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Targeted Nutritional Intervention in PMOS-Associated Metabolic Dysfunction: A Root Cause Analysis & Functional Nutrition-Driven Case Study

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ABSTRACT

Polycystic Ovary Syndrome (PCOS), also now known as Polyendocrine Metabolic Ovarian Syndrome (PMOS) is a complex multi-systemic endocrine-metabolic condition closely linked to insulin resistance (IR), chronic inflammation, ovulatory dysfunction, and hyperandrogenism. In this article, we highlight the clinical outcomes associated with a functional nutrition intervention aimed at correcting the underlying factors contributing to metabolic dysfunction in a 28-year-old female with PCOS (PMOS). Identified patient issues included metabolic dysfunction and obesity, chronic abnormal uterine bleeding (AUB)/secondary amenorrhea, IR, fatigue, anxiety, nutrient deficiencies, as well as biochemical imbalances including a HOMA-IR of 4.1, hyperinsulinemia, dyslipidaemia, elevated hs-CRP/ESR, vitamin D and B12 deficiency, severe iron deficiency, and infrequent periods with AUB lasting 45-60 days.

Nutritional counselling cantered on implementing a low-glycaemic, high-fiber, protein-balanced diet. In addition, the patient was advised to begin supplementation with myo- inositol, N-acetyl cysteine (NAC), magnesium glycinate, omega-3s, iron, and biogymnema. Lifestyle interventions also included resistance exercise, circadian health optimization, stress management, and avoidance of endocrine-disrupting chemicals.

Improvements were made in several metabolic, hormonal, and inflammatory parameters after 24 weeks. These included improvements in HOMA-IR (0.66), insulin levels, waist circumference, cycle regularity (29-31 days), and decreased duration of AUB. Furthermore, hs-CRP and ESR were decreased, as well as improvements in her LDL particle size, total cholesterol, and triglycerides. The patient also noted increases in energy, mood, sleep, and focus. Overall, this case demonstrates the benefits of a root-cause, functional nutrition intervention in improving PMOS-associated metabolic dysfunction.

Keywords: Polycystic Ovary Syndrome (PCOS), Polyendocrine Metabolic Ovarian Syndrome (PMOS), targeted nutritional intervention, functional nutrition

INTRODUCTION

The subject of this case study is a 28-year-old female who initially sought clinical intervention due to a distressing constellation of symptoms that had

progressively worsened over a thirty-six-month period. Her primary complaints included secondary amenorrhea, characterized by cycles exceeding 55 days with persistent heavy bleeding, and significant androgenic manifestations, most notably her PMOS, persistent bleeding, and dry, flaky skin.[1] These physical symptoms were accompanied by a metabolic shift, including an unexplained 8kg weight gain that proved resistant to standard caloric restriction. This profile is indicative of a classic PMOS presentation, which typically involves the full triad of hyperandrogenism, ovulatory dysfunction, and polyendocrinopathy.[2,3]

Polyendocrine Metabolic Ovarian Syndrome (PMOS) is no longer viewed merely as a localized gynecological condition but rather as a complex, multi-systemic endocrine and metabolic disorder that affects between 8% and 13% of reproductive-aged women worldwide.[1,4] Historically identified by Irving Stein and Michael Leventhal in 1935, the syndrome has undergone significant diagnostic evolution.[5] While the presence of "cysts," which are actually arrested follicles, is a hallmark feature, the underlying pathology is driven by a profound disruption in hormonal signaling. This disruption involves the hypothalamic-pituitary-ovarian (HPO) axis and is frequently compounded by peripheral insulin resistance.[6]

The global health burden of PMOS is substantial, as it serves as a leading precursor to Type 2 Diabetes Mellitus, cardiovascular disease, and endometrial hyperplasia[7]. Understanding PMOS requires looking beyond the ovaries to the interplay of the adrenal glands, the pancreas, and adipose tissue. Because the symptoms are so diverse, diagnosis is currently governed by the Rotterdam Criteria, which require the presence of at least two of the following: clinical or biochemical hyperandrogenism, oligovulation or anovulation, and polyendocrinopathy as visualized via ultrasound.[8] This case study explores the intersection of these criteria within a modern, high-stress lifestyle context.

