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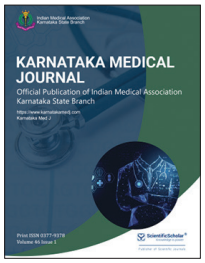

Review Article

Holistic lifestyle management of polycystic ovary syndrome

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ABSTRACT

Polycystic ovary syndrome (PCOS) affects up to 13% of women of reproductive age and presents a complex interplay of reproductive, metabolic and psychological challenges. Diagnosing PCOS involves identifying two of three features: polycystic ovaries, irregular ovulation and signs of hyperandrogenism. Insulin resistance (IR) exacerbates symptoms, with both lean and overweight women experiencing it, though it is more pronounced in those who are obese. Effective management of PCOS emphasises lifestyle interventions, including diet and physical activity. The current evidence-based guidelines suggest a balanced approach to diet and recommend weight loss and increased physical activity to improve metabolic and reproductive outcomes. Traditional dietary practices, including those rich in whole grains and legumes, along with modern strategies like low glycaemic index diets, have shown promise in managing PCOS symptoms. Similarly, physical activity, including a mix of aerobic and resistance exercises, improves metabolic health and symptom management. Emerging evidence also highlights the potential benefits of vitamins, supplements and minerals, such as Vitamin D, B-group vitamins and magnesium, in managing PCOS. Despite limited evidence on some non-pharmacological treatments, holistic care, integrating traditional and complementary approaches, is essential for optimising patient outcomes. This paper aims to offer a comprehensive overview of these lifestyle strategies, integrating emerging evidence with existing guidelines to enhance PCOS management and improve overall patient well-being.

Keywords: Polycystic ovary syndrome, Holistic management, Diet and exercise, Psychological interventions, Traditional medicine, Indian women's health

INTRODUCTION

Polycystic ovary syndrome (PCOS) is a common condition affecting up to 13% of women of reproductive age.[1] Diagnosing PCOS requires two of the following features: polycystic ovaries visible on ultrasound, irregular ovulation or absence of ovulation and clinical or biochemical signs of hyperandrogenism.[1] Women with PCOS often face a mix of reproductive challenges (such as infertility and pregnancy complications), metabolic issues (such as higher risks for type 2 diabetes [T2DM] and cardiovascular disease [CVD]) and psychological problems (including anxiety, depression, poor quality of life and disordered eating).[1]

Insulin resistance (IR) is a key issue in PCOS, leading to increased androgen levels and worsening symptoms.[2] Both lean and overweight women with PCOS can experience IR, but it is typically more severe in those who are overweight or obese. Women with PCOS tend to gain weight more easily, which further worsens IR and PCOS symptoms.[2] The exact reasons for this are not fully understood but may involve both psychological and biological mechanisms, as well as lifestyle

factors such as diet and physical activity. Therefore, improving IR and managing weight are crucial in PCOS treatment.[2]

The Evidence-Based Guideline for the Assessment and Management of PCOS emphasises lifestyle interventions as the primary early management strategy.[3] These interventions include improving diet and increasing physical activity.[3] For overall health benefits, the guideline promotes weight management, encouraging women to prevent weight gain and achieve modest weight loss if they are overweight.[3]

Lifestyle interventions can go beyond just physical health.[4] Since the 1970s, healthcare has shifted from a purely biomedical model (defining health as the absence of disease) to a holistic model that considers the biological, psychological, social, spiritual and ecological aspects of a person's health.[3,4] This approach requires various treatment strategies to improve overall well-being. Providing holistic care is now a key objective in healthcare reforms worldwide.[4]

The PCOS guideline also highlights the importance of emotional well-being for overall health and quality of life in women with PCOS.[3] It points out that the psychological impacts of PCOS are often underappreciated in clinical care and that many women are dissatisfied with the mental health support that they receive. Recommendations are given for screening, assessing and treating anxiety, depression, psychosexual dysfunction, eating disorders and poor body image.[5] Research shows that women with PCOS experience higher rates of depression and anxiety, lower satisfaction with their sex lives and a higher prevalence of disordered eating.[6] Symptoms such as hirsutism and weight gain can negatively affect body image, which is closely related to depression in women with PCOS.[7]

