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Caroline C. Jones  
*Georgia College & State University*

Jinkyung Park  
*Georgia College and State University*

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# THE USE AND EFFECTIVENESS OF DIET AND PHYSICAL ACTIVITY AS INTERVENTIONS FOR POLYCYSTIC OVARY SYNDROME. A REVIEW.

Caroline C. Jones, Georgia College & State University  
Jinkyung Park, Georgia College & State University

## Introduction

Polycystic Ovary Syndrome (PCOS) is a hormonal disorder that is common among women who are of reproductive age, most commonly in ages between 15 and 44 years of age. (Moran et al., 2010) It is most prevalent in women in their 20s and 30s. While the exact cause of PCOS is unknown, it is widely believed by many experts that genetic factors including excess levels of insulin and excess androgen are attributing factors. (Moran et al., 2010) Women with PCOS experience several different signs and symptoms including infrequent or prolonged menstrual periods leading to infertility and the development of cysts. (Iatrakis et al., 2006) Some other common symptoms of PCOS are weight gain, growth of excess hair, and acne (Iatrakis et al., 2006). There are currently several proposed interventions for women with PCOS such as medication, exercise, intermittent fasting, and changes in diet. (Almenning et al., 2015; Banting et al., 2014; Goss et al., 2014; Moran et al., 2017)

The purpose of this literature review is to understand the differing treatments and interventions that help alleviate the symptoms of PCOS and determine the effectiveness of these interventions. A literature review of three systematic reviews and twenty empirical reviews was conducted. Polycystic Ovary Syndrome is important to study, because of its wide impact. There is the potential for anyone who has ovaries to develop PCOS. With approximately half of the world's population being female, it is likely that we interact with people who have PCOS on a daily basis. It is important to be able to know the symptoms and if a woman is diagnosed with PCOS, know the best methods and interventions to support her and alleviate the side effects that are associated with it.

## PCOS

Polycystic ovary syndrome is a common endocrine disorder in reproductive-aged women, occurring in approximately 5-15% of the female population, with significant health-related comorbidities including but not limited to; reproductive implications, metabolic dysfunction, and cardiovascular risk. (Dokras et al., 2016; dos Santos et al., 2020) PCOS is characterized by chronic anovulation and hyperandrogenism in the absence of underlying adrenal or pituitary disease. (Khademi et al., 2010) Women with PCOS show physical symptoms including infrequent or irregular menstrual periods, excessive hair growth, acne, and infertility due to anovulation (Khademi et al., 2010) Women diagnosed with PCOS typically have more hospitalizations for gynecological conditions and are at a higher risk for a diagnosis of endometriosis and endometrial glandular hyperplasia compared to women without PCOS. (Hart & Doherty, 2015) PCOS is also related to a high risk of endometrial hyperplasia after many years of estrogen stimulation from anovulation. (Iatrakis et al., 2006)

PCOS has been associated with obesity, insulin resistance, and type II diabetes. A study found that approximately 50-60% of women with PCOS are overweight or obese, with PCOS women having higher weight compared with non-PCOS women at all time points. (Khademi et al., 2010; Teede et al., 2013) The key diagnostic feature for PCOS is irregular menstrual cycle. This characteristic has been strongly associated with BMI. (Teede et al., 2013) A cross-sectional survey showed that 11.5% of women of normal weight, with a BMI between 18 and 24.5 experienced irregular menstrual cycles often, while 14% of overweight women, with a BMI between 25 and 29.9, and 20.7% of obese women, with a BMI over 30, experience irregular

cycles often. (Teede et al., 2013) The risk of often having irregular menstrual cycles increased progressively with BMI. Weight loss has shown to improve most parameters of PCOS. In obese, anovulatory PCOS women, weight loss restores ovulation and pregnancy rates, decreases insulin levels, lowers testosterone levels while raising sex hormone binding globulin levels, and improves psychological considerations. (Khademi et al., 2010) The most preferred and effective method of treatment of PCOS is lifestyle modification, with weight loss being an important treatment strategy. (Khademi et al., 2010)

### **Physical Activity as an Intervention**

Physical activity has shown to be an effective intervention for weight loss as well as an effective therapeutic option for the reproductive and metabolic features of PCOS. (Banting et al., 2014) In baseline testing comparing women with PCOS to women who do not have PCOS, women with PCOS had greater hip-to-width ratios and lower fat oxidation rates. (Lionetti et al., 2021) Data suggests a difference in the capacity of sedentary PCOS women to store lipid in skeletal muscle compared with non-PCOS women. (Hutchison et al., 2012) Overweight women with PCOS have lower insulin sensitivity than a weight-and fitness-matched comparison group. (Hutchison et al., 2012) The influence of hyperandrogenism on the metabolic phenotype of PCOS is not clear. These findings suggest a possible androgenic pattern of lipid storage and its response exercise train in PCOS. (Hutchison et al., 2012)