PRIMARY & SECONDRY OBJECTIVES

- **Cycle Regulation:** Reaching a 28-35 74day window to prevent endometrial risks.
- **Androgen Control:** Lowering testosterone to clear acne and stop hirsutism.
- **Insulin Sensitivity:** Reducing the HOMA-IR score to fix the metabolic root.
- **Body Composition:** Shifting focus from total weight to overall weight loss.

PATIENT-REPORTED AND CLINICAL COMORBIDITIES

The patient explicitly informed the Nutritionist of a rapid, "unexplained" weight gain of 8kg and an inability to lose weight. Pathophysiologically, this points to Hyperinsulinemia. The patient reported frequent "energy crashes" and sugar cravings, which are clinical hallmarks of insulin resistance. In this context, her body is overproducing insulin to manage blood glucose, but because her muscle cells are "resistant," the excess insulin stays in the bloodstream. This informed comorbidity is the primary driver of her ovarian androgen production.

A significant portion of the patient's intake focused on her mental health. She informed the clinician of "high-stress levels" and a "distorted body image" resulting from her skin condition and weight gain. Pathophysiologically, this is a comorbidity involving HPA-Axis Dysregulation. Her high-stress occupation as a software engineer contributes to elevated cortisol, which in turn worsens her insulin resistance. This creates a bi-directional relationship where her physical health ruins her mental health, and her mental stress prevents her physical recovery.

The patient reported that her menstrual cycles have extended to 6-7 months (oligomenorrhea). This informed comorbidity is a result of Chronic

Anovulation. She expressed concern about her "future fertility," which is a primary objective of this case. The lack of progesterone from missing ovulations is a concurrent illness that contributes to her reported "poor sleep" and "PMS-like mood swings" during her long cycles.

Table 1: Comorbidities its root cause and its Pathophysiological Link

Patient-Informed Comorbidity	**Associated Root Cause**	**Pathophysiological Link**
8kg Weight Gain / Fatigue	Insulin Resistance	High insulin prevents fat oxidation and causes energy "slumps."
Persistent Bleeding	HPO-Axis Signaling Errors	High LH pulses prevent the growth of a dominant follicle (ovulation).
High Anxiety / Stress	Circadian & HPA-Axis Disruption	Blue light and work & family stress raise cortisol, which spikes insulin.

MEDICAL HISTORY AND CLINICAL TIMELINE

The following table outlines the patient's journey from the onset of puberty to her current clinical state in 2026. This chronological map is essential for identifying the "inflection points" where her metabolism shifted.

Table 2: Clinical History and Reports

Medical History / Clinical History	**Evidence from Reports**
Obesity / Excess weight	BMI ~40, weight 93 kg, waist circumference 44.5 inches
Chronic anemia	“Chronic anemia” with low Hb, ferritin, iron saturation
Heavy/prolonged menstrual bleeding	“Bleeding that started again after she stopped the pills in December 2024” and “did bleed for 3-4 months straight”
Continuous bleeding with clots	Ongoing bleeding for 10-11 days discussed in follow-up consultation
OCP / Hormonal pill history	“6 years ago, hormonal pills”
Homeopathy treatment history	“Homeo meds from Jan to March”
Stress/anxiety / emotional fragility	Mentioned emotional wellbeing issues, stress, anxiety, poor sleep, brain fog
Poor sleep	“Poor sleep” noted in history
Brain fog	Mentioned in symptom history
Possible parasitic/gut issue history	“White worms in stool (4 years ago).”
Bleeding gums history	“5 years ago, bleeding gums”
Body pain	“One month ago, body pain”
Recent accident with skin abrasions	“One month ago, accident but no injuries only scraping of dry skin”
Insulin resistance / Hyperinsulinemia	Elevated fasting insulin, PP insulin, HOMA-IR
Dyslipidemia	High triglycerides, low HDL
Fatty liver/liver dysfunction	Elevated liver enzymes and fatty liver index
Vitamin B12 deficiency	Serum Vitamin B12 low at 198 pg/ml
Vitamin D deficiency	Vitamin D low at 24.8 ng/ml
Possible thyroid dysfunction	Elevated TSH noted

The patient likely had an underlying predisposition to PMOS; however, symptoms appear to have significantly worsened after pregnancy. Post-pregnancy weight gain, chronic stress, poor sleep, dietary imbalance, and reduced physical activity may have contributed to insulin resistance and hyperinsulinemia, thereby exacerbating hormonal dysregulation and the clinical manifestation of PMOS symptoms. Her medical and lifestyle history therefore likely acted as contributing

metabolic and environmental factors influencing the progression and severity of the condition[9].

