



The Skinny on PCOS

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Objectives

- Provide a review of the medical nutrition therapy recommendations for the management of polycystic ovarian syndrome (PCOS).
- Learn the symptoms of and criteria for medical diagnosis; learn which lab values are monitored and evaluated in association with polycystic ovarian syndrome.
- Understand the current research associated with dietary supplementation in association with MNT for the management of polycystic ovarian syndrome.
- Understand the medical demographics associated with polycystic ovarian syndrome diagnosis.
- Practical application: Case study reviews of normal weight PCOS and overweight PCOS patients.



PCOS: Facts and History

PCOS: Set of symptoms caused by a hormonal imbalance affecting females of reproductive age. Cause unknown, possibly genetic?

- Most common endocrine disorder in females
- Characterized by hyperinsulinemia and hyperandrogenism
- 50% of women are overweight, 61-76% obese
- 60-80% have insulin resistance

Historical thoughts:

- Insulin resistance, ↑ fat storage, ↓ appetite, beneficial for survival rate during famine
- Stored fat was also considered helpful for pregnancy and to extend reproductive years, as cycle increases with age

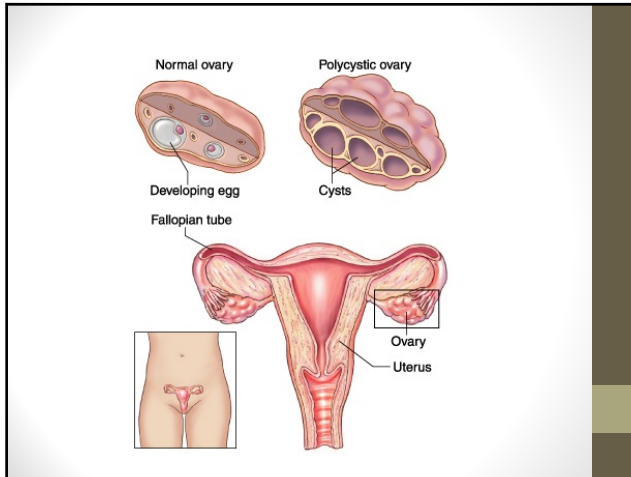


Barthelmess & Naz, 2015; Azziz, Dumesic & Goodarzi, 2018

History of PCOS

- **1935:** Irving F. Stein and Levanthal published case studies of women with menstrual disturbances and labeled as a reproductive disorder
- **1990:** PCOS and insulin resistance were connected = endocrine and reproductive disorder
- **1990:** NIH defined PCOS as chronic anovulation with clinical biochemical hyperandrogenism, without thyroid/adrenal dysfunction
- **2009:** Definition was revised to include hyperandrogenism for diagnosis
 - Early treatment was high protein and low carbohydrate = ↑ binge eating!
 - Cysts originally thought to *cause* hormonal imbalance; we now know that cysts are the *result* of hormonal imbalance.





PCOS Diagnosis and Symptoms

Diagnosis: No one test to diagnose

- Need 2 of 3 criteria:
 - Menses: infrequent, irregular, prolonged cycles
 - <9 periods/year, >35 days between cycles, abnormally heavy cycles
 - Physical symptoms of hyperandrogenism (male hormones)
 - Ovarian cysts
 - Adolescents: focus on hyperandrogenism and persistent oligomenorrhea vs. anovulation

Symptoms: Develop around first menstrual cycle, or with significant weight gain

- Excessive facial and body hair, male pattern hair loss, acne
- Irregular menses, skin tags, acanthosis nigricans



Barthelemy & Naz, 2015

“Skinny” PCOS

Normal-weight (NW) vs. Overweight (OW)

- NW more likely to be diagnosed at an older age & more likely to have polycystic ovaries
 - Late diagnosis may be due to clinicians having lower suspicion of symptoms being related to PCOS
- OW more likely to have a family history of overweight/obesity
 - Also more likely to have acanthosis nigricans & higher androgen levels
 - Many symptoms seen in OW individuals may be due to their excess weight, which is why they aren't seen as much in leaner individuals, such as insulin resistance and hyperglycemia