While the current PCOS guideline is comprehensive, it does not cover all aspects of PCOS care.[8] Some therapies, such as traditional, complementary and integrative medicine (TCIM), supplements, sleep and meditation interventions, are either briefly mentioned or not included at all.[9] Many of these therapies are new, and there is limited evidence on their effectiveness for PCOS.[8] However, as interest in non-pharmacological treatments grows, it is important to provide more guidance to healthcare providers on their potential benefits. Holistic care involves an open dialogue between doctors and patients, where healthcare providers involve patients in decision-making and respect their autonomy.[7-9]

This paper aims to provide an extensive overview of lifestyle strategies for managing PCOS, considering traditional components such as diet, physical activity and behavioural changes, as well as psychological and sleep interventions, and TCIM approaches such as supplements, herbal medicine, acupuncture and yoga. The goal is to offer a holistic view of patient care that integrates emerging evidence with existing guidelines, providing new insights for research and practice.

TRADITIONAL LIFESTYLE AND WEIGHT MANAGEMENT IN PCOS

The PCOS guideline recommends that all women with PCOS should adopt healthy lifestyle behaviours to achieve and maintain a healthy weight and optimise their overall health.[9] For women who are overweight, a weight loss of 5–10% is suggested, aiming for an energy deficit of 500–750 kcal/day (around 1200–1500 kcal/day).[9] While weight management is essential, the guideline highlights that a healthy lifestyle has benefits beyond just weight loss.[9]

A recent Cochrane review of 15 randomised controlled trials (RCTs) involving 498 participants found that lifestyle interventions, compared with minimal intervention or usual care, significantly reduce weight and body mass index (BMI).[9,10] These interventions also improve secondary reproductive outcomes such as the free androgen index (FAI), testosterone levels, sex hormone-binding globulin (SHBG) and hirsutism (measured by the Ferriman-Gallwey score).[9] In terms of metabolic outcomes, lifestyle changes resulted in significant reductions in total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C) and fasting insulin (FINS) levels. While the Cochrane review did not assess clinical reproductive outcomes, individual trials not included in the review have reported that modest weight loss (2–5% of total body weight) can improve ovulation and menstrual regularity.[11] Losing more than 5% of body weight is also associated with better chances of conception, live births, reduced ovarian volume and fewer ovarian follicles.[12]

Weight loss has clear benefits for PCOS, improving reproductive function, glucose regulation, androgen levels and lipid profiles. However, not all women respond equally to weight loss in terms of PCOS symptom improvement.[13] A study revealed that even after women achieved a weight loss of over 5% of their body weight, only one-third fully recovered from PCOS, while the majority experienced either partial improvement or no recovery.[3] Women with higher waist circumference (WC), waist-hip ratio (WHR) and androstenedione levels at baseline had poorer outcomes. This suggests that central adiposity (belly fat) and severe hyperandrogenism may predict how well someone responds to weight loss interventions in PCOS.[3] Another study by Huber-Buchholz *et al*. reported that women who achieved greater reductions in central fat and improved insulin sensitivity showed better symptom improvement with weight loss. This indicates that lifestyle interventions focusing on reducing IR and improving body composition (especially fat distribution) may help optimise PCOS management outcomes, independent of weight loss.[14]

For Indian women, adopting traditional dietary practices rich in whole grains, legumes, vegetables and spices, combined

with regular physical activity such as yoga, can provide a solid foundation for managing PCOS. Incorporating these lifestyle changes with modern nutritional and exercise guidance can enhance health benefits and improve overall quality of life.

