Content available at: https://www.ipinnovative.com/open-access-journals

IP Journal of Nutrition, Metabolism and Health Science

Journal homepage: https://www.jnmhs.com/

Review Article

Polycystic ovary syndrome increases risks of infertility: Role of a well-planned diet and other factors

Swapan Banerjee[1]*

[1]*Dept. of Nutrition, Seacom Skills University, Birbhum, West Bengal, India*

ARTICLE INFO

Article history:
Received 14-02-2024
Accepted 22-03-2024
Available online 01-05-2024

Keywords:
PCOS
Polycystic ovary syndrome
PCOS diet
Infertility
Stress
hyperandrogenism
Anovulation

ABSTRACT

Polycystic ovary syndrome (PCOS) is a hormonal disorder causing menstrual irregularities, insulin resistance, and infertility. Treatment options include medical treatments and lifestyle modifications. The guideline suggests various balanced strategies, including diet, exercise, behavioral interventions, and sleep. This article aimed to review the multiple diets, nutrients, and other factors responsible for PCOS-induced infertility, which is growing nowadays. The primary motive to recover PCOS is to reduce the risk of infertility among women. PCOS treatment involves birth control pills, diabetes medication, and estrogen receptor modulators. Lifestyle changes like resistance training and yoga can improve body composition and reduce fat. Traditional lifestyles, such as alcohol and tobacco, can hinder fertility. Weight loss improves PCOS status regardless of dietary composition. Low glycemic index diets reduce weight gain, improve insulin sensitivity, and reduce risk factors. The DASH diet, rich in fruits, vegetables, whole grains, nuts, legumes, and low-fat dairy, is recommended for managing PCOS. In conclusion, PCOS should be taken care of for young women with the help of diet, exercise, and medication, if needed, to avoid infertility under the supervision of a dietitian and physician.

This is an Open Access (OA) journal, and articles are distributed under the terms of the Creative Commons AttribFution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprint@ipinnovative.com

1. Introduction

Polycystic ovary syndrome (PCOS) is a hormonal disorder characterized by polycystic ovaries, hyperandrogenism, and anovulation. It can lead to menstrual irregularities, insulin resistance, metabolic, psychological, maternal, fetal, and neonatal complications, and infertility. So, PCOS is a prevalent endocrine disorder in women, leading to anovulatory infertility. Treatment options include medical treatments alone or in combination with lifestyle modifications based on diet and exercise.[1–4] PCOS is characterized by excess androgen, leading to adipose tissue deposition, insulin resistance, hyperinsulinemia, and ovary secretion. This cyclical interaction, combined with hypothalamic-pituitary dysfunction, can cause further ovarian dysfunction, potentially causing anovulation and infertility.[5,6] Ovulation disorders, particularly polycystic ovary syndrome (PCOS), account for around 25% of infertility cases, with PCOS accounting for 70%. Other associated endocrine and metabolic traits include obesity, acne, hirsutism, dyslipidemia, hyperinsulinism, type 2 diabetes, cardiovascular disease, miscarriage, and gestational diabetes.[7] The 2018 PCOS guideline acknowledges that specific dietary approaches don't provide better health outcomes. It suggests a range of balanced strategies based on lifestyle needs and preferences. A systematic review found minimal differences in anthropometric outcomes, concluding that weight loss improves PCOS presentation regardless of dietary composition. Emerging evidence suggests that a range of dietary strategies may produce beneficial effects on various syndromes due to polycystic ovaries. Research

* *Corresponding author*.
E-mail address: sbanerjee.researcher.21@gmail.com (S. Banerjee).

https://doi.org/10.18231/j.ijnmhs.2024.001
2582-6301/© 2024 Author(s), Published by Innovative Publication.

shows future lifestyle management in PCOS, focusing on diet, exercises, behavioral interventions, psychological, and sleep, empowering women with more treatment options.[8]

2. Literature Review

This review article was studied using a search of open-access literature using medical subject heading words (MeSH) as keywords. These were the "PCOS," "infertility," "PCOS diet," "PCOS prevention, "infertility prevention," and "Various diets." The articles were published and are accessible online, like the Directory of Open Access Journals, PubMed, Google Scholar, Semantic Scholar, etc., between the years 2010 and 2024, considered for inclusion for review purposes.

The study first demonstrated research based on the current and trending preventive approaches.Table 1 shows the two international studies and two Indian studies that discussed the various existing preventive approaches usually used in modern medicine. The study groups were PCOS women who had a higher fertility ratio and were more likely to experience infertility, with 72% reporting infertility. Fertility hormone treatment use was higher in these women, with oligo-hypomenorrhea being the chief complaint. Indian practitioners usually advise oral contraceptive pills (OCP) and other protocol drugs for symptom management.[1,5]

