


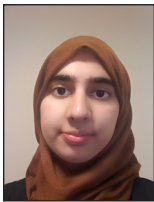


Review Article

A Review of Dietary Interventions for Polycystic Ovary Syndrome: Identifying the Optimal Approach

Nain Tara Raja¹, Sara Raja¹, Arslan Khaliq Raja³, Smriti Ray Chaudhuri Bhatta¹ , Eugenia Grand²

¹Department of Obstetrics and Gynaecology, University of Aberdeen's School of Medicine, Aberdeen, ²Department of Nutrition and Dietetics, National Health Service Lothian, ³University of Edinburgh, Edinburgh Medical School, Edinburgh, UK



***Corresponding author:**

Nain Tara Raja,
Department of Obstetrics and
Gynaecology, University of
Aberdeen's School of Medicine,
Aberdeen, UK

n.raja.21@abdn.ac.uk

Received: 18 April 2025

Accepted: 21 May 2025

Published: 23 June 2025

DOI

[10.25259/FSR_27_2025](https://doi.org/10.25259/FSR_27_2025)

Quick Response Code:



ABSTRACT

Polycystic Ovary Syndrome (PCOS) is a very prevalent endocrine disorder among women of reproductive age, occurring in approximately 4%-20% of women worldwide. It is associated with anovulation, hyperandrogenism, and polycystic ovarian morphology and has the potential to cause a variety of reproductive disorders, such as infertility and pregnancy complications. PCOS is also attributed to significant metabolic risk, such as insulin resistance, obesity, dyslipidaemia, and cardiovascular risks. Due to the nature of this disorder, lifestyle modification, better still, diet, is recommended as first-line management to minimise both reproductive and metabolic morbidity in women with PCOS. This paper will therefore endeavour to find out what is the optimal diet for PCOS patients to minimise the risk of chronic diseases.

This review article presents different dietary management strategies that have been experimented with in PCOS women and how they are impacting reproductive, metabolic, and endocrine health. Analysis conducted in this study includes some types of diets, including calorie diets, fat diets, pulse diets, and supplement diets like curcumin diet, cinnamon diet, inositol diet, and vitamin D diet. The effectiveness of commercial diet replacements and their impact on weight loss and metabolic improvement is also discussed. The review contains a meta-analysis of observational studies and randomised controlled trials which have contrasted the effect of such diets upon endpoints like weight loss, insulin sensitivity, balance of hormones, regularity of menses, and quality of life.

Literature provides the positive impact of dietary modification on PCOS clinical endpoints. Some women with PCOS were noted to have weight gain, insulin sensitivity, and lowered levels of hyperandrogenism on following specific diets. Also, calorie-restricted diets caused weight loss and improved metabolic control in glucose and lipid profiles. Pulse-based diets such as chickpeas and legumes also raised cardio-metabolic risk factors. Supplementation with curcumin, cinnamon, and inositol diets was found to possess the potential to reduce inflammation, enhance insulin sensitivity, and improve ovarian function. Besides this, Mediterranean and DASH diets proved to be most effective in improving ovarian function, reducing the levels of androgens, and enhancing fertility outcomes. Moreover, an exercise regimen along with diet can further enhance the reproductive and metabolic status in PCOS women.

This review shows that diet control is a key component to control the clinical presentation of PCOS. A Mediterranean dietary model, based on whole foods, healthy fats, and low-glycaemic carbohydrates, is one of the strongest dietary models for the control of the metabolic abnormalities related to PCOS, such as insulin resistance and hyperandrogenism. Furthermore, supplements such as curcumin, cinnamon, inositol, and vitamin D can supplement these activities to enhance the sensitivity of insulin, reduce inflammation, and promote hormonal balance. Finally, commercial meal-replacement drinks can also help one lose weight, which typically tends to remain challenging in women with PCOS. A basic approach of a Mediterranean diet complemented by lifestyle adjustments by the form of regular exercise and psychotherapy altogether illustrates the most effective way of treating PCOS.

Keywords: Dietary Interventions, Holistic Management, Insulin Resistance, PCOS.

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 License, which allows others to remix, transform, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

©2025 Published by Scientific Scholar on behalf of Fertility Science and Research

INTRODUCTION

Polycystic Ovary Syndrome (PCOS) is the most common type of endocrine disorder, leading to cardiometabolic abnormalities in women of reproductive age.^[1] PCOS affects 4%–20% of women worldwide.^[2] and is a complex disorder characterised by anovulation, hyperandrogenism and polycystic ovarian morphology, which can increase the risk of infertility and pregnancy complications.^[3] Androgen excess disrupts the hypothalamic-pituitary-ovarian axis and luteinising hormone (LH) hypersecretion, resulting in typical features such as oligomenorrhea, hirsutism and acne.^[4] Excess oestrogen exposure can lead to a higher risk of acquiring endometrial cancer.^[5]

Besides reproductive abnormalities, women with PCOS manifest metabolic risk factors such as dyslipidaemia, type 2 diabetes mellitus, obesity, and hypertension, which can increase the risk of cardiovascular disease.^[6] Studies have shown that insulin resistance (IR) is the most common cause of these abnormalities, whilst other factors, such as coronary artery calcification, C-reactive protein, and endothelial dysfunction, can further increase the risk of complications.^[3] Furthermore, psychological problems such as anxiety and

low mood affect women with hirsutism, which can decrease their quality of life.