Current literature shows that exercise training is effective in reducing BMI and improving insulin sensitivity markers in PCOS women. (Giallauria et al., 2008) In general, exercise has shown to reduce waist-to-hip ratio, effectively reduce BMI, and improve insulin sensitivity, although no change in sex hormones has been observed. (Giallauria et al., 2008) Moreover, present studies show that the exercise-induced improvement in both autonomic and cardiopulmonary function is inversely correlated to inflammatory markers, strengthening the role of exercise in improving the cardiovascular risk profile in young PCOS women. (Giallauria et al., 2008) Exercise has shown to reduce homocysteine levels, an indicator of cardiovascular risk in overweight PCOS women. (Khadem et al., 2010) The influence of hyperandrogenism on the metabolic phenotype of PCOS is not clear, however research suggests a possible

androgenic pattern of lipid storage and its response to exercise training in PCOS. (Hutchison et al., 2012)

Progressive resistance training is an anabolic exercise modality that can improve metabolic and endocrine disorders and reduce body fat, as well as improve skeletal muscle mass and strength muscle. (Kogure et al., 2018) Studies have consistently shown that PRT can increase insulin sensitivity in type 2 diabetes, however, PRT is not currently recommended or routinely prescribed in PCOS. (Cheema et al., 2014) Intensive, short-term resistance training has been hypothesized to be indicative of potential muscle strength gains due to the differences in testosterone concentration and free androgen index in PCOS women, as studies in other populations have reported a positive correlation between serum levels of testosterone and muscle strength (Kogure et al., 2018) Because PCOS shares common characteristics with various metabolic and endocrine disorders, similar results of progressive resistance training would be expected in women without PCOS, but with other metabolic complications. (Kogure et al., 2018)

High Intensity Interval Training (HIIT) over a period of approximately three months has proven to significantly reduce insulin resistance, improve endothelial function, improve HDL cholesterol and homocysteine in women with PCOS. (Almenning, et al., 2015) Insulin resistance is improved, likely due to improved signaling pathways, more by HIIT than moderate intensity training. (Almenning, et al. 2015) Positive changes in reproduction-related hormonal outcomes and after both HIIT and resistance training. Another study showed that after 12 weeks of HIIT, both insulin sensitivity and high-sensitivity C-reactive protein improved significantly in women with PCOS. (Faryadian et al., 2019)

The specific interaction between physical activity and mental health has not been explored in depth in PCOS, however preliminary data has shown that physically inactive women have higher depression scores than physically active women and there are associations between lower physical activity and mild depression. (Banting et al., 2014) Women with PCOS are more likely to perceive themselves as at risk of obesity and infertility, perceived greater importance in reducing future risk of prediabetes, gestational diabetes, type 2 diabetes, heart disease, obesity, and infertility than women without PCOS.

(Moran et al., 2010) Women with PCOS are also more likely to have fears about future health related to weight gain, loss of femininity, loss of sexuality, and infertility. (Moran et al., 2010) In preliminary data collected, fewer women with PCOS reported being physically active compared to women without PCOS. Furthermore, women with PCOS had poorer mental health with higher depression and anxiety scores. (Banting., 2014)

### **Diet as an Intervention**

Diet has also been shown to be an effective intervention for women to navigate PCOS. In women with PCOS, modest reduction in dietary CHO in the context of a weight-maintaining diet has shown numerous beneficial effects on the metabolic profile that may lead to decrease in circulating testosterone. (Gower et al., 2013) Moreover, seven days of calorie restriction induced a small but significant reduction in body weight and percentage of body fat in PCOS women. (Van Dam et al., 2002) This decrease in body weight was significant. Fasting glucose concentrations decreased considerably, and basal plasma leptin and insulin concentrations were almost halved. (Van Dam et al., 2002) Basal estradiol, estrone, sex hormone binding globulin, and androstenedione levels did not change in response to calorie restriction. In contrast, serum total testosterone levels were significantly reduced. (Van Dam et al., 2002) Short term calorie restriction also augmented daily luteinizing hormone secretion while suppressing plasma insulin, glucose, and leptin concentrations. (Van Dam et al., 2002)

