficial for overweight and obese women with PCOS. However, there is much debate about the optimal balance of macronutrients. Proponents of low carbohydrate (LC) diets advocate that high carbohydrate, low fat (HCLF) diets increase insulin levels, raise triglycerides, and lower HDL cholesterol. In contrast, opponents of low carbohydrate diets argue these diets are high in fat, leading to insulin resistance, weight gain, and heart disease (17).

What is the optimal diet for PCOS? Is the glycemic index relevant to PCOS? What follows are the evidence-based answers.

• **Carbohydrates.** The evidence is overwhelming that diets rich in fruits, vegetables, complex carbohydrates, and fiber lower chronic disease risk (29,30,31). The type of dietary carbohydrates may be more critical than the percentage. High fiber diets, particularly diets high in soluble fiber, prevent dyslipidemia and lower blood pressure (31). Studies indicate high fiber diets improve insulin sensitivity and facilitate weight loss (17).

• **Glycemic Index Diet.** There are many proponents of a low glycemic index (GI) diet as a means to improve insulin sensitivity. Low glycemic index foods are generally higher in fiber and less processed (32). Currently there is no conclusive evidence to support a therapeutic use of the glycemic index diet (33).

• **Fat.** A diet rich in omega-3 fatty acids and monounsaturated fats can improve insulin sensitivity and promote heart health in healthy people and those with diabetes. In contrast, dietary saturated fats increase insulin resistance and promote hyperlipidemia. Evidence supports consumption of a low-fat diet, comprised mostly of unsaturated fats (20,22).

• **Supplements.** Overall, findings are ambiguous regarding the supplemental use of flaxseed, glucomannan, guar gum, vitamin E, chromium, magnesium, and the botanical saw palmetto for PCOS (17).

Elevated levels of omega-3 fatty acids — alpha-linolenic, eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA) — appear to enhance ovulation. In addition to regularly consuming foods rich in omega-3 fatty acids, supplementation may be beneficial, but currently there is a lack of scientific evidence to support a specific recommendation (1). Foods rich in omega-3 fatty acids include fish, flaxseed, walnuts, flaxseed oil, canola oil and soybean oil.

Fish oil supplements, which contain the omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), have been found effective in improving glucose clearance, insulin sensitivity, decreasing fat deposition, protecting against heart disease, promoting ovulation, and treating depression (1,34). The American Heart Association (AHA) recommends that in addition to consuming fish at least twice weekly, people with coronary heart disease (CHD) should take 1 gm of EPA/DHA daily. AHA suggests that a supplement of 2 to 4 gm may be helpful for those with elevated triglyceride levels. Those taking more than 3 gm per day should be monitored by a physician (1).

Many fish oil supplements are available, including a fairly new supplement, Omega3BrainBooster™, a tasteless, odorless powder containing EPA/DHA that can be added to a variety of beverages and foods (www.omega3powder.com). My younger clients, who refuse to swallow a large fish oil supplement pill, are willing to add Omega3BrainBooster™ to their oatmeal,™yogurt, or juice. It is very well accepted and tolerated by young women and children. Belching is a common complaint of people taking fish oil pills.

Fish oil supplements may have a therapeutic role in PCOS treatment, especially for women with CHD, hypertriglyceridemia, and/or depression. At the present time, there is no research on a dose that is effective in women with PCOS (1). If a woman wants to try fish oil supplementation, start at a low dose of 1 gm/ day and increase to a maximum of 3 gm/day. Remember, high doses of fish oil can thin the blood and any woman on blood thinners should consult her physician before taking fish oil supplements.

Medications

Medications should only be prescribed as an adjunct to diet and exercise. Oral contraceptive pills (OCPs), androgen-blocking drugs, and insulin-sensitizing drugs are the three groups of medications used for PCOS treatment. Fertility drugs are prescribed for women trying to get pregnant (11).

- **OCA:** Low-dose oral contraceptive agents are prescribed for birth control because spontaneous ovulation can occasionally occur. Oral contraceptives, depending on the estrogen dose, can inhibit androgen, LH, and FSH production, stimulate regular menstrual periods, correct heavy uterine bleeding, and treat hirsutism. However, improvement may take up to one year (21). Of concern is the effect of oral contraceptive pills on glucose tolerance in women with PCOS. One study of 16 non-diabetic hyperandrogenic women found a decline in glucose tolerance over a six-month period, with two women developing diabetes. More research is needed to determine if OCA help or hinder glucose tolerance (11). Another issue with oral contraceptive pills is that once you stop taking them, the symptoms will reappear.

- **Androgen-blocking drugs.** Spironolactone™ (Aldactazide) is an androgen-blocking, antihypertensive diuretic agent. It is prescribed for the treatment of hirsutism, alopecia, and acne and is often prescribed along with an OCA. Spironolactone is contraindicated for women desiring pregnancy because it causes birth defects. Abnormal uterine bleeding is a possible side effect, which could be a problematic for women already experiencing abnormal bleeding (11,19,21).

- **Insulin-sensitizing drugs.** Metformin is a popular insulin-sensitizing medication prescribed for the management of type 2 diabetes. Although metformin is not an FDA-approved treatment of PCOS, it has shown promise in treating PCOS and appears more effective than other insulin-sensitizing agents. Metformin acts by increasing glucose uptake in fat and muscle cells, improving insulin sensitivity. Metformin decreases androgen levels and the symptoms of hyperandrogenism but does not improve weight, waist-to-hip ratio, or LDL levels (17,35). Side effects of Metformin may include GI distress and discomfort. Pregnant women should not take metformin.