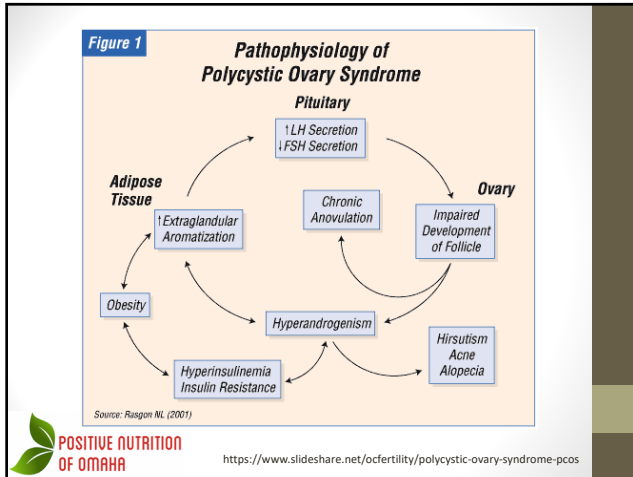
Karachalios, Kollias & Livadas, 2013; Levitsky, McManus & Misra, 2013

Causes of PCOS Symptoms

- High levels of androgens
 - Interfere with normal ovulation
 - Cause cysts to form
 - Produce other symptoms, including excess hair growth and acne
- High levels of insulin
 - Increase androgen levels
 - Can increase appetite and lead to weight gain
 - Linked to acanthosis nigricans



National Institute of Health; Mayo Clinic



Goals of Treatment

No cure: manage symptoms and associated conditions

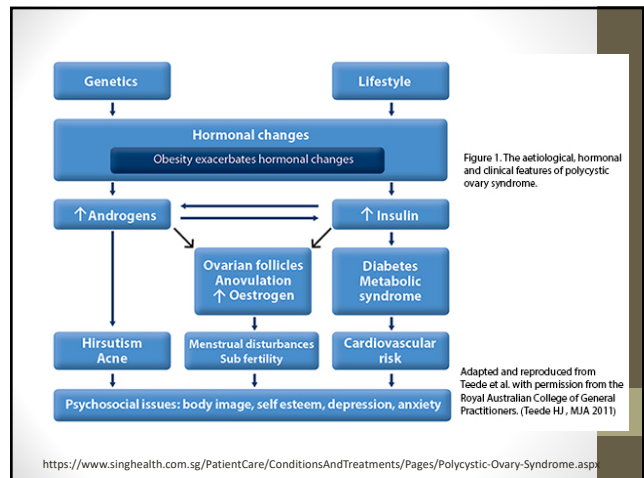
- Maintain or decrease weight
- Decrease insulin and androgens
 - Nutrition, exercise, and medications
 - Treatment of insulin resistance favors fertility, metabolic issues, and weight loss
- Prevent and treat heart disease risk factors
- Improve reproductive function/regulate menses
 - Medications, supplements, diet, exercise

POSITIVE NUTRITION OF OMAHA PCOS Workbook, Grassi A, Mattei SB

Conditions Associated with PCOS

- Impaired glucose tolerance (IGT)
- T2DM
- Metabolic syndrome
- Higher risk of CAD
- NASH (non-alcoholic steatohepatitis)
- Obstructive sleep apnea
- Overweight and obesity
- Mood disorders
- Endometrial hyperplasia
- Disordered eating

POSITIVE NUTRITION OF OMAHA National Institute of Health; Mayo Clinic



PCOS Treatment Team

- OB/GYN
 - Fertility and menses regulation
- Endocrinologist
 - Hormone irregularities, medication management, IGT, etc...
- Registered Dietitian
 - Nutrition management
 - Relationship with food
 - Disordered eating patterns
- Psychologist
 - Potential psychiatrist if psychiatric medications needed
 - Body image work
 - Depression, anxiety, stress management



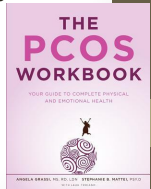
PCOS workbook, A. Grassi and S. Mattei

Summary of Nutrition Therapy

- Consume variety of foods from all food groups
- Limit sugar-sweetened beverages
- Eat carbohydrate-containing foods evenly through out the day
- Eat every 3-5 hours, listen to body cues
- Limit refined carbohydrates and simple sugars
- Lean protein and Omega-3 fats with most meals/snacks
- Limit trans and saturated fats, and foods high in Omega-6
- Consume fatty fish twice per week
- Take a 1000 mg fish oil (EPA + DHA) supplement daily