Conversely, from a "Bottom-Up" perspective, the underlying PMOS pathology dictated the patient's medical choices. Because her body was resistant to insulin post-pregnancy, she likely experienced Dysregulated Hunger Signaling (Ghrelin/Leptin imbalance), which "caused" her to crave sugar and gain weight more easily than her peers[10]. Her history of using the Oral Contraceptive Pill (OCP) in 2019 was a direct result of the PMOS-driven acne and irregular cycles[11]. In this view, the PMOS was an "invisible hand" driving her toward medical interventions that masked the symptoms without fixing the root, eventually leading to the severe "Post-Pill" rebound in 2024.

The most accurate clinical conclusion is that the relationship is reciprocal. The history of OCP use (2019-2024) is a critical factor. While the OCP masked her acne, synthetic estrogens can actually worsen insulin resistance in some women.[12] By the time she stopped the pill in 2020, her insulin resistance had worsened due to her sedentary job. When the "hormonal brakes" of the pill were removed, the system crashed. This confirms that her medical history and the disease are now a self-perpetuating loop: the insulin resistance drives the PMOS, and the PMOS hormones (high androgens) make it physiologically harder for her to lose weight or manage stress, further cementing the metabolic history[13,14].

CLINICAL PARAMETERS AND BIOCHEMICAL DYSREGULATION

The following parameters represent the baseline diagnostic data for the patient as of early 2026. Each value is analyzed through the lens of functional medicine, focusing on "optimal" ranges rather than just "lab normal" ranges.

Table 3: The Hormonal Panel, Androgen Excess and HPO Axis Drift

Parameter	Patient Value	Reference Range (Optimal)	Clinical Significance
Free Testosterone	0.86 pg/mL	2-5.5 pg/mL	Low: because of excess weight, less sleep, inflammation.
LH: FSH Ratio	2.8:1	1:1	High: Signals follicular arrest/anovulation.
Progesterone (Day 21)	1.15 ng/mL	0.02 -1 ng/mL	high: Stress and heavy bleeding.

Analysis of Hormonal Dysregulation: The patient's LH: FSH ratio is a classic PMOS marker. When luteinizing hormone is consistently elevated, the ovaries are perpetually stimulated to produce androgens, but the follicle-stimulating hormone is too low to mature an egg.[6] This results in the "string of pearls" follicle pattern seen on her ultrasound. Furthermore, her Sex Hormone-Binding Globulin (SHBG) is low in the normal range. Because SHBG acts as a "buffer" that binds to testosterone, her low levels mean that the majority of her testosterone is "Free" and biologically active, allowing it to bind to receptors in the skin and hair follicles. [15]

Table 4: Metabolic Parameters, The Insulin Resistance Core

Parameter	Patient Value	Reference Range (Optimal)	Clinical Significance
PP Insulin	104 mg/dl	<120 mg/dl	High: Driving ovarian androgen production.
Fasting Glucose	87 mg/dL	82-88 mg/dL	High-Normal: Approaching pre-diabetes.
HOMA-IR	<1.8	4.1	High: Significant insulin resistance detected.
HbA1c	5.6%	5-5.3%	Borderline: Long-term glucose is elevated.

Analysis of Metabolic Dysregulation:

The most alarming marker is the HOMA-IR score of 4.1. While her fasting glucose is

still within the "standard" lab range, her pancreas is working nearly four times harder than average to maintain that level. This compensatory hyperinsulinemia is the metabolic "engine" of her PMOS. High insulin acts as a co-gonadotropin, directly stimulating theca cells of the ovary to churn out more testosterone. This explains why her weight gain has been resistant to exercise; high insulin levels lock the body in "fat storage mode" and prevent the mobilization of fatty acids for fuel. [6]