To reduce the risk of reproductive and nonreproductive complications, lifestyle interventions such as dietary modification on its own or combined with exercise are recommended as a first-line treatment for women with PCOS.^[7] Obesity and IR can lead to low-grade inflammation in patients with PCOS, and diets containing omega-3, antioxidants and dietary fibres are thought to reduce the inflammation in these patients.^[8] Following a healthy diet and maintaining an appropriate weight can also help treat metabolic disorders.^[9] Therefore, various types of diets have been trialled in patients with PCOS. These include specific diets (pulse-based, calorie-based and fat-based) and alternative diets with added curcumin, vitamin D, inositol or cinnamon. Furthermore, commercial meal replacements have been researched for their effectiveness in weight loss with PCOS.^[7] This study aims to understand the different diet-based, alternative dietary management and commercial meal options for PCOS, the benefits of dietary management and the optimal dietary recommendations to decrease the risk of chronic diseases.

DIFFERENT DIETARY MANAGEMENT OPTIONS STUDIED

Specific Diet-Based Management Approaches

Table 1: Specific diet-based management, characteristics of included studies and outcome studied.

Study ID	Type of diet studied	Dietary components	Outcome
Deshmukh <i>et al.</i> ^[10]	Calorie-based diet	VRCD vs. moderate energy deficit approach	Significant reduction in weight in patients taking VLCD.
Zhang <i>et al.</i> ^[11]	Calorie-based diet	Dulaglutide with CRD	GLP-1 receptor agonist helps in reaching weight targets.
Hoover <i>et al.</i> ^[12]	Calorie-based diet	Low (41:19:40% energy from carbohydrate: protein: fat) and high (55:18:27) GL diets	Low glycemic load diet increases glucagon and decreases ghrelin in PCOS.
Legro <i>et al.</i> ^[13]	Calorie-based diet	Three groups containing (1. COC, 2. Weight loss and calorie restricted diet and 3. COC and lifestyle interventions)	Preconception weight loss leads to higher ovulation rates.
Gower <i>et al.</i> ^[14]	Calorie-based diet	Two diets (standard [STD], 55:18:27% energy from carbohydrate/protein/fat; lower-carbohydrate, 41:19:40)	Modest decrease in dietary carbohydrate leads to decrease testosterone in PCOS.
Nybacka <i>et al.</i> ^[15]	Calorie-based diet	Dietary management and physical exercise	Diet reduces androgen levels and serum AMH.
Nybacka <i>et al.</i> ^[16]	Calorie-based diet	Dietary management and physical exercise	Dietary management alone or with exercise helps to reduce weight and improve reproductive function.
Kasim-Karakas <i>et al.</i> ^[17]	Calorie-based diet	Daily calorie intake reduced to 700 kcal and supplemented with 240 kcal of protein or simple sugar.	Protein supplementation led to greater reductions in weight, apoprotein B, fat and cholesterol compared to simple sugar.

(Continued)

Table 1: Continued			
Study ID	Type of diet studied	Dietary components	Outcome
Moran <i>et al.</i> ^[18]	Calorie-based diet	Short-term meal replacement vs. longer-term fat or carbohydrate restrictions.	Both strategies are beneficial in reducing metabolic and reproductive variables and weight.
Stamets <i>et al.</i> ^[19]	Calorie-based diet	High protein vs. high carbohydrate diet. Fat levels were kept constant between the groups.	Both groups significantly reduced weight.
Phelan <i>et al.</i> ^[20]	Fat-based diet	n-6 vs. n-3 PUFA	PUFA helped to improve hormonal and lipid profiles. It further improved androgenic profile when combined with LC n-3.
Katcher <i>et al.</i> ^[21]	Fat-based diet	High-fat western meal vs. low-fat high fibre meal	Diet helped to control testosterone levels in women with PCOS.
Kazemi <i>et al.</i> ^[22]	Pulse-based diet	Lentils, beans, split peas, and chickpeas	Pulse-based diet improved cardio-metabolic risk factors in PCOS.
Cheshmeh <i>et al.</i> ^[23]	Supplement-based (green cardamom)	Calorie intake was reduced by 400–500 kcal based on adjusted ideal body weight and 3 g of cadmium powder was given to intention group.	Green cardamom significantly decreases serum CRP, IL-6 and TNF-a.
Karine <i>et al.</i> ^[24]	Supplement based	Curcumin, vitamin D, inositol, CoQ10	Decreased inflammation, restore in ovarian function and increased insulin sensitivity.
Karimi <i>et al.</i> ^[25]	Supplements based (synbiotic)	Each synbiotic capsule contained beneficial bacteria and prebiotic inulin.	Synbiotic supplements significantly decreased LDL and increased HDL.

VRCE: Very restricted caloric eating, VLCD: Very low-calorie diet, CRD: Calorie-restricted diet, GLP: Glucagon-like peptide, GL: Glycemic load, COC: Combined oral contraceptive, AMH: Anti-müllerian hormone, PUFA: Polyunsaturated fatty acid, LC: Low-carbohydrate, CRP: C-reactive protein, TNE: Total nutrient exposure, LDL: Low-density lipoprotein, HDL: High-density lipoprotein.