PCOS workbook, A. Grassi and S. Mattei



Nutrition Therapy - Carbohydrates

- Limit vs. avoid refined carbohydrates and simple sugars
 - PCOS carbohydrate cravings related to hyperinsulinemia
- Choose unrefined carbohydrates and whole grains
 - Increase fiber, chromium, magnesium, selenium = decrease insulin
 - Increase phytochemicals, fiber and antioxidants = decrease risk for cancer, heart disease, and diabetes
- Consistent Carbohydrates
 - Meals: 1-3 servings = 15-45 grams
 - Snacks: 1-2 servings = 15-30 grams



PCOS workbook, A. Grassi and S. Mattei

Nutrition Therapy – Fats

- Fats
 - Trans and saturated fats = increase insulin resistance
 - Fat restricted = decreases fertility
 - Increase Omega-3 and decrease Omega-6 intake
 - Goal ratio of 4:1, Americans diet 10:1
- Omega-6
 - Palm, corn, soy, safflower, cottonseed, grapeseed and sunflower
 - Increase risk of heart attacks, arrhythmias, arthritis, inflammation, stroke, osteoporosis, and disturbed mood
- Omega-3
 - ALA – chia seeds, walnuts, flaxseeds, hemp, canola oil
 - EPA & DHA – enriched egg yolks, salmon, tuna, trout, halibut
 - Improve mood, hair and skin quality
 - Decrease total cholesterol, triglycerides, insulin and blood pressure



PCOS workbook, A. Grassi and S. Mattei

Nutrition Therapy – Protein

- Protein
 - Moderate protein intake
 - Excessive protein increases infertility
 - High protein intake is associated with increased saturated fats, limited whole grains, fruits, and starchy vegetables
 - Low carbohydrate intake can lead to overeating and weight gain = ↑ PCOS!
 - Choose plant-based protein
 - Nuts, beans, soy, lentils, peas, seeds
 - Exceptions: Omega-3 enriched eggs, full-fat dairy, and fish for fertility



Labs to evaluate with PCOS

Lab Test	Lab Value		Lab Test	Lab Value	
Fasting Glucose	>100 mg/dL	elevated	Triglycerides (TG)	>150 mg/dL	elevated
Blood Pressure	>120/80 mmHg	elevated	High-Density Lipoproteins (HDL)	<40 mg/dL	low goal
Hemoglobin A1C	>6%	elevated	Low-Density Lipoproteins (LDL)	>100 mg/dL	elevated
Vitamin D, 25-hydroxy	<35 ng/dL	low	Total Cholesterol	>200 mg/dL	elevated
Luteinizing Hormone (LH)	~18 mIU/ml normal: 5-20	elevated	Total Testosterone	>50 ng/dL	elevated
Follicle Stimulating Hormone (FSH)	~6 mIU/ml normal: 5-20	normal-low	Free Androgen Index	>4.5	elevated
LH:FSH Ratio	1:1	normal	Free Insulin	>10	elevated



Nutrition Care Manual; PCOS Workbook Grassl & Mattei, 2009

Labs

Inflammation markers:

- C-reactive protein: >3 mg/L, elevated
 - CRP levels are 96% greater in PCOS
- Interleukin 18 (IL-18): high
 - Pro-inflammatory associated with insulin resistance and metabolic complications, correlates with testosterone levels
- Inflammation is found in both obese and non-obese patients
 - Non-obese patients are thought to have more visceral fat, causing inflammation



Barthelmeß & Naz, 2015; Grassl & Mattei, 2009

Medications

- Oral contraceptives are standard
 - Manage menstrual/hormonal abnormalities, hirsutism and acne concurrently
- Metformin
 - Usually second line of defense, mainly used in women with T2DM or IGT and unsuccessful lifestyle modification
 - Not approved specifically for treating PCOS
- Statins
 - Not indicated for all women with PCOS, instead only in women who meet current indications for statin therapy outside of PCOS



Arsanian, Ehrmann & Legro, 2013; Mayo Clinic; Barbieri & Ehrmann, 2016

Medications

- Anti-androgens (testosterone blockers)
 - Prevent androgen production or limit its effects on the body
 - Can lower androgen levels, reduce excess hair growth, and clear acne
 - Can cause birth defects, recommended to pair with contraceptives
 - Not FDA-approved for treatment of PCOS



National Institute of Health

Dietary Supplements

- Vitamin D
 - ~73% have low vitamin D levels
 - Can improve autoimmune complications, metabolic abnormalities and potentially PCOS
 - Obesity is a risk factor of vitamin D deficiency
- Inositol – 9 forms, 2 studied most in PCOS
 - MYO 2-4 grams and DCI(d-chiro) 50-100mg
 - Assist in signaling insulin and follicle stimulating hormone
 - Deficiency can lead to impaired insulin signaling and insulin resistance



