FORENSIC INSIGHTS AND HEALTH SCIENCES BULLETIN

Volume 4: Issue 2: 2026

https://doi.org/10.56770/fihsb2026424

# NUTRITIONAL AND LIFESTYLE MANAGEMENT OF POLYCYSTIC OVARY SYNDROME PCOS: A COMPREHENSIVE REVIEW

**Esha Qasim [*1], Haya Habib[1], Khudaija Saeed[2], Khadija tul Kubra[1], Iqra Musheer[1], Abdul Basit[3]**

[1]Department of Human Nutrition and Dietetics, Faculty of Medicine and Allied Health Sciences, The Islamia University of Bahawalpur, Punjab, Pakistan.
[2]Gulzar Surgimed Hospital, Civil Hospital Road, Bahawalpur, Punjab, Pakistan.
[3]Department of Public Health, School of Medicine, Far Eastern Federal University, Vladivostok, Russia

Submitted: May 21, 2026; Revised: July 9, 2026; Accepted: July 13, 2026; Published: October 31, 2026

## ABSTRACT

A prevalent endocrine condition that affects women of reproductive age is called polycystic ovarian syndrome, or PCOS. Hormonal imbalance, irregular menstruation, hyperandrogenism, insulin resistance, and polycystic ovaries are its hallmarks. Type 2 diabetes, obesity, infertility, and other metabolic, psychological, and reproductive issues are linked to PCOS. Its development is influenced by a number of factors, including dietary habits, environmental factors, lifestyle choices, and heredity. The primary line of treatment for PCOS is thought to be lifestyle change, which includes eating a balanced diet, exercising frequently, controlling weight, getting enough sleep, and reducing stress. The causes, signs, and function of insulin resistance are covered in this review, along with the significance of dietary and lifestyle changes for enhancing the health of PCO-affected women.

**Keywords:** Polycystic ovarian syndrome, Insulin resistance, Reproductive issues, Lifestyle change, Dietary habits, Environmental factors

[*]**Corresponding Author.** E-mail: eshaqasim03@gmail.com

## INTRODUCTION

Polycystic Ovary Syndrome (PCOS) increase serious complications among females. One in every 5–6 female is facing serious complications regarding infertility and irregularity in their menstrual cycles. Stress, obesity, fluctuation in hormonal level is the major cause worldwide. This condition is also named as Schlerocystic Ovaries, Multicystic ovaries, Stein Leventhal Syndrome which was named by an American gynecologist Irving F Stein, SR and Michael L. Leventhal. This endocrine disorder affects females under 18–44 age. PCOS, or polycystic ovarian syndrome, increases the risk of major difficulties in women. Serious issues with infertility and irregular menstruation cycles affect one in five to six women. Globally, the main causes include stress, obesity, and hormone fluctuations. Other names for this syndrome are Schlerocystic Ovaries, Multicystic Ovaries, and Stein Leventhal Syndrome, which was coined by American gynecologists Michael L. Leventhal and Irving F. Stein, SR. Females between the ages of 18 and 44 are affected by this endocrine condition. It is now acknowledged that women who exhibit normal menstrual periods along with hyperandrogenism and/or PCOS on ultrasonography are exhibiting this syndrome. Furthermore, most writers now concur that women with this disease may exhibit signs of ovarian dysfunction together with an ultrasound appearance of PCOS without any indication of testosterone excess. The physiological effects of PCOS affect a woman throughout her life, with metabolic and hyperandrogenic signs and symptoms emerging early in life, reproductive dysfunction becoming more apparent in adulthood, and metabolic and cardiovascular risk rising in middle and later life. PCOS symptoms are frequently identified in adolescence.

### Symptoms of PCOS

Most ladies are not even aware that they have PCOS [**1, 2**]. For an early identification of the issue, it is critical to pay attention to these signs. PCOS symptoms might appear in early adulthood, although they can also start soon after puberty. Anovulation causes irregular or absent menstruation in many

FIHSB is published by AMMANIF Publisher. The authors retain the copyright without restriction. This article is an open access article published under the terms and conditions of Creative Commons Attribution 4.0 International License.