Low carbohydrate, ketogenic diets have also shown to lead to improvement in body weight, percent free testosterone, luteinizing hormone/Follicle stimulating hormone ratio, fasting serum insulin, and other PCOS symptoms over a six-month period. (Mavropoulos et al., 2005) The use of a low carbohydrate, high saturated fat diet in 15 women with PCOS showed a 12.1 percent reduction in body weight and a reduction in fasting serum insulin from 24.2  $\mu$ IU/ml to 12.2  $\mu$ IU/ml. (Mavropoulos et al., 2005) A tightly controlled crossover dietary intervention showed that reduced carbohydrate diets result in greater loss of fat mass than a standard diet. This loss of fat mass is often achieved without any caloric restriction, but instead with only a moderate reduction in carbohydrate content and an increase of dietary fat (Goss et al., 2014) This shift in body composition suggests that a reduced carbohydrate diet improves fat oxidation while preserving lean mass.

(Goss et al., 2014) In women with PCOS, consumption of a weight-maintaining diet lower in carbohydrate content resulted in profound improvements in body composition and fat distribution by inducing preferential loss of fat mass, specifically from ectopic, metabolically harmful, adipose depots. (Goss et al., 2014)

While research is limited, time-restricted feeding and fasting have shown to be beneficial in weight loss for the general public as well as women diagnosed with PCOS. Five weeks of time-restricted feeding has shown to improve menstruation, gonadal profiles, body weight, BMI, body composition profiles, hyperinsulinemia and insulin resistance profiles, decreasing Alanine aminotransferase, high-sensitivity C-reactive protein and increasing insulin like growth factor-1, in a group of 15 women with PCOS (Li et al., 2021) This study showed that following time-restricted feeding, more than half of the subjects with hyperandrogenemia, often causing irregular menstruation, restored their regular menstrual cycle. (Li et al., 2021) Furthermore, in a Ramadan fasting study, fasting was shown to reduce the level of serum cortisol and noradrenaline in a group of women with PCOS. (Zangeneh et al., 2014) Time-restricted dieting may be beneficial to anovulatory PCOS on weight loss, especially in reducing body fat, improving menstruation, hyperandrogenemia, insulin, and chronic inflammation. (Li et al., 2021)

### **Combination of Physical Activity & Diet**

Lifestyle management, including healthy diet and physical activity, is currently advised as the first line of PCOS management. (Banting et al., 2014, Harrison et al., 2010) While women with PCOS had higher adiposity, the greater engagement in weight management practices observed was maintained on adjustment for BMI, indicating that PCOS status is associated with a higher prevalence of engaging in weight management practices. (Moran et al., 2017) Furthermore, reductions in depression and elevations in quality of life have been observed in combined physical activity and dietary interventions in PCOS. (Banting et al., 2014)

### **Critique**

While the current research on polycystic ovary syndrome has many strengths and has been extremely valuable for women navigating their PCOS diagnosis, there are still many barriers that need to be acknowledged to have a

more complete understanding of PCOS as a whole and the use of both physical activity and diet as interventions. PCOS has recently become a hot topic in healthcare, so up to date research on the most conducive physical activity and diet interventions is inconclusive. This provides a lack of clarity for women trying to determine the best course of action for treating PCOS. Moreover, there is not a standardized method of delivering research and healthcare information to women with PCOS or a standardized intervention method. The results of the research conducted could be influenced by a lack of standardization. Another limitation this research faces is that subjects for most of the current research on PCOS has been done on white, cis-gendered women living in developed countries. Current research fails to take into consideration the barriers minority women, women living in third world countries, and transgender males may face regarding PCOS and its treatment. There may be an absence of culturally appropriate research and interventions for women who fall outside of the white, cis-gendered identity.

### **Conclusion**

Polycystic ovary syndrome is a common endocrine disorder in reproductive-age women, occurring in 5-15% of the female population, with significant health-related

comorbidities including but not limited to; reproductive implications, metabolic dysfunction, and cardiovascular risk. (Dokras et al., 2016, dos Santos et al., 2020) PCOS has recently become a hot topic in women's health, as its implications have become more widely discussed. PCOS is an important topic of discussion as it has the potential to impact anyone with a uterus, approximately half of the world's population. Being knowledgeable in PCOS and the use of physical activity and diet as interventions is important so women who are diagnosed are aware of the treatment options, outside of a medication, that are available to them.

While it is clear that women with PCOS benefit greatly from a combination of both physical activity and dietary interventions to help navigate the effects of PCOS, it is unclear the specific impact of the use of both physical activity and diet as an intervention for PCOS. Future research may be beneficial to determine the most efficient diet and physical activity levels for women with PCOS to participate in. It is also important to continue research on minority women who may not have access to traditional medication or intervention options, as well as transgender males, especially those supplementing testosterone, and the impact that has on their PCOS diagnoses.



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