Barthelmeß & Naz, 2015; Kalra, Kalra & Shahrma, 2016

Dietary Supplements

- Fish oil
 - Omega-3's in fish oil have been shown to decrease lipid profile, inflammation, and time between periods
 - 1000mg EPA + DHA daily
- Chromium Picolinate
 - 200-500 mcg per day
 - 3 month trial showed a significant decrease in fasting blood sugars and increase in insulin sensitivity
 - Chromium had less side effects than Metformin when used to regulate insulin



Fesharaki, Khani & Mardanian, 2017; Amooee, Alborzi, Parsanezhad, Samsami & Shirazi, 2013

Dietary Supplements

- Zinc
 - 30-50 mg daily
 - Plays role in cholesterol and glucose metabolism and fertility
 - Reduce hair loss, clear up skin, reduce inflammation and bind insulin
- Magnesium
 - 100 -365 mg/day
 - Helps regulate glucose, insulin and blood pressure
 - Can improve mood, prevent migraine, and relieve PMS
 - 100 mg = 5 slices of whole grain bread, ½- 1 cup of beans, 1/4 cup of nuts, 1 cup of cooked spinach, or 3 bananas



PCOS Nutrition Center, natural medicines comprehensive database

Dietary Supplements

- Berberine
 - 500 mg, 3 times per day
 - Lowers cholesterol, blood pressure, testosterone and insulin levels
 - Fights inflammation, boosts fertility and pregnancy and aids in weight loss
 - Unsafe during pregnancy
- Cinnamon Cassia
 - Regulates menstrual cycle, improves insulin and cholesterol levels
 - 2 tsp/day or capsule form
 - 1 tsp = 4.75 grams, sold in 500 to 1000 mg doses



PCOS Nutrition Center, Natural Medicines Comprehensive Database

Case Study #1

- 30 yr. old Caucasian, former NCAA gymnast, 10 plus years taking BCP, presented due to past disordered eating and fertility.
- Height: 5'4" Weight: 118 lbs.
- **December 2014:** Went off BCP, 6 months menses irregular/stopped, refer to PCP, PCOS testing.
- **June 2015:** Blood work and ultrasound from PCP abnormal, Dx with PCOS, refer to OBGYN

Labs: Fasting Glucose 108 mg/dl - elevated
 Testosterone 50 ng/dl – high normal
 Estradiol 71pg/ml – estrogen levels during cycle stage
 LH – 15.2 – ratio of almost 4:1, goal is 1:1
 FSH – 4.7
 Prolactin – 10.1 ng/ml – used to assess for pituitary tumor
 TSH – 1.65 IU/ml – assess normal thyroid function



Case Study #1

- **June 2015:** OBGYN started letrozole for ovulation, Vitamin D, and Omega-3 supplements. Ovulation, pregnant, miscarried at 6 weeks, two more rounds of letrozole, with no pregnancy – referred to fertility clinic.
- **August 2015:** Fertility clinic not covered, started Ovasitol (Inositol) supplement. Started PCOS diet recommendations; limited carbohydrates and high-sugar foods, carbohydrate/protein ratio at meals/snacks, and intuitive eating principles.
- **December 2015:** Pregnant, healthy baby, stopped Ovasitol at 30 weeks; no breast milk production, unable to breastfeed. OGTT result was 99 at week 28 of pregnancy.
- **Summer 2017:** Started Ovasitol again, pregnant December 2017, plans to take Ovasitol for entire pregnancy and post delivery.



Case Study #2

- 18-year-old Asian-American, high school tennis player, presents with binge eating, hiding food, and weight gain.
- Height: 5' 1" Weight: 202.8 lbs.
- MOP very thin and food focused.
- Patient adopted at 3 months of age, MOP reports patient overate until vomiting as a younger child. Patient remembers overeating in 5th grade.
- Binge eating started in 8th grade, tried multiple diet programs.
- **November 2016:** Referred for nutrition assessment from Children's Hospital Behavioral Health program for binge eating. Upon nutrition assessment was recommended to see OB/GYN for possible PCOS. Diagnosis confirmed.
 - Started on Metformin, BCP, Vitamin D, and fish oil.