PCOS-affected women; however, some may develop ovarian cysts. It has many signs and symptoms Irregular periods are the most typical PCOS symptom [**3**]. PCOS first manifests as irregular or frightening periods. Observe your monthly cycle closely to identify PCOS. Excessive facial hair growth is known as Hirsutism. Women with PCOS have excessive hair growth because their ovaries secrete a large amount of the masculine hormone androgens. Up to 70% of women with PCOS experience Hirsutism, a frequent clinical manifestation of hyperandrogenism [**4**]. The face, arms, back, chest, thumbs, toes, and abdomen are among the areas that may be impacted by excessive hair growth, which is linked to PCOS because of hormonal fluctuations. PCOD-related hormone imbalance is the cause of acne and other facial problems. Male hormone overproduction is the cause of acne. Some women with PCOS have severe cystic acne [**5**]. Acne is an inflammatory disease that affects the sebaceous and apocrine glands that are attached to the hair follicle. While serum androgen levels are often not higher, the primary problem for female acne sufferers is increased sebum production. PCOS causes irregular periods and hormonal imbalance. This hormone imbalance is the source of sudden mood changes. Anxiety and depression are prevalent symptoms. Women with PCOS have an abrupt increase in weight due to the body's production of high levels of male hormones and insulin. One common indicator of PCOS is an accumulation of fat in the lower belly. There are significant national differences in the prevalence of overweight and obese women in PCOS cultures. In Kuwait, 37% of women with PCOS are overweight but not obese, compared to 10% in Italy. Research from the US and Australia shows that women with PCOS had the greatest rates of obesity, with 61% to 76% of them being obese. Because the periods are irregular, there is more buildup in the uterine wall. Every time a period happens, this results in increased bleeding. In females with PCOD, hair loss is a typical symptom. Some women experience total hair loss. This is due to an imbalance of hormones in the body. An overabundance of androgens causes hair loss or thinning of the scalp. Women with PCOD have increased insulin levels, which increases their risk of developing diabetes. One of the main characteristics of PCOS is insulin resistance [**6, 7**]. Epidemiologic studies have established strong evidence linking PCOS to a higher incidence of type 2 diabetes, gestational diabetes mellitus (GDM), and impaired glucose tolerance (IGT). There is a connection between GDM and PCOS. Although there hasn't been much research on prevalence to yet, a recent meta-analysis shows that women with PCOS are typically three times more likely to have the condition. Pelvic Pain: During menstruation, pelvic pain can occur in addition to excessive bleeding and headaches. Women with PCOS frequently complain of sleep problems, especially insomnia. It has been linked to PCOS, a sleep apnea disorder. One common sign of sleep apnea, which disrupts sleep, is breathing pauses during the night. The skin of the neck, groin, and area under the breasts may develop dark patches [**8**].

## CAUSES OF PCOS

### *Genetic Mechanism*

Genes related to steroidogenesis of the ovary and adrenal glands, steroid hormone actions and regulation, insulin action and secretion, energy homeostasis, and chronic inflammation are among the gene types linked to the development of PCOS [**9**]. Therefore, the development of PCOS is caused by specific changes in select genomes. Calpain 10 (CAPN10), cytochrome p450, insulin, androgen receptor (AR), fat mass obesity (FTO), and follicular stimulating hormone receptor (FSHR) are a few genes that contribute to the development of PCOS. Endocrine disrupting chemicals are defined by the Endocrine Society as "an exogenous chemical, or mixture of chemicals, that interfere with hormonal action." These chemicals have the potential to negatively impact the endocrine system. The frequently used EDC include bisphenol A (BPA), perchlorate, dioxins, phthalates, phytoestrogens, polychlorinated biphenyls (PCB), polybrominated diphenyl ethers (PBDE), triclosan, perfluoroalkyl and polyfluoroalkyl substances (PFAS), organophosphorus compounds, alkyl phenols (surfactants), parabens, methoxychlor, diethylstilbestrol (DDET) and its metabolite vinclozolin. By attaching to hormone receptors, EDCs function as either agonists or antagonists, increasing, decreasing, or blocking hormone activity. Inflammatory mediators, which alters normal steroidogenesis and causes PCOS to develop. Consumption of foods with a high glycemic index and a diet heavy in fat, particularly saturated fatty acids, raises the risk of insulin resistance and its associated problems, such as obesity and PCOS [**10**].

### *Role of Insulin Resistance in PCOS*

Insulin resistance and compensatory hyperinsulinemia are common features of PCOS. According to certain research, hyperinsulinemia increases ovarian androgen production and hinders ovulation, which both contribute to the condition's hyperandrogenism. This is the result of insulin stimulating the theca cell, an ovarian cell that produces testosterone through androgen biosynthesis [**11**]. Genetic influences, alternative reactions to excess energy, and non-heritable intrauterine and extrauterine environmental factors combine in the pathophysiology of insulin resistance in PCOS. Insulin resistance in PCOS is caused by several molecular mechanisms, such as increased free fatty acids, increased cytokine secretion, increased testosterone, and compromised post-