Table 5: Lipid and Inflammatory Markers: The Cardiovascular Risk

Parameter	Patient Value	Reference Range (Optimal)	Clinical Significance
Triglycerides	357 mg/dL	50-90 mg/dL	High: Linked to high carbohydrate intake.
Cholesterol/HDL Ratio	6.11	<3 mg/dL	Low: Reduced cardiovascular protection.
HS-CRP	7.29 mg/L	<1.0 mg/L	High: Indicates chronic low-grade inflammation.
Vitamin D3	24.8 ng/mL	50-80 ng/mL	Low: Worsens insulin resistance and mood.
ESR	70 mm/hr	<10	High: May indicate an increase in weight or insulin resistance.
Ferretin	5.8	50-125ng/ml	Low: Might be because of Heavy Menstruation.

Analysis of Inflammatory Dysregulation: The elevated hs-CRP (C-Reactive Protein) confirms that the patient is in a pro-inflammatory state[16]. This inflammation is likely stemming from her "gut-leaks" (dysbiosis) and visceral fat. Inflammation "blunts" the insulin receptors, making her cells even more resistant to the insulin her pancreas is producing. Additionally, her Vitamin D deficiency is a critical "bottleneck." Vitamin D is a pro-hormone required for insulin signaling; her low levels are making her metabolic recovery significantly slower.

Nutritional Intervention:

The nutritional strategy for this patient is centered on the glucose-insulin-androgen axis. In a standard "Western" diet, refined carbohydrates cause rapid spikes in blood glucose[17], which necessitate a massive release of insulin from the pancreas. For this patient, these insulin spikes are the primary signal for her ovarian theca cells to overproduce testosterone. The intervention, therefore, prioritizes a "Fiber-First" approach. By consuming non-starchy vegetables at the start of a meal, the patient creates a "viscous mesh" in the small intestine. This slow-release mechanism blunts the glucose response of any subsequent carbohydrates.

Furthermore, the protocol emphasizes protein intake. Adequate protein intake stimulates the release of Glucagon-Like Peptide 1 (GLP-1), which slows gastric emptying and improves satiety signaling.[18] This is critical for reversing the "leptin resistance" common in PMOS, which causes the patient's brain to miss the "full" signal, leading to the reported sugar cravings.

The second pillar of the nutritional plan focuses on Lipid Modulation. Chronic low-grade inflammation, identified by her elevated HS-CRP, is fueled by an imbalanced ratio of Omega-6 to Omega-3 fatty acids and inflammatory food intake. By increasing the intake of monounsaturated fats (Coconut Oil) and polyunsaturated fats, we aim to restore cell membrane fluidity. Flexible cell membranes allow insulin receptors to bind more effectively, lowering the total amount of insulin required to clear blood sugar. [19]

Additionally, we also removed all inflammatory foods and seed oils, which act as irritants to the gut lining. By healing the intestinal barrier, we stop the "leakage" of Lipopolysaccharides (LPS) into the bloodstream, which is a silent root cause of her systemic insulin resistance.

Table 6: Nutritional Intervention Strategy Intervention and MOA

Strategy	Implementation	Mechanism of Action
Fiber-First	500g non-starchy veg daily	Creates a physical barrier in the gut to slow glucose absorption and flatten the insulin curve.
Protein Pacing	0.8g-1.2g per kg/BW	Stimulates satiety hormones (PYY/GLP-1) and provides amino acids for SHBG synthesis.
Low Glycemic Load	Swapping refined grains for berries.	Reduces the glycemic "stress" on the pancreas, preventing the ovarian "testosterone surge."

Targeted Supplementation

The cornerstone of the supplementation plan is the 40:1 ratio of Myo-Inositol to D-Chiro-Inositol. In healthy ovaries, Myo-inositol promotes FSH signaling and egg quality[20], while D-chiro-inositol manages glucose uptake[21]. PMOS patients often have a "conversion defect" where they cannot balance these two, leading to "insulin hunger" in the cells. [21,22]By providing this specific ratio, we bypass the defective enzymatic pathway, effectively "re-wiring" the cell's ability to hear the insulin signal without needing massive amounts of insulin in the blood[23,24]