DIET AND PCOS MANAGEMENT

The 2018 PCOS guideline acknowledges that there is insufficient evidence to suggest that any specific dietary approach offers greater benefits for health outcomes in PCOS management.[15] Instead, it recommends that dietary strategies should be balanced and tailored to an individual's lifestyle needs and preferences, following general population dietary guidelines.[16] This recommendation is based on a systematic review that compared various dietary compositions, such as low carbohydrate, low glycaemic index (GI), low glycaemic load (GL), high protein, monounsaturated fatty acid (MUFA)-enriched and fat-counting diets.[16] The review found minimal differences between these diets in terms of their impact on body weight and other anthropometric outcomes, concluding that weight loss improves PCOS symptoms regardless of the specific dietary composition.[16]

However, emerging evidence suggests that various dietary strategies may positively affect PCOS features independent of weight loss. This growing body of research should be considered to better support the interests of both consumers and health professionals. To provide a comprehensive summary of current evidence, dietary strategies can be grouped based on their focus on modifying carbohydrate, protein and fat intake, as well as specific dietary patterns.[16]

For Indian women, adopting traditional dietary practices that are naturally balanced and rich in whole grains, legumes, vegetables and spices can align with these guidelines. Integrating such traditional diets with modern dietary strategies can help manage PCOS more effectively, emphasising the importance of a holistic approach that considers individual preferences and cultural practices.

CARBOHYDRATES AND PCOS MANAGEMENT

Altering carbohydrate composition is the most researched dietary approach for managing PCOS. Two systematic reviews published after the PCOS guidelines support changing carbohydrate intake to improve intermediate markers of PCOS. These reviews found that altering the type of carbohydrates [17] rather than the amount, is more effective for managing PCOS. Several RCTs and pre-post intervention studies demonstrate that following a low GI or GL diet for at least 8 weeks significantly reduces WC and BMI compared to high GI/GL or regular diets.[17] Although weight loss levels are generally comparable to other dietary compositions, these reductions are thought to result from decreased hunger, making it easier to follow dietary recommendations long-term.[18] Low GI/GL diets also improve insulin sensitivity and reproductive hormones (testosterone, SHBG and FAI) compared to high carbohydrate or control diets, leading to better reproductive function, particularly menstrual regularity.[17-19]

In addition, low GI/GL diets can improve risk factors for T2DM and CVD, including glucose levels, TC, LDL-C, triglycerides (TAG) and high-density lipoprotein cholesterol (HDL-C) compared to regular or high GI/GL diets.[17] It is important to note that the beneficial effects of low GI/GL diets may also be due to proportional increases in protein and/or fat intake.

For Indian women, incorporating low GI/GL foods, such as whole grains, legumes and vegetables, into traditional diets can help manage PCOS more effectively. Emphasising these dietary changes, along with reducing high GI foods such as refined carbohydrates and sugary snacks, can provide substantial health benefits and improve PCOS symptoms.

PROTEIN AND PCOS MANAGEMENT

Higher protein intake may help suppress androgen levels in women with PCOS more effectively than high carbohydrate diets. Research has shown that high-protein meals can reduce insulin and dehydroepiandrosterone (DHEA) stimulation compared to meals rich in glucose. Studies in the general population have also found that low GI/GL diets, which often include higher protein intake, reduce appetite and energy intake.[20,21]

RCTs and pre-post intervention studies indicate that high-protein diets, defined as containing at least 25% of total energy from protein, can reduce weight, BMI, WC, WHR and fat mass when followed for at least 4 weeks.[20] These diets also improve IR, as measured by FINS and homeostasis model assessment of IR (HOMA-IR), blood lipids, testosterone (T) levels and hirsutism (measured by the Ferriman-Gallwey score).[21] However, only a few studies demonstrated significant improvements in these measures when compared to low or standard protein diets or control diets. One study specifically looked at mental health outcomes and found that a high-protein diet reduced depression and improved self-esteem in women with PCOS.[20,21]

For Indian women, incorporating higher protein foods, such as pulses, legumes, dairy and lean meats, into traditional diets can enhance PCOS management. This approach, combined with reducing high GI foods and increasing protein intake, can help regulate blood sugar levels, reduce appetite and improve overall health outcomes.