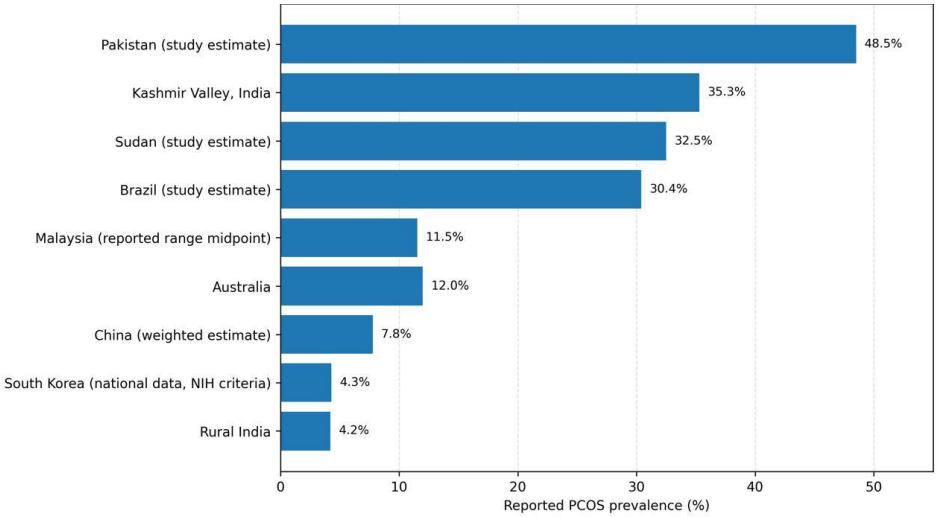



**Figure 1:** Prevalence of PCOS in world

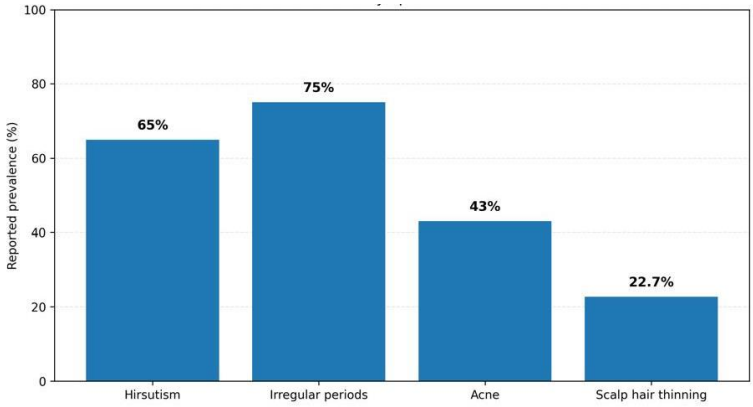



**Figure 2:** Most common symptoms in the patients with PCOS

receptor insulin action. Insulin resistance (IR), a metabolic disorder characterized by a decrease in cellular responsiveness to insulin signaling, appears to be an essential pathophysiologic process in the emergence of any metabolic consequence of PCOS. Insulin resistance and hyperinsulinemia are common in women with PCOS. Two problems that arise in women with PCOS are impaired glucose tolerance and type 2 diabetes. Anovulation and infertility result from the thickness of theca cells in the ovaries caused by hyperinsulinemia linked to insulin resistance [**12**]. In steroidogenic organs such as the ovary and the adrenal cortex, insulin stimulates the associated trophic hormones to promote steroidogenesis. Because hyperinsulinemia increases the activity of LH, it is the primary cause of increased ovarian or adrenal androgen release. Also, the hyperinsulinemia decreases the synthesis of sex hormone binding globulin (SHBG), which is a vital circulatory protein that controls testosterone levels, resulting into increased free circulating testosterone concentration [**13**].

**Importance of Diet in PCOS Management**

The American Society for Reproductive Medicine (ASRM) 2018 Guidelines state that diet modification and increased activity are the first-line treatments for PCOS. The food strategy for these women needs to be focused on achieving particular objectives, like enhancing IR and metabolic and reproductive processes. Szczuko et al.'s 2017 analysis of the diets of 54 PCOS-affected women of reproductive age revealed that inadequate diets may be the root cause of metabolic problems linked to abnormal ovarian function in PCOS-affected women. Because of its anti-inflammatory, anti-cancer, anti-obesogenic, and antioxidant qualities, the Mediterranean diet (MedDiet) is currently the gold standard dietary model in preventive medicine. Consequently, it is now part of the worldwide rules. among the recommended dietary models due to its unique characteristics, including the regular consumption of unsaturated fats, fibers, low-carbohydrate glycemic index, antioxidants, and vitamins, as well as adequate amounts of animal and vegetable proteins. Over the years, several studies have shown that adoption of Med Diet can protect against diseases like cardiovascular disease, obesity, type 2 diabetes (T2D) and nonalcoholic fatty liver disease (NAFLD). Low Carbohydrate Diets have also shown positive effects in women with PCOS by improving body weight, insulin resistance, blood sugar levels, and hormonal imbalance. LCDs may help regulate hormones and improve ovulation in women with PCOS. However, a large body of evidence shows that

higher intake of fiber, along with Low glycemic index carbohydrates, is beneficial for metabolic health, inflammation, gut function, body composition, satiety and long-term dietary adherence. High fiber intake in particular helps to reduce the GI and glycemic load of food and meals, which leads to reduced blood sugar spikes and therefore less circulating insulin and subsequent IR. A trial by Marsh et al. found that 29 women with overweight and PCOS (mean BMI = 34 kg/m2, mean age 31 years) assigned to a low GI diet lost more weight and gained menstrual cycle regularity compared with 20 women with overweight and PCOS (mean BMI = 34 kg/m2, mean age 29) assigned to a conventional healthy diet. In addition, 95% of women in the low-GI diet group reported Ovulation and normal menstrual cycles.