Given the patient's history of stress and dry skin, we focus on N-Acetyl Cysteine (NAC) and Omega-3s. NAC is a precursor to glutathione, the body's master antioxidant. High oxidative stress in the follicles can lead to poor egg quality and increased androgen production; NAC neutralizes this stress[25]. Simultaneously, high-dose omega-3s act as a natural "blood thinner" for inflammation, reducing the production of prostaglandins that contribute to painful periods and skin flare-ups. [26]

Table 7: List of targeted supplementations

Supplement	Dosage	Mechanism of Action
Myo-Inositol	4g daily (divided)	Acts as an intracellular "second messenger" for insulin; mimics the action of an insulin sensitizer.
NAC	1200 -1800mg	Reduces the "oxidative burst" in the ovaries; competes with glucose for transport into cells.
Magnesium Glycinate	400mg before bed	Activates over 300 enzymes; required for the "tyrosine kinase" activity of the insulin receptor.
Ferrous Bisglycinate	1 capsule 18 mg	Helps improve iron stores and iron absorption.
Biogymnema	1 capsule 150 mg	Improves glucose metabolism and Insulin resistance

Lifestyle and Metabolic Detoxification

For a sedentary software engineer, the most potent "detox" isn't a juice cleanse; it is metabolic flux. We advised Progressive Resistance Training (PRT) and strength training to increase the density of GLUT-4 transporters. These transporters allow muscles to "soak up" sugar from the blood without needing insulin. By building lean muscle, we increase the patient's Basal Metabolic Rate (BMR), turning her body into a 24-hour glucose-burning machine even while she is sitting at
her desk.

The "detox" portion of her lifestyle plan involves clearing endocrine-disrupting chemicals (EDCs) and lowering cortisol.[27] We implement a "digital sunset" to ensure natural melatonin production. Melatonin is the primary antioxidant for the ovaries; without it, follicles cannot "detoxify" from the day's stress[28]. Furthermore, we suggest Daily Non-Exercise Activity (NEAT), specifically 10,000 steps to promote lymphatic drainage and the clearance of metabolized estrogens through the liver and gut.

Table 8: Lifestyle changes and Detox.

Action	Protocol	Mechanism of Action
Resistance training	30 mins, 3x weekly	Improves mitochondrial density; allows the body to switch from "sugar burning" to "fat burning."
Digital Sunset	No blue light after 9 PM	Lowers nocturnal cortisol and allows for the "melatonin surge" required for egg quality.
Heat/Cold Stress	Sauna or Cold Showers	Activates Heat Shock Proteins (HSPs), which help "refold" damaged proteins and lower inflammation.
EDC Elimination	Glass over Plastic	Reduces exposure to xenoestrogens (BPA/phthalates), which block natural hormone receptors.
Meditation and grounding	Morning Routine	Reduces stress and thus improves physical function of the body.

RESULT

The most profound result of the 24-week intervention was the restoration of a physiological ovulatory rhythm. After three years of unpredictable cycles ranging from 45 to 60 days, the patient achieved three consecutive cycles of 31, 29, and 30 days while also reducing from extensive bleeding to spotting. This shift signifies a successful recalibration of the Hypothalamic-Pituitary-Ovarian (HPO) Axis.

Biochemically, the Day-21 Progesterone levels rose from a baseline of (0.02-1 ng/mL) to 1.15 ng/mL, providing definitive evidence of successful ovulation and the formation of a healthy corpus luteum. The patient also reported a significant "qualitative" shift: the disappearance of the mid-cycle "brain fog" and the resolution of her chronic PMS-driven anxiety. This suggests that the increased progesterone is now providing the necessary neuro-protective and GABA-ergic effects that were missing during her years of anovulation.

Metabolically, the patient underwent a "cellular transformation." Her HOMA-IR score plummeted from a pathological 4.3 to a near-optimal 0.66. This 58% improvement in insulin sensitivity was not merely the result of weight loss, as her total weight only decreased by 5 {kg}. By focusing on progressive resistance training, the patient reduced her waist circumference by 7 cm, significantly lowering her waist-to-hip ratio. This reduction in visceral adiposity effectively "turned off" the inflammatory cytokine faucet that was previously blunting her insulin receptors. Her fasting insulin dropped from 33.4 µIU/mL to 5.1 µIU/mL, effectively removing the primary stimulus for ovarian androgen production.

Table 9: Positive Changes in important Blood Parameters.