FATS AND PCOS MANAGEMENT

Fatty acid composition is crucial in managing metabolic disorders associated with PCOS, and increasing the intake

of MUFAs and polyunsaturated fatty acids (PUFAs) can be beneficial. Research has shown that high-fat meals can lead to prolonged reductions in testosterone (T) compared to low-fat meals due to delayed nutrient absorption.[22] However, studies have also found that saturated fat ingestion can elevate proatherogenic inflammatory markers and oxidative stress, worsening IR and androgen levels, especially in obese women with PCOS.[23,24]

Two experimental studies examined the effects of walnut (PUFA-rich) and almond (MUFA-rich) intake over at least 6 weeks in women with PCOS.[25] These studies found no significant differences in glucose regulation, lipids or androgens between the two groups, except for a significant decrease in haemoglobin A1c in the walnut group compared to the almond group. Another study suggested that increased walnut intake might raise fasting and postprandial glucose levels, possibly due to the control diet's high oleic acid content. These findings suggest minimal differences in benefits between PUFA and MUFA intake.[26,27] RCTs investigated the effects of diets rich in olive, canola and sunflower oils in women with PCOS. One study reported that consuming 25 g/day of canola oil reduced TAG, TC to HDL-C ratio, LDL-C to HDL-C ratio, TAG to HDL-C ratio and HOMA-IR, but not androgens, compared to olive and sunflower oils.[26] This could be due to the favourable fatty acid composition of canola oil, which has a similar MUFA content to olive oil, higher alpha-linolenic acid and a better omega-6 to omega-3 ratio.[26,27] Another study found that a low-carbohydrate diet resulted in lower weight and a better acute insulin response compared to a MUFA-enriched olive oil diet, suggesting that reducing carbohydrate intake might offer greater glucoregulatory benefits than increasing MUFA intake.[28] In addition, two RCTs compared hypocaloric low-fat diets to low-carbohydrate or low-GI diets, showing reductions in weight, WC, body fat, FINS and FAI in both groups, but with no significant differences between the groups.[28]

For Indian women, incorporating healthy fats from sources such as nuts, seeds, olive oil and canola oil, while also managing carbohydrate intake, can help improve PCOS symptoms. Traditional Indian diets, which include various healthy fats and balanced meals, can be adjusted to focus on these beneficial fats and reduce saturated fat intake to optimise health outcomes.

DIETARY AND EATING PATTERNS FOR PCOS MANAGEMENT

In addition to diets focusing on specific macronutrient manipulations, various dietary patterns have been explored for managing PCOS. A systematic review involving 19 studies and 1193 participants published in 2020 identified the Dietary Approaches to Stop Hypertension (DASH) diet as particularly effective in reducing IR.[3] The DASH diet, rich in fruits, vegetables, whole grains, nuts, legumes and low-fat dairy, and predominantly low in GI carbohydrates, has shown significant benefits.[23] RCTs in women with PCOS have demonstrated that following the DASH diet for 8–12 weeks can lead to improvements in weight, BMI, IR and hormonal profiles, including SHBG, androstenedione and the FAI.[23] Other dietary patterns have also shown promising results. A vegetarian diet reduced inflammatory markers such as C-reactive protein, resistin and adiponectin compared to a meat-inclusive diet. A vegan diet resulted in weight loss at 3 months but not at 6 months.[29] Similarly, a pulse-based diet (rich in legumes) led to reductions in weight, insulin sensitivity and reproductive hormones comparable to a healthy control diet. These dietary patterns are high in fibre and plant proteins, which can positively affect microbial diversity and promote the production of short-chain fatty acids with potential anti-inflammatory effects.[30] Animal studies have suggested that gut microbiota may play a role in IR and ovarian dysfunction in PCOS, indicating that plant-based diets could offer metabolic and hormonal benefits due to their high prebiotic content. However, more research is needed to understand the exact role of gut microbiota in PCOS and to investigate the effects of dietary prebiotics on PCOS outcomes through RCTs.[31] In addition, specific eating patterns, such as consuming smaller, more frequent meals throughout the day and eating a larger breakfast with a smaller dinner, have been found to improve insulin sensitivity and reduce androgens. This is particularly relevant for women with PCOS, who are more likely to skip breakfast or consume their meals later in the day.[31] Studies focusing on specific food items, such as raw onions, concentrated pomegranate juice and flaxseed powder, have produced inconsistent results. A key limitation of these single-food studies is that foods are never consumed in isolation within a diet. This oversight fails to consider the interactions among various dietary constituents within meals, thus limiting the practical applicability of these findings in formulating dietary recommendations.[28-30]