Excessive consumption of calories and saturated fatty acids is the hallmark of high-fat diets, which can increase the risk of heart disease, weight gain, and obesity, among other health issues. Although obesity is the main cause of this connection, cross-sectional studies indicate that increased fat intake is linked to decreased insulin sensitivity. Numerous studies have demonstrated that not all high-fat diets are detrimental to the development and course of PCOS. As therapeutic tools, alternative food strategies have been assessed, taking into account both the quantity and quality of fats. Low-fat dairy products, lean red meat, fish, poultry, fish oils, olive oils, whole grains, and seeds like pumpkin, sunflower, and almonds are all good foods for PCOS. Many of these foods are typical of certain dietary patterns, like the ketogenic and Mediterranean diets. Fatty fish is a common food that is high in omega-3 fatty acids. However, some plant-based meals, such nuts and seeds, include alpha-linolenic acid, which is the precursor of EPA and DHA. Alpha-lipoic acid, N-acetylcysteine, and omega-3 fatty acids have been demonstrated to have anti-inflammatory and antioxidant qualities in addition to improving IR in women with PCOS [**14**].

Both male and female reproductive processes depend heavily on vitamin D. Reproductive function, metabolic changes, and mental health are all associated with vitamin D levels in PCOS. In PCOS patients, vitamin D therapy reduces endometrial thickness as well as blood androgen and AMH levels [**15**]. When combined, they have beneficial effects on folliculogenesis and the menstrual cycle. Vitamin D deficiency, which is characterized by blood 25-hydroxyvitamin D levels below 20 ng/mL, is prevalent in PCOS-affected women and may have an impact on endometrial receptivity, ovarian function, and embryo quality. Therefore, sufficient amounts of vitamin D may aid in the management of hormonal and metabolic abnormalities associated with PCOS. According to certain research, women with PCOS had lower levels of Zn, Ni, Mn, and Cu in their erythrocytes than women in good health [**16**]. It appears that the PCOS group needs a rich diet or mineral supplements. It is worthwhile to think about incorporating foods high in these components into the diet. Due to impaired Na, K-ATPase activity, and the L-calcium channel, PCOS women had higher levels of macroelements (Mg and K), which seemed to have a protective impact. Regrettably, an elevated Na content in red blood cells was also discovered, which has detrimental effects on the body, including water retention. Greater Mg and Zn contents were associated with greater HDL levels in the PCOS-NIR group, but higher Na and Ni levels were associated with lower HDL levels. This association is hard to understand; thus further research is required.

**Weight Management and Its Effects on PCOS**

While dietary modification is frequently recommended to accomplish weight loss, it is crucial to promote the adoption of a healthy and balanced diet in women with PCOS to maximize overall health and wellbeing. Obesity and polycystic ovarian syndrome are closely related conditions. It is suggested that women with PCOS are impacted by both lifestyle-related extrinsic insulin resistance and PCOS-specific intrinsic insulin resistance with increasing weight. Insulin resistance is significantly increased by obesity, particularly abdominal obesity [**17**]. In both the general population and women with PCOS, insulin resistance is significantly linked to an elevated risk for DM2 and CVD. Additionally, overweight, obesity, and abdominal obesity may be more common in women with PCOS. Additionally, women with PCOS may have higher incidences of obesity, overweight, and abdominal obesity. However, despite the dearth of population-based data, the prevalence of obesity among women with PCOS differs significantly between nations, making cross-national comparisons challenging [**18**]. A recent study comparing age-matched controls from the National Health and Nutrition Examination Survey I (NHANES I) study (n = 2586) with women with PCOS(n = 401) found that a higher percentage of PCOS women had a BMI of more than 30 and a lower percentage of PCOS women had a BMI of less than 25. Losing weight has been shown to improve several reproductive, metabolic, and psychological characteristics in overweight and obese women with PCOS. Reproductive function, as well as metabolic and psychological characteristics, can be improved by managing weight through lifestyle change that combines behavioral, nutritional, and exercise management. Over the course of six to twelve months, reduced-energy diets (500–1000 kcal/day reduction) can lower body weight by seven to ten percent. Lifestyle programs must address concerns like time limits, emotional eating, stress management, and self-esteem. Stress and time constraints are major obstacles to weight loss for young women, regardless of PCOS status. Weight loss improves reproductive and metabolic parameters in overweight women with PCOS, and lifestyle control is recommended as an initial therapy option. Important strategies for managing weight in young women include preventing excessive weight gain in normal-weight women, reducing weight in overweight and obese women, and maintaining weight loss over the long term. Obese women and girls with PCOS need to be carefully managed clinically, ideally by a multidisciplinary team of specialists, with the patient at the center of the treatment [**19**].

