

<http://www.fssc.com.au/ivf-treatment-programs/polycystic-ovarian-syndrome/>

# The Effects of Nutrition and Exercise on Polycystic Ovary Syndrome

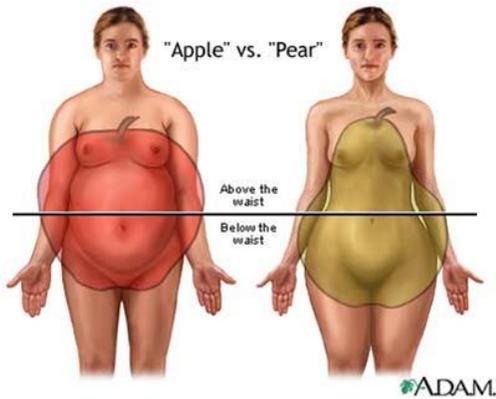
By Alicia Benner

## Introduction

Polycystic Ovary Syndrome (PCOS) is a common endocrine disorder as it is prevalent in 5-10% of premenopausal women (Dunaif, 2013). The clinical and biochemical markers of PCOS vary, but it is most commonly defined as the association of hyperandrogenism and anovulation in women. Hyperandrogenism is characterized by elevated serum levels of androgens, specifically androstenedione and testosterone. There is also hypersecretion of luteinizing hormone, which triggers ovulation and the development of the corpus luteum in females, and abnormally low serum levels of follicle stimulating hormone, which promotes the formation of ova in females. The clinical symptoms of hyperandrogenism are alopecia (male-patterned baldness), hirsutism (abnormal facial and body hair in women), and acne. Chronic anovulation varies from oligomenorrhea (infrequent menstruation), amenorrhea (an absence of menstruation), and dysfunctional uterine bleeding. These disturbances in menstruation commonly manifest themselves at menarche and lead to infertility (Franks et al, 2014). Polycystic ovaries, defined as having eight or more subcapsular follicular cysts that are less than 10 mm in diameter and an increased ovarian stroma, are no longer a requirement to make a diagnosis of PCOS (Dunaif, 2013).

Link to video describing PCOS and the PCOS Foundation:  
<http://www.youtube.com/watch?v=FTPlltOWB94>

# Insulin Resistance and Obesity



<http://bestcancerfightingfoods.blogspot.com/2010/05/female-upper-body-fat-and-pcos.html>

## Rotterdam Criteria

Clinical diagnoses of PCOS is based on the Rotterdam criteria, which requires that 2 of these 3 symptoms are present in the individual: 1) anovulation or oligo-ovulation 2) clinical and or biochemical signs of hyperandrogenism 3) polycystic ovaries. There must also be an exclusion of other etiologies such as androgen-secreting tumors, Cushing's syndrome, or congenital adrenal hyperplasia (Bruner et al, 2006). Obesity is common in PCOS women, although not every PCOS woman is obese. Obesity has been linked to hyperandrogenism, as women who have upper body obesity are more likely to have higher levels of androgens than lower body obese women (Dunaif, 2013).

Insulin resistance is commonly seen in women with PCOS. In 1980 a study conducted by Burghen et al. concluded that PCOS is associated with hyperinsulinemia. Many studies have been conducted to explore the connection between insulin resistance and PCOS. A significant positive correlation between increased levels of androgens and insulin resistance is seen, which may suggest that insulin resistance plays an etiological role in PCOS. Hyperthecosis, which is enlargement of the ovary and the presence of luteinized cells in the ovary that produce androgens, is found to be more extensive in PCOS women that have insulin resistance. This indicates that insulin has an effect on ovarian morphology and function.

Obese PCOS women have a 30% higher rate of insulin resistance than lean PCOS women. Isolated adipocyte cells from PCOS women have shown a significant decrease in insulin sensitivity. It is clear that obesity plays a factor in insulin resistance, and it is hypothesized that obesity combined with genetic defects in insulin produce glucose intolerance in PCOS women. Research seems to point that insulin resistance is an intrinsic factor of PCOS rather than a result of the disorder.

Studies have been conducted to determine whether hyperinsulinemia contributes to hyperandrogenism or vice versa. A study in female rats puts forth the idea that high levels of androgens may result in an increase of type II b skeletal muscle fibers, which are less sensitive to insulin.

There are also studies showing that decreased level of insulin result in decreased levels of androgens. Supporting this theory, insulin has been found to be more dominant in regulating sex hormone binding globulin (SHBG) than sex steroids. SHBG is a protein that transports sex hormones and is a factor in regulating the amount of free hormone in the plasma. It has been found that both obese and lean PCOS women have lower insulin sensitivity, but the debate remains over the interaction between insulin resistance, obesity, and PCOS.