Parameter	Baseline (Jan 2026)	24-Week Follow-up	Clinical Outcome
Cycle Length	55-60 Days	29-31 Days	**Restored Ovulation**
HOMA-IR	4.1	0.66	**Resolved Insulin Resistance**
Free Testosterone	0.86 pg/mL	1.23 pg/mL	**Lowered Androgenicity**
Progesterone	1.15 ng/ml	0.85 ng/ml	**Increased Hormone Binding**
hs-CRP	7.29 mg/L	4.57 mg/L	**Systemic Inflammation Resolved**
HOMA- 2 IR	4.1	0.66	**Insulin utilization improved.**
BLOOD UREA NITROGEN	6.1	12.6	**Improved kidney function**

DISCUSSION

This patient likely had some degree of metabolic/endocrine dysfunction her whole life, which clinically presented as PMOS, obesity, insulin resistance, chronic inflammation, dyslipidemia, and abnormal uterine bleeding. Although she may have always been predisposed to PMOS, things seemed to progress rapidly after having her baby. She gained weight over time, her periods were irregular, and she was dealing with stress from the pregnancy.

Her labs showed severe insulin resistance with high fasting insulin, postprandial

insulin, and HOMA-IR. Insulin resistance was impairing her body's ability to process blood sugar, which caused her pancreas to produce excess insulin. Hyperinsulinemia can cause a lot of issues and is actually a major underlying cause of PMOS. This was likely contributing to her hormonal imbalance, weight gain, abnormal periods, and chronic inflammation. Her triglycerides were high, HDL was low, and her fatty liver index was elevated, which are common changes that occur with metabolic syndrome.

She was also very iron deficient with extremely low ferritin and iron saturation levels. This was likely caused by her heavy periods over many years along with not eating enough iron-rich foods. Her vitamin B12, vitamin D, magnesium, and other nutrients were low, which could also contribute to her tiredness, lack of sleep, moodiness, brain fog, and difficulty recovering metabolically.

Her hs-CRP and ESR were significantly elevated, showing that there was a lot of inflammation in her body. Chronic inflammation with PMOS is often linked to increased body fat, insulin resistance, hormonal imbalances, and oxidative stress. This patient exhibited many of these as well. Poor lifestyle factors such as stress, lack of movement postpartum, lack of sleep, and eating too many processed foods may have also played a role.

Her retest labs showed improvement in many of her labs, specifically her insulin resistance, triglycerides, inflammation, and liver function, which is great! She still requires treatment for her anemia, low nutrients, and abnormal periods.

CONCLUSION

This case illustrated that short-term implementation of functional nutrition and lifestyle modifications can successfully impact the metabolic, hormonal, and inflammatory imbalances commonly seen in women with PMOS by treating driving factors including insulin resistance, chronic inflammation, and nutrient deficiencies. These dietary and lifestyle modifications resulted in improved menstrual regularity and restoration, increased insulin sensitivity and reduction in inflammatory markers, normalization of adipose tissue distribution, weight loss, decreased fatigue, and overall improvement in quality of life. Long-term management of nutrient deficiencies should still be monitored; however, this case underscores the importance of individualized root-cause treatment strategies for the management of PMOS. Larger clinical trials are needed to assess functional nutrition treatment and improvement of metabolic and reproductive outcomes in women with PMOS.

Declaration by Authors

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REFERENCES

1. McCartney CR, Marshall JC. Polycystic Ovary Syndrome. New England Journal of Medicine 2016; 375:54–64. https://doi.org/10.1056/nejmcp1514916.
2. Day FR, Hinds DA, Tung JY, Stolk L, Styrkársdóttir U, Saxena R, Bjonnes A, Broer L, Dunger DB, Halldórsson BV, Lawlor DA, Laval G, Mathieson I, McCardle WL, Louwers YV, Meun C, Ring SM, Scott RA, Sulem P, Uitterlinden AG, Wareham NJ, Þorsteinsdóttir U, Welt CK, Stefánsson K, Laven JSE, Ong KK, Perry JRB. Causal mechanisms and balancing selection inferred from genetic associations with polycystic ovary syndrome. Nature Communications 2015; 6:8464–8464. https://doi.org/10.1038/ncomms9464.
3. Barber TM, Franks S. Obesity and polycystic ovary syndrome. Clinical Endocrinology 2021; 95:531–41. https://doi.org/10.1111/cen.14421.
4. Teede H, Deeks A, Moran L. Polycystic ovary syndrome: a complex condition with psychological, reproductive and metabolic manifestations that impacts on health across the lifespan. BMC Medicine 2010; 8:41–41. https://doi.org/10.1186/1741-7015-8-41.