**Exercise and Physical Activity in PCOS**

Exercise increases insulin sensitivity regardless of PCOS status or level of insulin resistance. Additionally, physical training enhances the benefits of exercise on insulin sensitivity by optimizing glucose transport and metabolism [**20**]. Therefore, frequent physical activity lowers overall cardiovascular risk regardless of PCOS status. Given the prevalence of both metabolic dysfunction and innate insulin resistance in obese women with PCOS, this is especially desirable. Optimized physical activity is frequently used in conjunction with dietary modifications as a successful lifestyle strategy for weight loss. Crucially, though, the positive effects of physical activity on insulin sensitivity frequently result from the activity itself (as well as from avoiding sedentariness), rather than necessarily from any accompanying weight reduction (although any consequent weight loss would be expected to further improve insulin sensitivity). Aerobic exercise can help enhance reproductive function in women with PCOS, including regular ovulation and menstrual cyclicity. Exercise and physical activity have been shown to improve reproductive function in women with PCOS, but it should be noted that excessive exercise may have the opposite effect. According to published research, women with PCOS who exercise for more than 60 minutes a day may be more likely to experience anovulation. On the other hand, exercising for 30 to 60 minutes a day lowers the chance of anovulatory infertility. Therefore, women with PCOS should be urged to exercise regularly for 30 to 60 minutes a day, but to avoid overdoing it, to improve insulin sensitivity, reproductive health, and general metabolic health. Lastly, as sedentariness is linked to worse overall metabolic health, cardiorespiratory fitness, and liver fat, it is critical to stress the significance of physical activity to reduce it [**21**].

**Optimization of Sleep**

The significance of sleep for healthy physiological processes cannot be overstated. Almost every facet of mental and emotional performance is significantly impacted by sleep deprivation, which also has detrimental effects on physiology in general, including the promotion of inflammation, metabolic malfunction, and—most importantly—insulin resistance [**22**]. Lack of sleep is not only a risk factor for insulin resistance on its own, but it also raises BMI, alters appetite, and increases caloric intake. Examining how OSA treatment affects PCOS clinical features is justified by the substantial correlation between PCOS and OSA, which is mediated through effects on insulin resistance. In fact, a study that examined the effects of CPAP therapy in a group of women with OSA and PCOS showed that the treatment was successful [**23**]. Additionally, a major systematic review of the literature found that bariatric surgery has an 85% resolution rate, making it a great therapy choice for OSA. As a result, we want to evaluate obese women with PCOS for OSA in a proactive manner. In obese women with PCOS, screening for OSA should be part of a yearly evaluation [**24**]. Once there is a clinical suspicion of OSA, we should have a low barrier for seeking polysomnography and targeted sleep examination. Given the established effectiveness of bariatric surgery, a diagnosis of OSA encourages obese women with PCOS to be considered for the procedure. Lastly, specialized teams are frequently needed to effectively treat OSA in women with PCOS using CPAP therapy. Along with the efficient diagnosis and treatment. Optimizing sleep sufficiency is crucial for OSA in obese women with PCOS. Sleep adequacy seems to be a prerequisite for the effectiveness of adopted lifestyle changes [including dietary modification] to lose weight [**25**]. In one study, overweight participants who received tailored counseling on sleep hygiene for two weeks were able to sleep for seven to eight hours every night, as opposed to their typical pre-study sleep duration of less than six and a half hours. This intervention led to a 7% increase in daytime activity, a 14% decrease in overall appetite ratings (especially for sweet and salty meals), and an improvement in tiredness [**26**]. A key component of lifestyle management for obesity, especially in women with PCOS, is getting enough sleep, according to this study. The ability to modify one's diet and engage in physical activity depends on adequate sleep. Conversely, sleep deprivation hinders attempts to lose weight through lifestyle measures, including adverse effects on appetite and overall wellbeing. To optimize sleep duration, there are useful strategies that include avoidance of blue light from screens during late evening, to allow natural melatonin release and the onset of sleepiness [**27**]. Furthermore, it is necessary for the body to cool up prior to sleep, therefore ensuring a cool bedroom is important. A focus on daily routines is also important, with avoidance of food and exercise in the hour before sleep, and ensuring physical activity during the day can also facilitate restful sleep.