For Indian women, integrating these dietary patterns and eating habits into traditional diets can be beneficial for managing PCOS. Emphasising a diet rich in fruits, vegetables, whole grains and plant proteins while paying attention to meal timing and frequency can help improve metabolic and hormonal health outcomes.

PHYSICAL ACTIVITY IN PCOS MANAGEMENT

The 2018 PCOS guideline recommends at least 150 min/week of moderate-intensity exercise or 75 min/week of vigorous-intensity exercise to prevent weight gain. For weight loss and prevention of weight regain, the guideline suggests increasing this to 250 min/week of moderate-intensity or 150 min/week of vigorous-intensity exercise.[15] In addition, minimising

sedentary time and including strength training exercises 2 days/week are advised.

A comprehensive review of 27 papers from 18 trials up until June 2017 found that exercise improved FINS, IR (HOMA-IR), TC, LDL-C, TAG, body composition (body fat percentage and WC) and aerobic fitness (VO_2max) compared to usual care or control groups.[32] The review highlighted that aerobic exercise specifically improved BMI, WC, body fat percentage, FINS, HOMA-IR, TC, TAG and VO_2max. Resistance training, while showing a decrease in HDL-C and an increase in BMI, improved WC and other anthropometric measures.[32] Combined interventions of aerobic and resistance training had no significant effect on the measured markers. The review also noted that more outcomes improved when interventions were supervised, of shorter duration (≤12 weeks) and conducted in women who were above a healthy weight. More recent systematic reviews have further examined the effects of specific types of exercise on PCOS outcomes.[33] Vigorous aerobic exercise has been shown to improve insulin responsiveness and resistance, including HOMA-IR and the insulin sensitivity index, as well as body composition, including WC and BMI and cardiorespiratory fitness (VO_2max). High-intensity interval training may be effective for improving IR and BMI, although results have been inconsistent. Interventions combining aerobic and resistance exercise or focusing solely on resistance training did not significantly improve BMI or weight status.[32,33] However, resistance training led to beneficial changes in body composition, such as reduced body fat and WC, increased lean mass and improved strength.[33] This is crucial as the degree of central adiposity predicts responsiveness to weight loss interventions in PCOS, with greater reductions in central fat correlating with greater symptom improvement. Resistance training may also improve androgen levels, but findings are inconsistent, and more research is needed. There is insufficient evidence to assess the effects of exercise type on reproductive function.[32]

For Indian women with PCOS, incorporating a mix of aerobic and resistance exercises into their weekly routine, along with minimising sedentary behaviour and including strength training, can help manage symptoms effectively. This balanced approach can improve metabolic health, body composition and overall fitness, contributing to better PCOS management.