Alternative Diet-Based Management Approaches

Studies evaluating the characteristics and outcomes of specific diet based management options has been summarized in Table 1. These include calorie-based diet,^[10–19] pulse-based diet,^[20–22] fat-based diet,^[20,21] and alternative dietary management.^[23–25]

Previously, metformin was considered a beneficial drug in managing patients with PCOS; however, it showed minimal efficacy in non-obese, non-insulin-resistant patients.^[26] Clinical treatment, such as hormone therapy, can be used to regulate the menstrual cycles, improve IR, and decrease androgens; however, studies have shown that these treatment options have side effects and low compliance.^[27] Therefore, alternative treatment options such as curcumin, cinnamon, inositol, and vitamin D are beneficial in reducing inflammation and IR and restoring ovarian function in patients with PCOS and avoiding side effects.^[28]

Curcumin

Curcumin is a polyphenol that is used in many Asian countries. It has been shown to improve the biochemical

profile and ovulation in patients with PCOS.^[29] Studies have also shown that curcumin can be used to treat various diseases such as telogen effluvium and type 2 diabetes.^[7] Many patients with PCOS have IR, which leads to greater production of insulin. This, in turn, leads to an increase in the expression of LH by activation of cytochrome P450c17. Curcumin specifically works by inhibiting cytochrome P450c17, which leads to less LH production and therefore improves hyperandrogenism.^[30] Moreover, curcumin also has an antidiabetic effect by different mechanisms. This includes increasing glycogenesis and decreasing gluconeogenesis in the liver as well as increasing glucose uptake in the cell. Furthermore, some literature has shown that curcumin also has an anti-inflammatory effect in PCOS patients by reducing oxidative stress.^[31]

Cinnamon

Cinnamon is one of the oldest herbal remedies used in medicine. Distinct parts of this plant offer numerous benefits; however, the most essential part, which can also benefit patients with PCOS, is the volatile oil. This is an essential oil which contains insulin-like activity.^[32] In a study,

fifteen women with PCOS were given cinnamon extract for 8 weeks, and the insulin sensitivity was measured by using an oral glucose tolerance test and fasting glucose at baseline and 2 hours after ingestion of the cinnamon. This study showed that cinnamon helps to increase insulin sensitivity by increasing the activity of phosphatidylinositol 4-kinase. This, in turn, helps to increase glucose uptake into the cells and promote glycogenesis, as well as improve gynaecological problems and the menstrual cycle in women with PCOS.

Inositol

Inositol is a carbocyclic sugar which can be found in various body organs such as the brain, liver and kidney. Inositol can develop into several types of stereoisomers that offer numerous benefits, and the most important ones in women with PCOS include D-chiro inositol (DCI) and myoinositol (MI).^[33] They are both insulin-sensitising agents, and MI works by increasing cell uptake of glucose. MI has been shown to be beneficial by enhancing the production of oocytes and embryos, making it a key factor in assisted reproductive treatment. In contrast, high concentrations of DCI in the ovary can decrease the production of oocytes.^[34]

In one study, 50 obese females with PCOS were randomly allocated to receive either MI or MI+DCI (40:1) for around 6 months. At the end of the trial, no significant difference was found between the groups; however, at 3 months, the combination group was shown to be more effective in reducing the risk of metabolic syndrome in obese females with PCOS.^[35] In another study carried out in 44 obese females with PCOS, DCI was given for 6–8 weeks, and the serum progesterone, serum and glucose steroids, and ovulation were measured before and after oral administration. The results suggested that in 19 out of 22 females, plasma triglyceride levels, serum testosterone and blood pressure were reduced.^[7] The results of these studies suggest that inositol can also play an important role in improving fertility, regulating IR and regulating menstrual cycles in women with PCOS.

Vitamin D

Vitamin D deficiency is a known cause of metabolic syndrome in women with PCOS. There has also been an association of vitamin D deficiency and other diseases such as type 2 diabetes and cardiovascular disease. Also, a high proportion of women with PCOS have vitamin D deficiency (67%–85%).^[36] Therefore, fixing vitamin D deficiency in these females is crucial to address these metabolic disturbances. The mechanism by which vitamin D deficiency and type 2 diabetes are linked is not very well understood; however, literature has shown that through certain receptors on pancreatic beta cells, vitamin D controls glucose-insulin homeostasis.^[37] This, in turn, leads to direct activation of the

insulin receptor gene as well as enhancing the expression of insulin receptors. Therefore, vitamin D supplementation can help by increasing the production and release of insulin, leading to the greater uptake of glucose by the cells.

Some studies have suggested that vitamin D also helps to improve the outcome of pregnancy in these patients, and its deficiency is linked with male and female infertility.^[38] Furthermore, a randomised controlled trial suggested that low doses of vitamin D (<400 IU/d) have been shown to improve insulin sensitivity and fasting glucose levels in PCOS patients.^[31]

Commercial Meal Replacements

Due to abnormalities in hormone homeostasis as well as appetite regulation, weight loss might be difficult to achieve in patients with PCOS.^[39] Studies have shown that less than 15% of patients maintain weight loss when undergoing weight loss interventions.^[40] Therefore, effective dietary management is crucial in maintaining weight loss as well as enhancing the reproductive and metabolic health in patients with PCOS.

A study suggested that meal replacements are highly effective as a short-term strategy for weight reduction in patients with PCOS. This involved 8 weeks of energy restriction (phase 1) and 24 weeks of meal replacement (phase 2), where participants either followed a fat-counting or carbohydrate-counting protocol, and the resting energy expenditure, total fat-free mass and total fat mass were measured at various times during the 32 weeks. The results suggest that 34 women completed phase 1, and 23 women completed phase 2. During phase 1, there were significant ($P < 0.05$) reductions in weight (5.6 ± 2.4 kg), waist circumference (6.1 ± 2.5 cm), body fat (4.1 ± 2.2 kg), insulin levels (2.8 ± 1.1 mU/l), total testosterone (0.3 ± 0.7 nmol/l), and free androgen index (3.1 ± 4.6), all of which were maintained throughout phase 2. No significant differences were observed between the two diet groups for any of these variables. These findings suggest that meal replacement with reduced energy diets can lead to greater weight reduction compared to reduced energy diets alone.^[41]