**Lifestyle Modification**

Adolescent girls with PCOS can improve their clinical, metabolic, and hormonal characteristics by changing their lifestyle to consume fewer calories and engage in frequent exercise. A desk job, a diet heavy in processed meats, fried meals, hot dogs, and sausages, as well as excessive sugar and carbonated drink consumption, all lead to insulin and hormonal imbalances that activate androgen receptors outside the ovary, which in turn causes PCOS [**28**]. By adopting new lifestyle habits, such as practicing yoga every day, eating a balanced diet, and consuming less dairy and fast food, patients with PCOS can improve their insulin sensitivity and lose weight. Therefore, changing one's lifestyle should be the main course of treatment for PCOS sufferers. Unfortunately, all of these therapies only work temporarily, so maintaining this regimen throughout the course of a person’s life is necessary for long-term weight loss [**29**]. Although we cannot entirely avoid stress in our daily lives, we can certainly increase our ability to handle it. Practicing yoga regularly might help you reduce stress. Even unintended weight gain in women can be caused by stress. The body stores fat as a result of cortisol [**30**]. The synthesis of the stress hormone cortisol is reduced when one enters a tranquil mood. Through breathing exercises that completely calm the body, yoga-like Shavasana (Corpse pose)

reduces any stress [**31**]. The consequences of hormone imbalance may be countered by relaxation, which can also deal with unpleasant feelings, irritation, and frequent mood swings. Yoga may help with weight loss through effective stress management, a reduced tendency for stress eating, and improved body awareness, especially with regard to hunger, satiety mindfulness, and mindful eating [**32**].

Strong yoga poses increase heart rate, which promotes cardiovascular exercise and weight loss. In anxious PCOS bodies and minds, asanas and pranayama promote hormonal balance and deep relaxation, which help control cortisol and adrenal levels [**33**]. Early use of yoga and meditation can help us develop a healthy body and mind. Breathing exercises, or pranayamas, are powerful techniques for maintaining mental peace. Programs for mindfulness meditation have been more and more popular over the past few decades, and they are being included into clinical trials to improve psychological health and reduce stress in a range of physical conditions. By engaging in mindfulness meditation, one can reduce the production of adrenal androgens, which are released by the adrenal glands in reaction to psychological distress [**34**]. By implementing and upholding the lifestyle changes necessary to reduce symptoms and prevent issues, women with PCOS can benefit from medical nutrition therapy (MNT). An assessment of lifestyle changes that would help a PCOS patient achieve and maintain clinical goals is the basis of MNT [**35**]. Pharmacotherapy may be added if lifestyle management fails to produce the desired results. The Endocrine Society advises hormonal contraceptives as the first-line treatment for managing irregular menstruation and reducing hirsutism and acne in premenopausal women who are not currently attempting to conceive. [**36**]

## CONCLUSION

A complicated endocrine and metabolic condition, PCOS affects women at various phases of their lives. Its growth and progression are influenced by insulin resistance, hormonal imbalance, obesity, genetics, and environmental factors. A balanced diet, frequent exercise, enough sleep, stress reduction, and weight control are all important aspects of lifestyle change that help alleviate symptoms and lessen long-term problems. The quality of life for women with PCOS can be greatly enhanced by early diagnosis and appropriate dietary and medication therapy.

**Authors Contribution**: data collection, Q. Esha and H. Haya; resources, S. Khudaija, and K. Khadija; supervision, M. Iqra; review and editing, A. Basit.