VITAMINS, VITAMIN-LIKE SUPPLEMENTS AND MINERALS

Vitamins

B-group vitamins (B1, B6 and B12), folic acid (B9) and Vitamins D, E and K are essential for various biological processes influencing PCOS's metabolic and reproductive features. B-group vitamins, alongside folic acid, regulate homocysteine (Hcy) levels, an amino acid linked to CVD risk and often elevated in PCOS due to folate deficiency.[33] An RCT involving B-group vitamins and folic acid reported a reduction in metformin-induced Hcy levels. Folic acid alone, examined in two RCTs (n = 69 and n = 81), improved FINS, HOMA-IR, C-reactive protein, total antioxidant capacity and glutathione at doses ≥5 mg/day compared with placebo.[34] Vitamin D supplementation, according to three large-scale meta-analyses, enhances IR, fasting glucose, lipid profiles and androgen levels.[35] While Vitamin E has shown benefits on fertility in other populations and improved androgen profiles when combined with coenzyme Q10 in PCOS, no RCTs have assessed Vitamin E alone in PCOS. Vitamin K has limited literature; one RCT (n = 84) reported improvements in anthropometry, insulin and androgen profiles with 90 μg/day of Menaquinone-7 for 8 weeks.[36]

Vitamin-like supplements

Vitamin-like supplements such as bioflavonoids, carnitine and alpha-lipoic acid (α-LA) offer antioxidant benefits and may aid fatty acid and glucose metabolism, potentially benefiting PCOS. Bioflavonoids, plant-derived polyphenolic compounds, have been inversely associated with metabolic syndrome in PCOS. A pilot study with 36 mg/day of the soy isoflavone genistein for 6 months improved lipid profiles but not other PCOS parameters. Carnitine, particularly L-carnitine, is often lower in PCOS and linked to hyperandrogenism, hyperinsulinaemia and reduced oocyte quality. One RCT showed L-carnitine's positive effects on mental health and oxidative stress markers, though results should be interpreted cautiously. α-LA, in a small pre-post study (n = 6), improved IR, LDL-C and TAG. Another RCT (n = 46) reported improvements in BMI, metabolic markers and menstrual cyclicity with α-LA (600 mg/day for 180 days), though this was combined with D-chiro-inositol, complicating the attribution of effects solely to α-LA.

Minerals

Minerals such as calcium, zinc, selenium, magnesium and chromium picolinate (CrP) are investigated for their insulin-sensitising, antioxidant and anti-inflammatory properties in PCOS. Women with PCOS may be at higher risk of deficiencies in calcium, zinc and selenium.[3] A systematic review (six RCTs) found that Vitamin D and calcium co-supplementation improved lipid and androgen profiles, follicular health and menstrual cyclicity, though it is challenging to isolate calcium's effects due to its frequent co-supplementation with Vitamin D.[3] Zinc supplementation (often combined with other nutrients) improved IR, lipids, testosterone, follicle stimulating hormone and dehydroepiandrosterone sulphate according to another systematic review.[3,37,38] Selenium supplementation

showed reduced IR, oxidative stress and inflammation but with inconsistent results for anthropometry, lipids and androgens. Magnesium supplementation was associated with reduced IR in observational studies, but RCTs have shown inconsistencies. Two meta-analyses of CrP reported reduced BMI, FINS and free testosterone in one study, while another reported decreased IR but increased testosterone levels.[39]

CONCLUSION

This review, adopting a holistic view of health, has identified emerging research areas that should be considered for future lifestyle management strategies in PCOS. Integrating evidence not only from the diet, physical activity and behavioural interventions but also from psychological support, sleep management and TCIM approaches can enhance patient-centred care. By providing women with a broader range of options, clinicians can support greater autonomy and individualised treatment plans. This approach is consistent with the core goals of the 2018 PCOS guidelines, which emphasize understanding the unmet needs of women with PCOS and actively involving them in the co-design of guidelines, implementation and dissemination.

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Authors' contributions

MS: primarily responsible for conceptualizing the review topic, conducting literature searches, and drafting the manuscript; AP: Contributed significantly by synthesizing the data, designing figures/tables, and providing critical revisions to the manuscript.

Both authors have read and approved the final manuscript and agree to be accountable for all aspects of the work.

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Institutional Review Board approval is not required.

Declaration of patient consent

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