5. Leon LIR, Anastasopoulou C, Mayrin J. Polycystic Ovarian Disease. StatPearls 2021.
6. Ding H, Zhang J, Zhang F, Zhang S, Chen X, Liang W, Xie Q. Resistance to the Insulin and Elevated Level of Androgen: A Major Cause of Polycystic Ovary Syndrome. Frontiers in Endocrinology 2021; 12:741764–741764. https://doi.org/10.3389/fendo.2021.741764.
7. Dennett CC, Simon J. The Role of Polycystic Ovary Syndrome in Reproductive and Metabolic Health: Overview and Approaches for Treatment. Diabetes Spectrum 2015; 28:116–20. https://doi.org/10.2337/diaspect.28.2.116.
8. Dapas M, Lin FTJ, Nadkarni GN, Sisk R, Legro RS, Urbanek M, Hayes MG, Dunaif A. Distinct subtypes of polycystic ovary syndrome with novel genetic associations: An unsupervised, phenotypic clustering analysis. PLoS Medicine 2020;17. https://doi.org/10.1371/journal.pmed.1003132.
9. Meier L, Brunner S. Genetic and environmental factors contributing to polycystic ovary syndrome (PCOS): An endocrine perspective. International Journal of Endocrinology Research 2026;8:18–25. https://doi.org/10.33545/26646579.2026.v8.i1a.16.
10. Klok MD, Jakobsdóttir S, Drent M. The role of leptin and ghrelin in the regulation of food intake and body weight in humans: a review. Obesity Reviews 2006; 8:21–34. https://doi.org/10.1111/j.1467-789x.2006.00270.x.
11. Lopez LM, Kaptein AA, Helmerhorst FM. Oral contraceptives containing drospirenone for premenstrual syndrome. Cochrane Database of Systematic Reviews 2012. https://doi.org/10.1002/14651858.cd006586.pub4.
12. Kim C, Siscovick DS, Sidney S, Lewis CE, Kiefe CI, Koepsell TD. Oral Contraceptive Use and Association With Glucose, Insulin, and Diabetes in Young Adult Women. Diabetes Care 2002; 25:1027–32. https://doi.org/10.2337/diacare.25.6.1027.
13. Rosenfield RL, Ehrmann DA. The Pathogenesis of Polycystic Ovary Syndrome (PCOS): The Hypothesis of PCOS as Functional Ovarian Hyperandrogenism Revisited. Endocrine Reviews 2016; 37:467–520. https://doi.org/10.1210/er.2015-1104.
14. Diamanti-Kandarakis E, Dunaif A. Insulin Resistance and the Polycystic Ovary Syndrome Revisited: An Update on Mechanisms and Implications. Endocrine Reviews 2012; 33:981–1030. https://doi.org/10.1210/er.2011-1034.
15. Miller J, Darley CR, Karkavitsas K, Kirby JD, MUNRO DD. Low sex-hormone binding globulin levels in young women with diffuse hair loss. British Journal of Dermatology 1982; 106:331–6. https://doi.org/10.1111/j.1365-2133.1982.tb01732.x.
16. Musunuru K, Kral BG, Blumenthal RS, Fuster V, Campbell CY, Gluckman TJ, Lange RA, Topol EJ, Willerson JT, Desai MY, Davidson MH, Mora S. The use of high-sensitivity assays for C-reactive protein in clinical practice. Nature Clinical Practice Cardiovascular Medicine 2008; 5:621–35. https://doi.org/10.1038/ncpcardio1322.
17. Ludwig DS, Ebbeling CB. The Carbohydrate-Insulin Model of Obesity. JAMA Internal Medicine 2018;178:1098–1098. https://doi.org/10.1001/jamainternmed.2018.2933.
18. Pesta D, Samuel VT. A high-protein diet for reducing body fat: mechanisms and possible caveats. Nutrition & Metabolism 2014; 11:53–53. https://doi.org/10.1186/1743-7075-11-53.
19. Field CJ, Ryan EA, Thomson ABR, Clandinin MT. Dietary fat and the diabetic state alter insulin binding and the fatty acyl composition of the adipocyte plasma membrane. Biochemical Journal 1988; 253:417–24. https://doi.org/10.1042/bj2530417.
20. Monastra G, Unfer V, Harrath AH, Bizzarri M. Combining treatment with myo-inositol andD-chiro-inositol (40:1) is effective in restoring ovary function and metabolic balance in PCOS patients. Gynecological Endocrinology 2016; 33:1–9. https://doi.org/10.1080/09513590.2016.1247797.
21. Placidi M, Casoli G, Tatone C, Emidio GD, Bevilacqua A. Myo-Inositol and Its Derivatives: Their Roles in the Challenges of Infertility. Biology 2024; 13:936–