- **Fertility drugs.** Clomiphene citrate (Clomid™) is generally the first fertility medication prescribed to women with PCOS. About 70 percent of women with PCOS who take Clomid become pregnant—however, there is a risk of multiple births. For those women who do not become pregnant on Clomid, human menstrual gonadotropin (Pergonal™) or human chorionic gonadotropin (HCG) are the next drugs of choice, but have a higher risk of multiple births and medical complications (21). Leuprolide (Lupron™), a gonadotropin-releasing hormone agonist, is prescribed to reduce miscarriage risk, which is higher in women with PCOS (21).

Exercise

Exercise is proven to reduce insulin resistance and facilitate weight loss. Women with PCOS should participate in regular aerobic exercise and strength training to improve their physical and mental well-being (11).

Summary

Dietitians have a unique opportunity to empower women to take control of their health and alleviate the symptoms and prevent the long-term consequences of PCOS. When symptoms of PCOS are present, a woman should seek medical attention for evaluation and treatment. While the symptoms may not be life threatening, the sooner the diagnosis is made the sooner treatment and prevention of the Metabolic Syndrome, type 2 diabetes, and heart disease can begin. The first line of treatment is diet and weight loss. I have found it is more effective to get women to focus on what to eat (whole grains, fruits, vegetables, foods rich in omega-3 fatty acids), rather than on foods not to eat. It is easier to incorporate a new, positive eating habit than to focus on what NOT to eat. The goal is to have positive habits replace negative habits over time. The chart below lists general dietary guidelines for women with PCOS.

Dietary and Lifestyle Guidelines for PCOS

- **Focus on whole foods (avoid processed and refined foods)**
- **Focus on fiber-rich foods: whole grains, vegetables, legumes, fruits**
- **Balance carbohydrate intake throughout the day**
- **Consume carbohydrate foods with protein and/or low-fat foods**
- **Consume at least 40 grams of carbohydrates daily to prevent ketosis**
- **Choose “good” fats (foods rich in omega-3 fatty acids: salmon and tuna, flaxseed, nuts, seeds, etc)**
- **Include monounsaturated fats (olive oil, canola oil, nuts)**
- **Pay attention to portion sizes and do not overeat**
- **Exercise regularly, including aerobic exercise and strength training**

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Examination for PCO08

1. Which of the following statement best describes polycystic ovary syndrome (PCOS):
 - a. affects about 25 percent of women in the US
 - b. is a hormone imbalance resulting in low levels of testosterone
 - c. is characterized by hypoinsulinemia and insulin resistance
 - d. is characterized by insulin resistance and elevated androgen levels
 - e. all of the above

2. Which of the following are signs or symptoms of PCOS:
 - a. precocious puberty
 - b. androgenic alopecia
 - c. oligomenorrhea
 - d. amenorrhea
 - e. all of the above

3. Hirsutism is:
 - a. excessive growth of facial and body hair
 - b. the loss of female scalp hair
 - c. rarely experienced by teenage girls with PCOS
 - d. caused by low levels of testosterone
 - e. caused by high levels of estrogen

4. Which of the following best describes how a diagnosis of PCOS is made:
 - a. the oral glucose tolerance test (GTT) is the primary diagnostic tool
 - b. determined by a physical examination, blood tests, and ultrasound
 - c. determined solely by the presence of polycystic ovaries
 - d. usually made during menopause
 - e. all of the above

5. Women with PCOS are at increased risk for which of the following:
 - a. Infertility and loss of muscle mass
 - b. loss of muscle mass and cardiovascular disease
 - c. osteoporosis and hypertension
 - d. cardiovascular disease and infertility
 - e. hypertension and renal disease

6. Which of the following plays a significant role in the pathology and symptoms of PCOS:
 - a. decreased androgen production secondary to hyperinsulinemia
 - b. hyperlipidemia
 - c. obesity secondary to elevated serum glucose levels
 - d. increased insulin production secondary to insulin resistance
 - e. all of the above

7. What is the recommended carbohydrate intake for women with PCOS:
 - a. Eat less than 40 grams of carbohydrate daily
 - b. Intake should be limited to 20 percent of calories
 - c. Increase intake of whole grains and fiber-rich foods
 - d. Limit intake of fruits and vegetables that are high in soluble fiber
 - e. Eat at least 60 percent of calories from carbohydrates

8. Which of the following statements about weight loss in women with PCOS are true:
 - a. it is the primary treatment goal
 - b. it is difficult due to insulin resistance
 - c. it improves insulin sensitivity
 - d. it promotes ovulation
 - e. all of the above

9. Which of the following would you recommend as an optimal diet for overweight women with PCOS:
 - a. A diet that is hypocaloric
 - b. A diet that includes fiber-rich foods
 - c. A diet that includes foods rich in omega-3 fatty acids
 - d. A diet high in unsaturated and monounsaturated fats
 - e. All of the above

10. Young women with PCOS :
 - a. May be at increased risk of developing an eating disorder
 - b. Are more likely to experience a miscarriage
 - c. May experience puberty at an early age
 - d. Are at greater risk of developing depression
 - e. all of the above

11. Which of the following drugs is an androgen-blocking agent that is effective in the treatment of hirsutism.
 - a. spironolactone
 - b. metformin
 - c. Lupron
 - d. Clomid
 - e. OCP

12. Metformin is used in women with PCOS for which of the following reasons:
 - a. it is proven safe for pregnant women
 - b. it is an antihypertensive agent
 - c. it improves insulin sensitivity at the cellular level
 - d. it helps decrease menstrual bleeding
 - e. a and c



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