BENEFITS OF DIETARY MANAGEMENT

General Health and Weight Loss

Many diets have been proposed for managing patients with PCOS, and healthy eating should be followed by all patients, especially those who are obese. Dietary management has many benefits, not only in reducing weight but also in improving the reproductive, metabolic and endocrine profile in these patients.^[42] Obesity can worsen the phenotypic symptoms, such as acne and hirsutism, as well as reduce the efficacy of fertility treatment.^[43] Dealing with these symptoms can be challenging, but weight loss is recommended to alleviate them. Lifestyle

interventions such as exercise and dietary modification are the first-line recommendations to target weight loss. Many diets are beneficial when managing these patients. For example, the most common types of diets include energy restriction, high protein, Mediterranean and low glycaemic index diets. Out of these diets high-protein diet has been shown to benefit these patients the most to reduce weight as well as improve IR.^[34]

Endocrine Profile

The main pathophysiological feature in PCOS is IR, which can worsen the clinical features as well as hyperandrogenism in these patients.^[31] The mechanism by which this happens is unclear; however, studies have shown that IR has been linked to an increase in insulin receptor substrate 1 serine phosphorylation in muscle and an increase in insulin receptors, which leads to reduced insulin signalling.^[44] Furthermore, there is a higher prevalence of obesity in patients with PCOS, which can further worsen IR and aggravate the symptoms of PCOS. The Rotterdam criteria can be used to diagnose PCOS if two out of the three criteria are met. These include oligo-anovulation, polycystic ovary of ultrasound and clinical or biochemical hyperandrogenism.^[45] Studies have shown that the levels of LH, cholesterol, triglycerides, testosterone and levels of fasting and postprandial glucose levels were significantly higher in women with PCOS.^[46] The ovaries are the main source of excess androgen production in PCOS. Many patients with PCOS have raised testosterone due to a decrease in the levels of sex hormone-binding globulin (SHBG), and this can be used as the key marker for the diagnosis of PCOS.^[47] Studies have shown that regular physical exercise can help to decrease insulin levels with no significant changes in SHBG, sex hormones and LH.^[37] Furthermore, strength or resistance training can help to improve androgen levels and insulin sensitivity, although further studies are required to understand this better.^[48]

Metabolic Profile

Many patients with PCOS are at a higher risk of acquiring metabolic disorders such as lipid disorders, hypertension, cardiovascular disease, and an increased risk of endometrial cancer.^[34] Moreover, studies have shown that women with PCOS are 30%–40% likely to get metabolic syndrome in the next 20 years.^[49] The previous cross-sectional study has suggested that the risk of developing metabolic disorders increases in women undergoing perimenopause or menopause.^[50] However, recent studies have shown that the risk of developing cardiovascular disease, diabetes and stroke does not increase in women who reach perimenopause.^[51] Further research is required to see whether the risk of acquiring metabolic disorders increases in perimenopausal females compared to early reproductive life.

Reproductive Outcomes

Many patients with PCOS are at an increased risk of infertility, with ovulatory dysfunction being the most common cause of this. The combination of IR, hyperandrogenism and obesity can further exacerbate the reproductive health of a woman with PCOS by impairing the endometrium's ability to attach to the blastocyst as well as decreasing the production of the ovum.^[52] Furthermore, many patients with PCOS suffer from absent or irregular menstruation due to an imbalance of certain hormones such as FSH, LH, insulin and androgen.^[53] Studies have shown that various diets can be used to improve reproductive outcomes in patients with PCOS. These include increased regularity of menstrual cycle and ovulation, and a decrease in the frequency of miscarriages, as well as lowering SHBG and decreasing androgen production, which leads to an improvement in hirsutism.^[54] Research has shown that the Mediterranean, Dietary Approach to Stop Hypertension (DASH), vegetarian and low-carbohydrate diets are beneficial in improving fertility in these patients. However, a low-carbohydrate diet was described as the best diet to improve reproductive outcomes in women with PCOS.^[37]

DIET COMBINED WITH ADDITIONAL LIFESTYLE MEASURES

Obesity is one of the key concerns amongst females with PCOS. A report has shown that the risk of obesity in females with PCOS is four times higher compared to healthy individuals.^[55] Furthermore, being obese leads to reproductive problems such as irregular menstrual cycles, lower rates of ovulation and raised testosterone, which result in physical symptoms such as acne, issues with body image, and facial hair.^[31] Due to these symptoms, PCOS can hugely affect self-confidence and the quality of life in these patients, as well as lead to depression and anxiety. Lifestyle modifications are shown to be cost-effective compared to pharmacological management and can prevent metabolic and reproductive problems.^[56] Therefore, lifestyle measures such as regular exercise with a balanced diet are crucial when managing patients with PCOS.