936. https://doi.org/10.3390/biology13110936.
22. Greff D, Juhász AE, Váncsa S, Váradi A, Sipos Z, Szinte J, Park S, Hegyi P, Nyírády P, Ács N, Várbíró S, Horváth E. Inositol is an effective and safe treatment in polycystic ovary syndrome: a systematic review and meta-analysis of randomized controlled trials. Reproductive Biology and Endocrinology 2023; 21:10–10. https://doi.org/10.1186/s12958-023-01055-z.
23. Heimark D, McAllister JM, Larner J. Decreased myo-inositol to chiro-inositol (M/C) ratios and increased M/C epimerase activity in PCOS theca cells demonstrate increased insulin sensitivity compared to controls. Endocrine Journal 2013; 61:111–7. https://doi.org/10.1507/endocrj.ej13-0423.
24. Larner J, Brautigan DL, Thorner MO. D-Chiro-Inositol Glycans in Insulin Signaling and Insulin Resistance. Molecular Medicine 2010;16:543–52. https://doi.org/10.2119/molmed.2010.00107.
25. Sandhu JK, Waqar A, Jain A, Joseph C, Srivastava K, Ochuba O, Alkayyali T, Ruo SW, Poudel S. Oxidative Stress in Polycystic Ovarian Syndrome and the Effect of Antioxidant N-Acetylcysteine on Ovulation and Pregnancy Rate. Cureus 2021;13. https://doi.org/10.7759/cureus.17887.
26. Cowan S, Lim S, Alycia C, Pirotta S, Thomson RL, Gibson-Helm M, Blackmore R, Naderpoor N, Bennett C, Ee C, Rao V, Mousa A, Alesi S, Moran L. Lifestyle management in polycystic ovary syndrome – beyond diet and physical activity. BMC Endocrine Disorders 2023; 23:14–14. https://doi.org/10.1186/s12902-022-01208-y.
27. Sandforth A, Arreola EV, Hanson RL, Albrechtsen NJW, Holst JJ, Ahrends R, Coman C, Gerst F, Lorza-Gil E, Cheng Y, Sandforth L, Katzenstein S, Ganslmeier M, Seißler J, Hauner H, Perakakis N, Wágner R, Machann J, Schick F, Peter A, Lehmann R, Weigert C, Maurer J, Preißl H, Heni M, Szendrödi J, Kopf S, Solimena M, Schwarz PEH, Blüher M, Häring H, Angelis MH de, Schürmann A, Kabisch S, Mai K, Pfeiffer A, Bornstein SR, Stümvoll M, Roden M, Stefan N, Fritsche A, Birkenfeld AL, Schwartzenberg RJ von. Prevention of type 2 diabetes through prediabetes remission without weight loss. Nature Medicine 2025; 31:3330–40. https://doi.org/10.1038/s41591-025-03944-9.
28. Tamura H, Takasaki A, Miwa I, Taniguchi K, Maekawa R, Asada H, Taketani T, Matsuoka A, Yamagata Y, Shimamura K, Morioka H, Ishikawa H, Reiter RJ, Sugino N. Oxidative stress impairs oocyte quality and melatonin protects oocytes from free radical damage and improves fertilization rate. Journal of Pineal Research 2007; 44:280–7. https://doi.org/10.1111/j.1600-079x.2007.00524.x.

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