Case Study #2

- Patient was hiding and binge eating in her car and bedroom.
- MOP wanted her on low-carbohydrate diet.
- **November 2016 – August 2017:**
 - Treat binge eating first and started Intuitive Eating/Mindful Eating principles; encouraged mom to step back and allow patient to be in charge of foods. Patient started hunger/fullness charting.
 - Patient encouraged to not eat in car, bedroom or in front of screens for mindful eating practices.
 - 4-5 months later, started patient on PCOS diet recommendations, added snacks, smaller portions at meals, whole grains, increase fruit and vegetable consumption.
 - **Nutrition Goals:**
 - 2 fruits & 2 vegetable per day
 - Choose whole grains for 2 meals per day
 - If eating non-PCOS friendly foods, portion and balance with protein.



Case Study #2

- **Outcomes, August 2017:**
 - No binge eating or secretive eating
 - Patient increased in ability to recognize hunger/fullness cues
 - Patient increased fruit/vegetable intake to once per day
 - 7.7 lbs. weight loss
- **College Plan for 2017-2018:**
 - Patient transitioned to ED and IE RD at college
 - **RD update:** December 2017, 1st semester - struggled with increased fried foods and large portion availability; 2nd semester - worked on IE principles and finding PCOS foods on campus or to keep in dorm room.
 - **RD update:** March 2018, RD had discharged the patient and felt she no longer needed nutrition counseling.



MNT Research Study

Intervention:

- Subjects consumed three, 16-day, eucaloric diets, each separated by a 3-week washout period. A frequently sampled, intravenous, glucose tolerance test was administered at baseline and following each diet.

Objective:

- To determine whether eucaloric diets either enriched with monounsaturated fatty acids (MUFA; 17% energy) or low in carbohydrates (Low CHO; 43% energy) would increase insulin sensitivity (Si) and decrease circulating insulin concentrations, relative to a standard diet (STD; 56% CHO, 31% fat, 16% protein), among women with PCOS.



Darnell, Douglas, Gower, Oster & Ovalle, 2006

MNT Research Study

Results:

- Fasting insulin was lower following the Low CHO diet relative to the STD diet.
- Acute insulin response to glucose was lower following the Low CHO diet relative to the MUFA diet.
- Fasting glucose, insulin sensitivity and the circulating concentrations of reproductive hormones were not significantly affected by the intervention.

Conclusion:

- A moderate reduction in dietary carbohydrate reduced the fasting and post challenge insulin concentrations among women with PCOS, which, over time, may improve reproductive/endocrine outcomes.



Darnell, Douglas, Gower, Oster & Ovalle, 2006

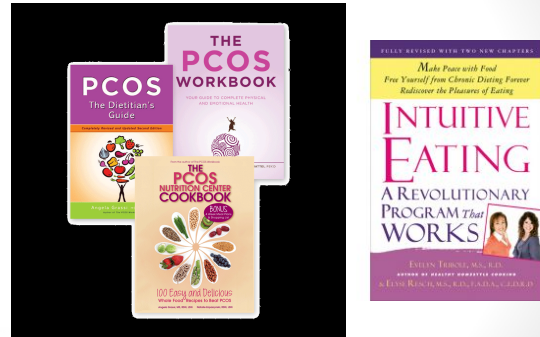
Dietary Intervention Research

- An extensive search in PubMed, Scopus and Google Scholar from 1995 till 2017.
- Articles screened on quality and a total of 25 articles including cohort, randomized controlled trial, review and meta-analysis were included in the review.
- This systematic review revealed that lifestyle interventions are effective in reducing BMI in PCOS women but due to the difficulty in maintaining low calorie diet, lifestyle interventions should be accompanied with exercise.
- Metformin was found to be effective in improving the indicators of DM in PCOS women especially if accompanied with lifestyle modification.



Dashti, Et al. 2017

Resources



POLYCYSTIC OVARIAN SYNDROME

HYPERANDROGENISM, ACNE, HIRSHUTISM, MALE-PATTERN HAIR LOSS, ELEVATED SERUM ANDROGENS

POLYCYSTIC OVARIES ON ULTRASOUND

ASSOCIATED WITH OBESITY AND INSULIN RESISTANCE

MESTRUAL DYSFUNCTION, OLIGOMENORRHEA OR AMENORRHEA

TREATMENT OPTIONS: WEIGHT LOSS, ORAL CONTRACEPTIVES, SPIRONOLACTONE

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