A systematic review looking at the lifestyle intervention in women with PCOS reported that this intervention can improve body mass index and free androgen index.^[57] It also showed that weight reduction of 5%–10% can lead to psychological, reproductive, and metabolic benefits, and weight loss of 2–3 kg is associated with a reduced risk of type 2 diabetes and cardiovascular diseases. Furthermore, a study carried out in Australia looking at eating disorders in women with and without PCOS reported that psychological problems associated with PCOS are underestimated, and women do not feel that they are getting the right support to manage their mental health.^[58] Therefore, lifestyle

intervention can help to manage psychological symptoms in these patients. Although weight loss has many benefits in women with PCOS, not all women get a similar response to weight reduction. For example, a study suggested that out of all the women who achieved a weight loss of >5%, only one-third showed improvement in their symptoms, and the rest showed either limited or no recovery from PCOS.^[59] Therefore, the degrees of responsiveness to lifestyle intervention vary between women with PCOS. Overall, lifestyle measures such as exercise and diet modification are recommended first-line interventions for managing patients with PCOS, especially those who are obese or overweight.^[60]

DISCUSSION

In this review, we analysed various diets with different macronutrient compositions, including calorie replacement, pulse diet, fat-based diet, and Mediterranean diet. The Mediterranean diet has favourable health benefits due to many fruits, vegetables, legumes, whole grains, and healthy fats associated with it. It is also rich in fish and poultry, and limits red meat and processed foods. This diet is associated with improved cardiovascular health and a lowered risk of chronic disease.^[61] Many calorie-restricted diets focus on weight loss strategies to reduce caloric intake with the intent to improve metabolic health. The pulse diet is mostly based on legumes to provide low-fat, nutrient-dense foods that are high in fibre and protein alongside other foods, which may help improve glycaemic control and cardiovascular health. Fat-based diets promote a high-fat and low-carbohydrate diet and place individuals in a ketosis state; ketogenic diets are fat-based diets that create a ketosis state and improve weight loss and metabolic health. All the diets mentioned provide different health benefits but also highlight the importance of food composition on health.

Based on the studies reviewed, it appears that dietary habits significantly influence both laboratory results and clinical manifestations associated with PCOS. The studies suggest that modifications to women's diets have led to favourable outcomes regarding the syndrome's clinical presentation. These studies reported improvements such as weight loss and reduction in IR, hyperandrogenism, and cardiovascular disease. Moreover, these studies also suggested that women with PCOS experience a significant health improvement, such as a decrease in many metabolic markers, such as free testosterone, glucose, insulin levels and body fat percentage. Additionally, diet modification led to a reduction in hyperandrogenism and improvement in lipid profile, as well as decreased the severity of common symptoms associated with PCOS, such as acne and hair loss, and improved the regularity of menstrual cycles.

According to the findings of this review, many diets can positively influence both the laboratory and clinical aspects

of the syndrome. The types of diets we looked at in this review include pulse-based (such as lentils, beans, split peas, and chickpeas), calorie-based, fat-based and supplement-based (such as curcumin, cinnamon, inositol and vitamin D), as well as commercial meal replacements. Moreover, we also explored how diet modification with additional lifestyle measures (such as exercise) affects the metabolic, reproductive, and endocrine profile of patients with PCOS. We found that a diet that significantly helps patients with PCOS should be low in glycaemic index to help maintain blood glucose levels, which can help to improve reproductive outcomes in women with PCOS, contain low-fat dairy, and contain fish that is specifically high in omega-3, which is beneficial in improving the overall health of these patients.

Supplement-based diet has been shown to enhance insulin sensitivity, helping to regulate blood sugar levels more effectively. This can reduce the risk of developing type 2 diabetes and improve overall metabolic health. Furthermore, a supplement-based diet is associated with weight reduction, as well as helping to reduce inflammation by lowering the oxidative stress in patients with PCOS. Furthermore, we also found that Mediterranean and DASH diets, both of which are very similar, help to improve ovarian health in these patients. Therefore, following this dietary pattern may lead to better outcomes for women with PCOS.

Lastly, lifestyle intervention, such as exercise with diet modification, helps to further maintain weight loss, which can often be challenging for women dealing with PCOS.

CONCLUSION

Based on the reviewed studies and evidence, a Mediterranean diet emerges as one of the most beneficial dietary patterns for managing PCOS. This diet emphasises whole foods, healthy fats, lean proteins, and low glycaemic index carbohydrates, making it effective in addressing IR, reducing hyperandrogenism, and improving overall metabolic health.

Additionally, incorporating dietary supplements such as curcumin, cinnamon, inositol, and vitamin D can further enhance the positive outcomes for women with PCOS. These supplements support metabolic processes, enhance insulin sensitivity, and help restore hormonal balance.

Furthermore, integrating commercial meal replacements and emphasising a balanced diet rich in omega-3 fatty acids and low-fat dairy can promote weight loss and maintain long-term health improvements.

Ultimately, a comprehensive approach that includes a Mediterranean diet combined with lifestyle modifications, such as regular exercise and psychological support, proves to be the most effective strategy for managing PCOS. This combination not only addresses the physiological aspects of

the syndrome but also contributes to improved psychological well-being, offering a holistic pathway to better health for women with PCOS.

Author contribution

NTR, SR, AKR, SRCB: Conceptualization; NTR, SR: Methodology, investigation; NTR, SR, AKR: Data curation, writing – original draft preparation; NTR, SR, AKR, SRCB, EG: Writing – review & editing; SRCB: Supervision.

Ethical approval: Institutional Review Board approval is not required.

Declaration of patients consent: Patient's consent is not required as patient's identity is not disclosed or compromised.

Financial support and sponsorship: Nil.