**Funding:** No funding involved.

**Ethical Approval:** Not applicable

**Conflict of Interest:** Nil.

**Consent for Publication:** All authors approved the manuscript for publication.

## REFERENCES

1. Zahdeh M, Hallak H. Knowledge, perception, and management of polycystic ovary syndrome among women in Palestine: A mixed-method study. Women's Health. 2025;21. doi:10.1177/17455057251333270
2. Kim M, Yi SJ. Exploring the Disease Experience in Women with PCOS: A Qualitative Content Analysis. Healthcare. 2025;13[24]:3243. doi:10.3390/healthcare13243243
3. Kim M, Yi SJ. Exploring the Disease Experience in Women with PCOS: A Qualitative Content Analysis. Healthcare. 2025;13[24]:3243. doi:10.3390/healthcare13243243
4. Escobar-Morreale HF, Carmina E, Dewailly D, Gambineri A, Kelestimur F, Moghetti P, et al. Epidemiology, diagnosis and management of hirsutism: a consensus statement by the Androgen Excess and Polycystic Ovary Syndrome Society. Hum Reprod Update. 2012;18[2]:146-170. doi:10.1093/humupd/dmr042
5. Damoulaki E, Sioutis D, Sarli V, Trakakis E, Mastorakos G, Katoulis A, et al. Polycystic Ovary Syndrome-Associated Acne: The Interplay of Hyperandrogenism, Insulin Resistance, and Therapeutic Strategies. Cureus. 2025;17[11]:e98103. DOI: 10.7759/cureus.98103
6. Yang J, Chen C. Hormonal changes in PCOS. J Endocrinol. 2024;261[1]:e230342. doi:10.1530/JOE-23-0342
7. Purwar A, Nagpure S. Insulin Resistance in Polycystic Ovarian Syndrome. Cureus. 2022;14[10]:e30351. doi:10.7759/cureus.30351
8. Neelam, Hajam YA, Basheer M, Kumar R. An Overview on Female Reproductive Disorders. In: Hajam YA, Rai S, eds. Nanotherapeutics in the Treatment of Reproductive Disorders. 1st ed. Apple Academic Press; 2026:chap 5. doi:10.1201/9781779640093-5
9. Iqbal L, Fatima SN. Impact Of Hormone- Related Genes on Polycystic Ovary Syndrome [PCOS]: Review Report. sjas [Internet]. 2026 Jun. 25 [cited 2026 Sep. 30];1[1]:108-32. Available from: https://journalscinex.com/sjas/article/view/9
10. Manta A, Paschou SA, Isari G, Mavroeidi I, Kalantaridou S, Peppa M. Glycemic Index and Glycemic Load Estimates in the Dietary Approach of Polycystic Ovary Syndrome. Nutrients. 2023;15[15]:3483. doi:10.3390/nu15153483
11. Emma J Houston, Nicole M Templeman; Reappraising the relationship between hyperinsulinemia and insulin resistance in PCOS. J Endocrinol 1 May 2025; 265 [2]: e240269. https://doi.org/10.1530/JOE-24-0269
12. Zhao, H., Zhang, J., Cheng, X. et al. Insulin resistance in polycystic ovary syndrome across various tissues: an updated review of pathogenesis, evaluation, and treatment. J Ovarian Res 16, 9 [2023]. https://doi.org/10.1186/s13048-022-01091-0
13. Xing C, Zhang J, Zhao H, He B. Effect of Sex Hormone-Binding Globulin on Polycystic Ovary Syndrome: Mechanisms, Manifestations, Genetics, and Treatment. Int J Womens Health. 2022;14:91-105. doi:10.2147/IJWH.S344542
14. Zhang H, Wang W, Zhao J, Jiao P, Zeng L, Zhang H, Zhao Y, Shi L, Hu H, Luo L, Fukuzawa I, Li D, Li R and Qiao J [2023] Relationship between body composition, insulin resistance, and hormonal profiles in women with polycystic ovary syndrome. Front. Endocrinol. 13:1085656. doi: 10.3389/fendo.2022.1085656
15. Jurczewska J, Ostrowska J, Chełchowska M, Panczyk M, Rudnicka E, Kucharski M, et al. Abdominal Obesity