Long-term complications of the disorder are increased risks of developing type II diabetes, endometrial cancer, cardiovascular disease, and impaired glucose tolerance (Dunaif, 2013). Lifestyle changes seem to be an effective way to manage the symptoms and potential complications of PCOS.

# Literature Review

Lifestyle modifications, specifically diet and exercise, have been proven to effectively manage the symptoms and decrease the risk factors that are associated with PCOS. Many people claim that this is more effective than medication. Most of the studies that have been conducted explore the effect of diet and exercise on obese PCOS women, and it has been found that weight loss is an important factor for favorable results. Diets with restrictive caloric intakes that result in weight loss have been shown to improve hormone concentrations, cardio metabolic risk factors, and reproductive functioning in obese PCOS women.

In a study conducted by Bruner et al studying weight loss through diet compared to weight loss through diet and exercise it was concluded that both groups reduced their body fatness and fasting insulin levels. Bruner et al referenced a study conducted by Speroff et al that found that fat deposition in the abdominal region is correlated with decreased levels of SHBG and increased levels of androgens (Bruner et al, 2006). Lass et al conducted a study on obese PCOS adolescent girls. They provided a one-year intervention, which included exercise, nutritional guidance, and behavior therapy. They found that the participants that successfully lowered their BMI significantly improved insulin resistance, decreased levels of free testosterone, LH, and LH/FSH. SHBG levels were increased. These results indicate that testosterone and SHBG are connected to hyperinsulinemia (Lass, 2011).

However, it has been shown that alterations in body composition are more beneficial as compared to weight loss. Endurance and resistance exercise training decreases fat mass but increases free fat mass. Bruner et al found that though weight loss was similar between the nutrition group and nutrition and exercise group, the nutrition and exercise group had a 12% decrease in fat mass compared to only a 3% decrease in fat mass in the nutrition group. The nutrition and exercise group resulted in a 39% increase in SHBG levels as compared to only an 8% increase in the nutrition group. Exercise results in an increase in free fat mass, which raises the resting metabolic rate, and will contribute to sustained weight management whereas dieting may decrease the levels of free fat mass in an individual. Indeed, a 10% increase in RMR was seen in the diet and exercise group as compared to a decrease in RMR in the nutrition group (Bruner et al, 2006).

These findings are of great importance because obese PCOS women may be discouraged by the difficulty they experience in losing weight. However, changing their body composition is more

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<http://studiofitnessmorrobay.com/fitness/its-time-to-cut-ties-with-the-scale/>

effective, and can be attained by incorporating exercise into their lifestyle. Banting et al surveyed 153 women and found that PCOS women are less active than non-PCOS women, and though they have a medical incentive to exercise, they are hindered by a lack of self-confidence. PCOS women also have higher rates of depression and anxiety than controls (Banting et al, 2014). The knowledge that weight loss in itself is not the goal, but rather a reduction in fat mass and increase in free fat mass may encourage PCOS women to integrate exercise into their daily lives.

Specific dietary guidelines have been studied and found to positively impact PCOS symptoms. Eating foods with a low glycemic index, consuming omega 3, raw red onion, and the timing of caloric consumption are

all effective in improving the syndromes of PCOS.

Marsh et al studied the effects of a healthy, low caloric diet as compared to a healthy, low caloric and GI diet in obese PCOS women. They found that 95% of the women eating the low GI diet had improved menstruation as opposed to only a 63% improvement in the general healthy diet. Also, insulin sensitivity improved three times more in the low GI diet than in the general healthy diet (Marsh et al, 2010).

Outadsahelomadarek et al studied the effect of omega 3 on PCOS induced female rats. Omega 3 is an antioxidant that combats oxidative stress, which is an imbalance between the amounts of free radicals and neutralization of them in the body. This imbalance may lead to subfertility and can occur due to hyperglycemia and excessive weight. The female rats that consumed omega 3 experienced an improvement of production of oxidative enzymes, which led to a reduction in oxidative species. Testosterone was lowered and FSH levels were also increased (Outadsahelomadarek et al, 2014). These results indicate that omega-3 consumption can have a positive effect on the hormonal balance of PCOS women.