Conflicts of interest: There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation: The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

REFERENCES

- Osibogun O, Ogunmoroti O, Michos ED. Polycystic Ovary Syndrome and Cardiometabolic Risk: Opportunities for Cardiovascular Disease Prevention. *Trends Cardiovasc Med* 2020;30:399–404.
- Deswal R, Narwal V, Dang A, Pundir CS. The Prevalence of Polycystic Ovary Syndrome: A Brief Systematic Review. *J Hum Reprod Sci* 2020;13:261–71.
- Carmina E, Lobo RA. Polycystic Ovary Syndrome (PCOS): Arguably the Most Common Endocrinopathy is Associated with Significant Morbidity in Women. *J Clin Endocrinol Metab* 1999;84:1897–9.
- Palomba S, Daolio J, La Sala GB. Oocyte Competence in Women with Polycystic ovary Syndrome. *Trends Endocrinol Metab* 2017;28:186–98.
- Sonino N, Fava GA, Mani E, Belluardo P, Boscaro M. Quality of Life of Hirsute Women. *Postgrad Med J* 1993;69:186–9.
- Sangaraju SL, Yepes D, Grandes XA, Talanki Manjunatha R, Habib S. Cardio-Metabolic Disease and Polycystic Ovarian Syndrome (PCOS): A Narrative Review. *Cureus* 2022;14:e25076.
- Çıtar Dazıroğlu ME, Acar Tek N. The Effect on Inflammation of Adherence to the Mediterranean Diet in Polycystic Ovary Syndrome. *Curr Nutr Rep* 2023;12:191–202.
- Szczuko M, Kikut J, Szczuko U, Szydłowska I, Nawrocka-Rutkowska J, Ziętek M, *et al.* Nutrition Strategy and Life Style in Polycystic Ovary Syndrome-Narrative Review. *Nutrients* 2021;13:2452.
- Thessaloniki ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group. Consensus on Infertility Treatment Related to Polycystic Ovary Syndrome. *Hum Reprod* (2008) 23:462–77.
- Deshmukh S, Smith J, Lee A, Patel R, Johnson M, Nguyen T, *et al.* Comparison of Very Low-Calorie Diet with Moderate Energy Deficit in Weight Loss Among Women with PCOS. *Nutrients*. 2023;15:112.
- Zhang Y, Wang L, Chen X, Liu Y, Zhao H, Li Q, *et al.* Effect of Dulaglutide Combined with a Calorie-Restricted Diet on Weight Loss in Women with PCOS. *Front Endocrinol* 2023;14:1152738.
- Hoover SE, Gower BA, Cedillo YE, Chandler-Laney PC, Deemer SE, Goss AM. Changes in Ghrelin and Glucagon Following a Low Glycemic Load Diet in Women with PCOS. *J Clin Endocrinol Metab* 2021;106:e2151–e2161.
- Legro RS, Dodson WC, Kunselman AR, Stetter CM, Kris-Etherton PM, Williams NI, *et al.* Ovulation and Pregnancy Rates in Overweight Women with PCOS: Lifestyle Intervention vs Combined Oral Contraceptives. *J Clin Endocrinol Metab* 2015;100:4048–4058.
- Gower BA, Chandler-Laney PC, Ovalle F, Granger WM, Azziz R, Darnell BE, *et al.* Favourable Metabolic Effects of a Eucaloric Lower-Carbohydrate Diet in Women with PCOS. *Clin Endocrinol (Oxf)* 2013;79:550–557.
- Nybacka Å, Carlström K, Ståhl S, Svanberg L, Holte J. Serum Antimüllerian Hormone in Response to Dietary and Exercise Intervention in Overweight women with Polycystic Ovary Syndrome—A Randomized Controlled Trial. *Clin Endocrinol (Oxf)* 2013;79:698–706.
- Nybacka Å, Carlström K, Ståhl S, Svanberg L, Holte J. Randomized Comparison of the Influence of Dietary Management, Exercise, or Both on Reproductive Function in Overweight Women with Polycystic ovary Syndrome. *Acta Obstet Gynecol Scand* 2011;90:1239–1248.
- Kasim-Karakas SE, Almario RU, Cunningham W. Effects of Protein Versus Simple Sugar Intake on Weight Loss in Polycystic Ovary Syndrome. *Fertil Steril* 2009;92:264–271. Available from: <https://profiles.ucdavis.edu/search/profiles.ucdavis.edu>
- Moran LJ, Noakes M, Clifton PM, Tomlinson L, Norman RJ. Short-Term Meal Replacement Followed by Macronutrient Restriction: A Randomized Controlled Trial in Overweight Women with Polycystic Ovary Syndrome. *J Clin Endocrinol Metab* 2006;91:436–445.
- Stamets K, Taylor DS, Kunselman AR, Demers LM, Legro RS. A Randomized Trial of the Effects of Two Types of Short-Term Hypocaloric Diets on Weight Loss in Women with Polycystic Ovary Syndrome. *J Am Diet Assoc* 2004;104:1498–1506.
- Phelan N, O'Connor A, Tun TK, Boran G, Gibney J, Roche HM. Hormonal and Metabolic Effects of Omega-3 Polyunsaturated Fatty Acid Supplementation in Polycystic Ovary Syndrome: A Randomized Controlled Trial. *Clin Endocrinol (Oxf)* 2011;75:628–634.
- Katcher HI, Kunselman AR, Dmitrovic R, Demers LM, Gnatuk CL, Kris-Etherton PM, *et al.* Comparison of the Effects of Two Hypocaloric Diets on Weight Loss and Cardiovascular Risk Reduction in Overweight Women with Polycystic ovary Syndrome. *Fertil Steril* 2010;94:2208–2213.
- Kazemi M, McBreairty LE, Chizen DR, Pierson RA, Chilibeck PD, Zello GA. A Comparison of a Pulse-Based Diet and the Therapeutic Lifestyle Changes Diet in Combination with Exercise and Health Counseling on the Cardiometabolic Risk Profile in Women with Polycystic Ovary Syndrome: A Randomized Controlled Trial. *Clin Nutr ESPEN* 2018;23:31–38.
- Cheshmeh S, Hosseini SA, Jafari M. Green Cardamom Supplementation Improves Inflammatory Markers in Overweight Women with Polycystic Ovary Syndrome: A Randomized Double-Blind Placebo-Controlled Clinical Trial. *Phytother Res* 2022;36:2846–2854.
- Karine P, Smith J, Lee A, Patel R, Johnson M, Nguyen T, *et al.* Effects of Curcumin, Vitamin D, Inositol, and Coenzyme Q10 on Inflammation and Ovarian Function in Women with