in Women with Polycystic Ovary Syndrome and Its Relationship with Diet, Physical Activity and Insulin Resistance: A Pilot Study. Nutrients. 2023;15[16]:3652. doi:10.3390/nu15163652
16. Kelly CC, Lyall H, Petrie JR, Gould GW, Connell JM, Sattar N. Low Grade Chronic Inflammation in Women with Polycystic Ovarian Syndrome. J Clin Endocrinol Metab. 2001;86[6]:2453-2455. doi:10.1210/jc.86.6.2453
17. Cooney LG, Dokras A. Depression and Anxiety in Polycystic Ovary Syndrome: Etiology and Treatment. Endocrinol Metab Clin North Am. 2021;50[1]:83-96. doi:10.1016/j.ecl.2020.10.006
18. Teede, H. J., Tay, C. T., Laven, J., Dokras, A., Moran, L. J., Piltonen, T. T., et al. Recommendations from the 2023 International Evidence-based Guideline for the Assessment and Management of Polycystic Ovary Syndrome. Fertil Steril. 2023;120[4]:767-793. doi:10.1016/j.fertnstert.2023.07.025
19. Lord, J. M., Flight, I. H., & Norman, R. J. [2003]. Metformin in polycystic ovary syndrome: systematic review and meta-analysis. BMJ, 327[7421], 951. https://doi.org/10.1136/bmj.327.7421.951
20. Arabzadeh E, Khalilinejad M, Gholami M. Impact of exercise training on insulin resistance and metabolic pathways in polycystic ovary syndrome: A review. Sci Sports. 2025. 10.1016/j.scispo.2025.05.003
21. Hernández-López OA, Murillo-Ortíz B, Luna-Marco C, Cacace J, Hermo-Argibay A, Ramírez V, et al. Cardiorespiratory fitness as a key predictor of metabolic, inflammatory, and oxidative stress biomarkers in adults with different physical activity levels. Free Radic Biol Med. 2025. doi:10.1016/j.freeradbiomed.2025.08.058
22. Al-Farsi HY, Al-Fahdi EY, Al-Balushi MA, Al-Jahwari AN, Al-Maskari AM, Das S. Sleep disturbances associated with different systems of the body: Underlying mechanisms involved and consequences.Current Medicinal Chemistry. 2025 Oct;32[34]:762450. DOI:10.2174/0109298673350476250331181123
23. Li J, Liu Y, Zheng X, Cao D, Wu Y, Huang X, Chen B. Clinical characteristics and pregnancy outcomes in polycystic ovary syndrome complicated by obstructive sleep apnea: a correlative study. Frontiers in Medicine. 2026 Apr 15;13:1714294. https://doi.org/10.3389/fmed.2026.1714294
24. Abdul Jafar NK, Al Balushi A, Subramanian A, Lee SI, Bennett CJ, Moran LJ, Mousa A, Tay CT, Teede HJ, Mansfield DR. Obstructive sleep apnea syndrome in polycystic ovary syndrome: a systematic review and meta-analysis. Frontiers in endocrinology. 2025 Apr 4;16:1532519. https://doi.org/10.3389/fendo.2025.1532519
25. Cowan S, Lim S, Alycia C, et al. Lifestyle management in polycystic ovary syndrome – beyond diet and physical activity. BMC Endocr Disord. 2023;23:14. https://doi.org/10.1186/s12902-022-01208-y
26. De Leon AA, Hanlon EC. Impact of sleep restriction on food intake and food choice. Neurological modulation of sleep. 2020 Jan 1:217-28.
27. Grzelak A. Managing blue light exposure: impacts on sleep quality and circadian health. Quality in Sport. 2024 Dec 27;25:56741-.https://doi.org/10.12775/QS.2024.25.56741
28. Abdolahian S, Tehrani FR, Amiri M, Ghodsi D, Yarandi RB, Jafari M, Majd HA, Nahidi F. Effect of lifestyle modifications on anthropometric, clinical, and biochemical parameters in adolescent girls with polycystic ovary syndrome: a systematic review and meta-analysis. BMC endocrine disorders. 2020 May 19;20[1]:71. https://doi.org/10.1186/s12902-020-00552-1
29. Montesi L, El Ghoch M, Brodosi L, Calugi S, Marchesini G, Dalle Grave R. Long-term weight loss maintenance for obesity: a multidisciplinary approach. Diabetes, metabolic syndrome and obesity: targets and therapy. 2016 Feb 26:37-46.https://doi.org/10.2147/DMSO.S89836
30. Daubenmier J, Kristeller J, Hecht FM, Maninger N, Kuwata M, Jhaveri K, Lustig RH, Kemeny M, Karan L, Epel E. Mindfulness intervention for stress eating to reduce cortisol and abdominal fat among overweight and obese women: an exploratory randomized controlled study. Journal of obesity. 2011;2011[1]:651936. https://doi.org/10.1155/2011/651936
31. Balkrishna A, Rana M, Mishra S, Srivastava D, Bhardwaj R, Singh S, Rajput SK, Arya V. Incredible combination of lifestyle modification and herbal remedies for polycystic ovarian syndrome management. Evidence-Based Complementary and Alternative Medicine. 2023;2023[1]:3705508. https://doi.org/10.1155/2023/3705508
32. Raana, M., Masaud, I., Ishaq, S., Mumtaz, A., Rana, J.A., Butt, B., Aslam, B., Afzal, M., Imman, A., Shoaib, U., Sami, K.H. and Essa, M. 2024. Investigating the synergistic effects of resveratrol and metformin on insulin sensitivity and ovulatory function in women with PCOS. Journal of Contemporary Pharmacy. 8, 1 (Jun. 2024), 33–37. https://doi.org/10.56770/jcp2024816
33. Balkrishna A, Rana M, Mishra S, Srivastava D, Bhardwaj R, Singh S, Rajput SK, Arya V. Incredible combination of lifestyle modification and herbal remedies for polycystic ovarian syndrome management. Evidence-Based Complementary and Alternative Medicine. 2023;2023[1]:3705508.https://doi.org/10.1155/2023/3705508
34. Ring HZ, Kern R. Zen meditation and the neuro-immuno-endocrine axis. Health. 2024;16[12]:1242-9. https://doi.org/10.4236/health.2024.1612086
35. Moran LJ, Tassone EC, Boyle J, Brennan L, Harrison CL, Hirschberg AL, Lim S, Marsh K, Misso ML, Redman L, Thondan M. Evidence summaries and recommendations from the international evidence-based guideline for the assessment and management of polycystic ovary syndrome: lifestyle management. Obesity Reviews. 2020 Oct;21[10]:e13046.https://doi.org/10.1111/obr.13046
36. Martin KA, Chang RJ, Ehrmann DA, Ibanez L, Lobo RA, Rosenfield RL, Shapiro J, Montori VM, Swiglo BA. Evaluation and treatment of hirsutism in premenopausal women: an endocrine society clinical practice guideline. The Journal of Clinical Endocrinology & Metabolism. 2008 Apr 1;93[4]:1105-20.https://doi.org/10.1210/jc.2007-2437