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<https://www.chfa.ca/resources/what-you-should-know-about-omega-3-fatty-acids-and-fish-oil/>

Jakubowicz et al studied the effect of the timing of caloric intake on 60 non-obese PCOS women. One group of women consumed the majority of their 1800-calorie diet at breakfast (980 Calories), and the other groups consumed a 980 Calorie dinner. A change in BMI was not detected in either group, however the breakfast group saw an 8% decrease in mean serum fasting glucose and a 53% decrease in insulin concentration. The dinner group saw no change in these parameters. The breakfast group also experienced a 2-fold increase in SHBG and 50% decrease in free testosterone concentration. Again, the dinner group experienced no change. By the third month of the study 50% of the women in the breakfast group ovulated, and only 20% of the women in the dinner group experienced ovulation (Jakubowicz et al, 2013).

PCOS women are 7.4 times more likely to experience heart disease than non-PCOS women, and it is estimated that 70% of PCOS women have abnormal lipid profiles, with cholesterol being the most common. Consuming raw red onion was found to decrease cholesterol levels (Ebrahimi et al, 2014).



<http://skinnychef.com/blog/shopping-cooking-eating-healthier>

# Recommendations

The available data on PCOS shows that women can actively combat the disorder as well as the side effects through making certain lifestyle changes, but many women do not know how to effectively do this. Provided are practical ways to incorporate the above research findings into your everyday lifestyle.

## Caloric Intake:

Obese PCOS women should restrict their Caloric intake in an effort to lose weight. The recommended amount of weight to lose is 1 pound per week. This means that a weekly caloric deficit of 3,500 Calories or a daily deficit of 500 Calories needs to be created. This deficit can be modified based off of the Calories spent in exercise (Williams, 2013).

## Low Glycemic Index:

The Glycemic Index indicates the effect of carbohydrate on blood glucose levels over a span of two hours. The values are the following:

- 70 or greater: High GI food
- 69-55: Medium GI food
- 55 or less: Low GI food

PCOS women should abstain from foods that have a high glycemic index because eating carbohydrates with a low GI has been proven to improve insulin resistance, which will reduce the levels of androgens. In general it is recommended to abstain from foods high in refined sugars and starchy foods. Foods that are high in fiber usually have a low glycemic index (Williams, p 127).

## Glycemic Index of Common Foods

**TABLE 4.4 Glycemic Index (GI) and Glycemic Load (GL) of common foods**

Reference food glucose = 100  
 Low GI foods—below 55  
 Intermediate GI foods—between 55 and 69  
 High GI foods—more than 70

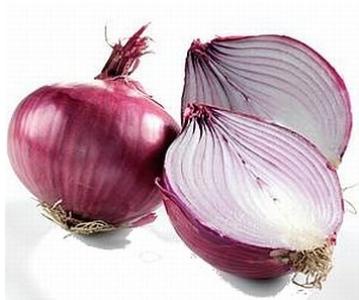
Low GL foods—below 10  
 Intermediate GL foods—between 11 and 19  
 High GL foods—more than 20

	Serving Size (grams)	Glycemic Index (GI)*	Carbohydrate (grams)	Glycemic Load (GL)
<b>Pastas/grains</b>				
Brown rice	1 cup	55	46	25
White, long grain	1 cup	56	45	25
White, short grain	1 cup	72	53	38
Spaghetti	1 cup	41	40	16
<b>Vegetables</b>				
Carrots, boiled	1 cup	49	16	8
Sweet corn	1 cup	55	39	21
Potato, baked	1 cup	85	57	48
New (red) potato, boiled	1 cup	62	29	18
<b>Dairy foods</b>				
Milk, whole	1 cup	27	11	3
Milk, skim	1 cup	32	12	4
Yogurt, low-fat	1 cup	33	17	6
Ice cream	1 cup	61	31	19
<b>Legumes</b>				
Baked beans	1 cup	48	54	26
Kidney beans	1 cup	27	38	10
Lentils	1 cup	30	40	12
Navy beans	1 cup	38	54	21
<b>Sugars</b>				
Honey	1 tsp	73	6	4
Sucrose	1 tsp	65	5	3
Fructose	1 tsp	23	5	1
Lactose	1 tsp	46	5	2
<b>Breads and muffins</b>				
Bagel	1 small	72	30	22
Whole wheat bread	1 slice	69	13	9
White bread	1 slice	70	10	7
Croissant	1 small	67	26	17
<b>Fruits</b>				
Apple	1 medium	38	22	8
Banana	1 medium	55	29	16
Grapefruit	1 medium	25	32	8
Orange	1 medium	44	15	7
<b>Beverages</b>				
Apple juice	1 cup	40	29	12
Orange juice	1 cup	46	26	13
Gatorade	1 cup	78	15	12
Coca-Cola	1 cup	63	26	16
<b>Snack foods</b>				
Potato chips	1 oz	54	15	8
Vanilla wafers	5 cookies	77	15	12
Chocolate	1 oz	49	18	9
Jelly beans	1 oz	80	26	21