- Polycystic Ovary Syndrome: A Randomized Controlled Trial. *Nutr Res Pract* 2022;16:231–239.
25. Karimi E, Samadi M, Gholami M. Synbiotic Supplementation Improves Lipid Profile in Women with Polycystic Ovary Syndrome: A Randomized Double-Blind Placebo-Controlled Trial. *Probiotics Antimicrob Proteins*. 2020;12:998–1004.
 26. Shang Y, Zhou H, He R, Lu W. Dietary Modification for Reproductive Health in Women With Polycystic Ovary Syndrome: A Systematic Review and Meta-Analysis. *Front Endocrinol (Lausanne)* 2021;12:735954.
 27. Dennett CC, Simon J. The Role of Polycystic Ovary Syndrome in Reproductive and Metabolic Health: Overview and Approaches for Treatment. *Diabetes Spectr* 2015;28:116–20.
 28. Wang F, Dou P, Wei W, Liu PJ. Effects of High-Protein Diets on the Cardiometabolic Factors and Reproductive Hormones of Women with Polycystic Ovary Syndrome: A Systematic Review and Meta-Analysis. *Nutr Diabetes* 2024;14:6.
 29. Che X, Chen Z, Liu M, Mo Z. Dietary Interventions: A Promising Treatment for Polycystic Ovary Syndrome. *Ann Nutr Metab* 2021;77:313–23.
 30. Stepto NK, Cassar S, Joham AE, Hutchison SK, Harrison CL, Goldstein RF, *et al.* Women with Polycystic Ovary Syndrome Have Intrinsic Insulin Resistance on Euglycaemic-Hyperinsulaemic Clamp. *Hum Reprod* 2013;28:777–84.
 31. Lim SS, Davies MJ, Norman RJ, Moran LJ. Overweight, Obesity and Central Obesity in Women with Polycystic Ovary Syndrome: A Systematic Review and Meta-Analysis. *Hum Reprod Update* 2012;18:618–37.
 32. Pikee S, Shivani S, Jayshree B. Endocrine and Metabolic Profile of Different Phenotypes of Polycystic Ovarian Syndrome. *J Obstet Gynaecol India* 2016;66(Suppl 1):560–6. <https://doi.org/10.1007/s13224-016-0898-7>
 33. Hahn S, Kuehnel W, Tan S, Kramer K, Schmidt M, Roesler S, *et al.* Diagnostic Value of Calculated Testosterone Indices in the Assessment of Polycystic Ovary Syndrome. *Clin Chem Lab Med* 2007;45:202–7.
 34. Shele G, Genkil J, Speelman D. A Systematic Review of the Effects of Exercise on Hormones in Women with Polycystic Ovary Syndrome. *J Funct Morphol Kinesiol* 2020;5:35
 35. Vigorito C, Giallauria F, Palomba S, Cascella T, Manguso F, Lucci R, *et al.* Beneficial Effects of a Three-Month Structured Exercise Training Program on Cardiopulmonary Functional Capacity in Young Women with Polycystic Ovary Syndrome. *J Clin Endocrinol Metab* 2007;92:1379–84.
 36. Vaidya A, Yadav S, Vaidya A. A Study on the Clinical and Hormonal Profile of Polycystic Ovarian Syndrome Patients Attending a Tertiary Care Hospital: A Descriptive Cross-sectional Study. *JNMA J Nepal Med Assoc* 2020;58:875–88.
 37. Giri A, Joshi A, Shrestha S, Chaudhary A. Metabolic Syndrome among Patients with Polycystic Ovarian Syndrome Presenting to a Tertiary Care Hospital: A Descriptive Cross-Sectional Study. *JNMA J Nepal Med Assoc* 2022;60:137–41.
 38. Kiani AK, Donato K, Dhuli K, Stuppia L, Bertelli M. Dietary Supplements for Polycystic Ovary Syndrome. *J Prev Med Hyg* 2022;63(2 Suppl 3):E206–13. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9710389/> [Last accessed date 24 July 2024].
 39. Jia L-Y, Feng J-X, Li J-L, Liu F-Y, Xie L-Z, Luo S-J. The Complementary and Alternative Medicine for Polycystic Ovary Syndrome: A Review of Clinical Application and Mechanism. *Evid Based Complement Alternat Med* 2021. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7935573/> [Last accessed 24 July 2024].
 40. Singh G, Maurya S, DeLampasona MP, Catalan CA. A Comparison of Chemical, Antioxidant and Antimicrobial studies of Cinnamon Leaf and Bark Volatile Oils, Oleoresins and Their Constituents. *Food Chem Toxicol* 2007;45:1650–61.
 41. Heshmati J, Sepidarkish M, Morvaridzadeh M, Farsi F, Tripathi N, Razavi M, *et al.* The Effect of Cinnamon Supplementation on Glycemic Control in Women with Polycystic Ovary Syndrome: A Systematic Review and Meta-Analysis. *J Food Biochem* 2021;45:e13543.
 42. Facchinetti F, Espinola M, Dewailly D, Ozay AC, Prapas N, Vazquez-Levin M, *et al.* Expert Group on Inositols in Preclinical and Clinical Research Breakthroughs in the Use of Inositols for Assisted Reproductive Treatment (ART). *Trends Endocrinol Metab* 2020;31:570–9.
 43. Nordio M, Proietti E. The Combined Therapy with Myo-Inositol and D-Chiro-Inositol Reduces the Risk of Metabolic Disease in PCOS Overweight Patients Compared to Myo-Inositol Supplementation Alone. *Eur Rev Med Pharmacol Sci* 2012;16:575–81.
 44. Nestler JE, Jakubowicz DJ, Reamer P, Gunn RD, Allan G. Ovulatory and Metabolic Effects of D-Chiro-Inositol in the Polycystic ovary Syndrome. *N Engl J Med* 1999;340:1314–20.
 45. Wehr E, Pilz S, Schweighofer N, Giuliani A, Kopera D, Pieber TR, *et al.* Association of Hypovitaminosis D with Metabolic Disturbances in Polycystic Ovary Syndrome. *Eur J Endocrinol* 2009;161:575–82.
 46. Alvarez JA, Ashraf A. Role of Vitamin D in Insulin Secretion and Insulin Sensitivity for Glucose Homeostasis. *Int J Endocrinol* 2010;35:1385.
 47. Precone V, Notarangelo A, Marceddu G, D'Agruma L, Cannarella R, Calogero AE, *et al.* A Simultaneous Next-Generation Sequencing Approach to the Diagnosis of Couple Infertility. *Minerva Endocrinol (Torino)* 2022;47:4–10
 48. Łągowska K, Bajerska J, Jamka M. The Role of Vitamin D Oral Supplementation in Insulin Resistance in Women with Polycystic Ovary Syndrome: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Nutrients* 2018;10:1637.
 49. Chien YJ, Chang CY, Wu MY, Chen CH, Horng YS, Wu HC. Effects of Curcumin on Glycemic Control and Lipid Profile in Polycystic Ovary Syndrome: Systematic Review with Meta-Analysis and Trial Sequential Analysis. *Nutrients* 2021;13:684.
 50. Nistico S, Tamburi F, Bennardo L, Dastoli S, Schipani G, Caro G, *et al.* Treatment of Telogen Effluvium Using a Dietary Supplement Containing *Boswellia serrata*, *Curcuma longa*, and *Vitis vinifera*: Results of an Observational Study. *Dermatol Ther* 2019;32:e12842.
 51. Wojcik M, Krawczyk M, Wojcik P, Cypryk K, Wozniak LA. Molecular Mechanisms Underlying Curcumin-Mediated Therapeutic Effects in Type 2 Diabetes and Cancer. *Oxid Med Cell Longev* 2018;2018:9698258.
 52. Moran LJ, Noakes M, Clifton PM, Wittert GA, Tomlinson L, Galletly C, *et al.* Ghrelin and Measures of Satiety Are Altered in

- Polycystic Ovary Syndrome But Not Differentially Affected by Diet Composition. *J Clin Endocrinol Metab* 2004;89(7):3337–44.
53. Ayyad C, Andersen T. Long-Term Efficacy of Dietary Treatment of Obesity: A Systematic Review of Studies Published Between 1931 and 1999. *Obes Rev* 2000;1:113–9.
 54. Moran LJ, Noakes M, Clifton PM, Wittert GA, Williams G, Norman RJ. Short-Term Meal Replacements Followed by Dietary Macronutrient Restriction Enhance Weight Loss in Polycystic Ovary Syndrome. *Am J Clin Nutr* 2006;84:77–87.
 55. Noakes M, Foster PR, Keogh JB, Clifton PM. Meal Replacements are as Effective as Structured Weight-Loss Diets for Treating Obesity in Adults with Features of Metabolic Syndrome. *J Nutr* 2004;134:1894–9.
 56. Lim SS, Hutchison SK, Van Ryswyk E, Norman RJ, Teede HJ, Moran LJ. Lifestyle Changes in Women with Polycystic Ovary Syndrome. *Cochrane Database Syst Rev* 2019;3:CD007506.
 57. Clark AM, Thornley B, Tomlinson L, Galletley C, Norman RJ. Weight Loss in Obese Infertile Women Results in Improvement in Reproductive Outcome for all Forms of Fertility Treatment. *Hum Reprod* 1998;13:1502-5
 58. Pirotta S, Barillaro M, Brennan L, Grassi A, Jeanes YM, Joham AE, *et al.* Disordered Eating Behaviours and Eating Disorders in Women in Australia with and without Polycystic Ovary Syndrome: A Cross-Sectional Study. *J Clin Med* 2019;8:1682.
 59. Pasquali R, Gambineri A, Cavazza C, Ibarra Gasparini D, Ciampaglia W, Cognigni GE, *et al.* Heterogeneity in the Responsiveness to Long-Term Lifestyle Intervention and Predictability in Obese Women with Polycystic Ovary Syndrome. *Eur J Endocrinol* 2011;164:53–60.
 60. Witchel SF, Teede HJ, Peña AS. Curtailing PCOS. *Pediatr Res* 2020;87:353–61.
 61. Estruch R, Ros E, Salas-Salvadó J, Covas MI, Corella D, Arós F, *et al.* Primary Prevention of Cardiovascular Disease with a Mediterranean Diet Supplemented with Extra-Virgin Olive Oil or Nuts. *N Engl J Med* 2018;378:e34.

How to cite this article: Raja NT, Bhatta SRC, Grand E. A Review of Dietary Interventions for Polycystic Ovary Syndrome: Identifying the Optimal Approach. *Fertil Sci Res.* 2025;12:18. doi: 10.25259/FSR_27_2025