(Williams, p 130)

### Omega-3:

Females diagnosed with PCOS should make sure that they are getting an adequate amount of omega-3 (1.1grams per day) (Williams, p 178) because omega-3 is shown to aid in hormonal balance in PCOS women (Outadsahelomadarek et al, 2014). Foods that contain Omega-3 are green leafy vegetables, canola oil, flaxseed oil, soy, fish, and some nuts (Williams, p 178).



[http://www.econnect-usa.com/miva/merchant.mvc?Screen=PROD&Store\\_Code=C&Product\\_Code=ceaparosie\\_1kg&Category\\_Code=VEG](http://www.econnect-usa.com/miva/merchant.mvc?Screen=PROD&Store_Code=C&Product_Code=ceaparosie_1kg&Category_Code=VEG)

### Raw Red Onion:

Raw red onion has been shown to reduce cholesterol levels in women with PCOS. Being that 70% of PCOS women have abnormal lipid profiles, with high levels of cholesterol being predominant, it is suggested that PCOS women consume a serving of raw red onion daily (Ebrahimi et al, 2014).

#### Suggestions for incorporation a daily serving of raw red onion into your diet:

- **Breakfast:** Top eggs (scrambled or omelet) with raw red onion.
- **Lunch:** Prepare a vegetable salad that includes raw red onion.
- **Dinner:** Prepare a stir-fry, but rather than sautéing the red onion, sprinkle the dish with raw red onion to complete it.

### Timing of Caloric Consumption:

Consumption of the majority of the daily Calories in the morning is recommended for PCOS women as this results in a decrease in mean serum glucose, decrease in insulin levels in the blood, higher levels of SHBG, and lower levels of testosterone. These effects may be related to the fact that consuming large amounts of Calories in the morning is critical to optimize metabolism, which will help obese women manage their weight. The effects of a large intake of Calories in the morning happen with no change in BMI (Jakubowicz et al, 2013). This is encouraging to lean women with PCOS because many of the suggestions to manage the symptoms of PCOS are related to losing weight, which is not practical for lean women. The positive effects of a high caloric consumption in the morning with no change in BMI is also encouraging to obese PCOS women because losing weight may seem like a daunting task.

#### PCOS women should adhere to the following timing of Calorie consumption:

<b>Breakfast</b>	<b>Highest caloric meal</b>
<b>Lunch</b>	<b>Intermediate caloric meal</b>
<b>Dinner</b>	<b>Lowest caloric meal</b>

# Exercise Training

Both obese and lean PCOS women should make exercise a daily part of their lives for weight loss and changing body composition by decreasing fat mass and increasing free fat mass. This has been proven to increase the resting metabolic rate, which will aid in long-term weight management. Weight loss should be focused specifically in the abdominal region as weight deposition in this area is linked to lower levels of SHBG and higher levels of androgens. Successfully decreasing fat mass while increasing free fat mass leads to improved insulin resistance, lower levels of free testosterone, lower levels of LH, and a lower LH/FSH. It also increases SHBG. All of these factors work to improve the side effects and risk factors of PCOS (Bruner et al, 2006).

A work out plan that incorporates both endurance and resistance training would be recommended for PCOS women. It may be beneficial to find a specific work out plan or to get involved at a local fitness center and take fitness classes or have a personal trainer to help direct the exercise and provide motivation for the individual. Banting et al found that PCOS women are less likely to work out and have a lack of self-confidence (Banting et al, 2014), so the extra motivation that a class or plan provides would be helpful to the individual. It should also be remembered that weight loss is not the ultimate goal, but rather a change in body composition.



<http://abstractthealth.com/articles/using-free-weights-or-machines/>

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## Conclusion

In conclusion, PCOS is very challenging both physically and emotionally for a woman. However, with proper nutrition and exercise a woman can improve the symptoms and decrease the risk factors that are associated with the disorder. Lifestyle modifications require commitment and can be challenging at times, but yield very encouraging results. The disorder is not fully understood (Dunaif, 2013), therefore a woman diagnosed with PCOS should keep up to date on research that is being conducted in order to most effectively manage her symptoms. A great starting point is to follow the above suggestions that are made based off of the literature.

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