2.1. Role of medicines

The primary choice for PCOS treatment is birth control pills (OCP) that regulate menstrual cycles, lower androgen levels, and reduce acne. At the same time, diabetes medication helps lower insulin resistance in PCOS, reduce androgen levels, slow hair growth, and improve regular ovulation. Clomiphene citrate is a selective estrogen receptor modulator used for ovulation induction in women with PCOS. It blocks estrogen receptors, increasing GnRH pulse amplitude and follicle-stimulating hormone (FSH) production.[12] Letrozole, an aromatase inhibitor (selective non-steroidal), suppresses androgen-to-estrogen conversion, enhancing ovulatory rates by increasing pituitary secretion and follicular sensitivity to FSH.[13] A study reviewed the literature on food and drug interactions over twenty years, highlighting the potential adverse effects of common foods and prescribed medications for the medication of lifestyle disorders. The study emphasized the importance of selecting appropriate foods and medications to avoid health hazards and complications due to adverse reactions. In the case of interactions with food with discussed drugs, grapefruit juices, high-fat dairy food, and alcohol should be avoided.[14]

2.2. Exercises and activities

A study reported that resistance training improves body composition and strength and reduces body fat, weight circumference, and lean mass. This is crucial for weight loss interventions in PCOS, as women with more significant reductions in central fat show better symptom improvement. Resistance training may also improve androgen levels, but more research is needed. There is insufficient evidence to assess the effects of exercise type on reproductive function. 15 Many studies have already shown that obesity, hypothyroidism, dyslipidemia, hirsutism, acne, etc., are often correlated with PCOS.[7,9–11] A study showed that yoga intervention reduced obesity from 54.7% to 51.3% and reduced mild/moderate hypothyroidism to subclinical stage 7.4% in women's communities, with diet and yoga combined providing significant benefits. However, yoga also can help directly or indirectly to PCOS patients.[15]

2.3. Behavioral modifications and addictions

Behavioral changes and overcoming addictions to alcohol and tobacco are needed to improve the sustainability of lifestyle changes, especially for women with PCOS. However, most research on lifestyle change in PCOS focuses on short-term dietary interventions with or without exercise, although there needs to be more research on behavioral change strategies. Randomized control trials experimented with 'behavioral interventions,' showing the benefits of weight loss and improved androgen and lipid profiles.[16] A study also reported that traditional lifestyle strategies, including alcohol and cigarette use, are challenging for enhancing fertility and reproductive outcomes in women with PCOS, as well as evaluating CVD and thromboembolism risk associated with oral contraceptives.[17]

2.4. Psychological aspects

The PCOS guideline emphasizes the importance of awareness, assessment, and management of quality of life, depression, anxiety, psychosexual dysfunction, negative body image, and disordered eating. If negative body image, disordered eating, or eating disorders are suspected, a stepped approach for screening is recommended.[18] Cognitive behavioral interventions, such as counseling, cognitive behavioral therapy (CBT), and mindfulness meditation, can improve engagement and adherence to a healthy lifestyle in women with PCOS. Mindfulness meditation has been shown to reduce stress and enhance psychological well-being, but only a few studies investigated its use.[17–19]

2.5. Role of major nutrients

A study showed that weight loss improves PCOS status regardless of dietary composition. Emerging evidence suggests that various nutritional strategies may produce favorable effects on PCOS features independent of weight loss. The study focussed on modifying carbohydrates,

Table 1: Various studies on existing preventive measures for PCOS-induced infertility

Authors and year [7,9–11]	**Study group**	**Design and Interventions**	**Observation and Results**
Rees at el.,2016	Nine thousand six hundred sixty-eight women with PCOS vs. control group.	Compared fertility ratios, miscarriage rates, pre-eclampsia, gestational diabetes, premature delivery, delivery method, and neonatal outcomes.	Women with PCOS revealed a standardized fertility ratio of 1.16 post-index date. Factors such as miscarriage, pre-eclampsia, GDM, and premature delivery increased, with 28% of births by cesarean section.
Joham et al.,2015	Nine thousand one hundred forty-five respondents aged 28-33 years, among eight thousand six hundred twelve women with known PCOS.	The Australian Longitudinal Study on Women's Health focuses on self-reported PCOS status, BMI, infertility, and its therapy. Logistic regression was used to examine factors associated with infertility and its treatments.	PCOS prevalence was 6%, with 72% of women reporting infertility. Infertility was found to be 15-fold higher in PCOS women, independent of BMI. Fertility hormone treatment use was higher in PCOS women.
Mirdha et al.,2023	A rural tertiary care center recruited ninety-six PCOS women.	Medical management using Clomiphene citrate, metformin, and letrozole, focusing on morphological features, menstrual patterns, hormonal profile, and successful ovulation induction and conception outcomes.	The study found that oligo-hypomenorrhea was the chief complaint, with a high LH/FSH ratio, and that letrozole treatment had the highest successful ovulation rate.
Shah and. Patil.,2018;	Based on Indian endocrinologists, gynecologists, reproductive endocrinologists, dermatologists, public health experts, and researchers.	The study analyzed published literature, clinical practice guidelines, and medical specialty societies from 2003 to 2017 to suggest recommendations on oral contraceptive pills and polycystic ovarian syndrome.	The consensus statement advises Indian practitioners on the use of Oral Contraceptive Pills in women with PCOS, highlighting their role in symptom management and recommending new formulations to minimize side effects and indications.

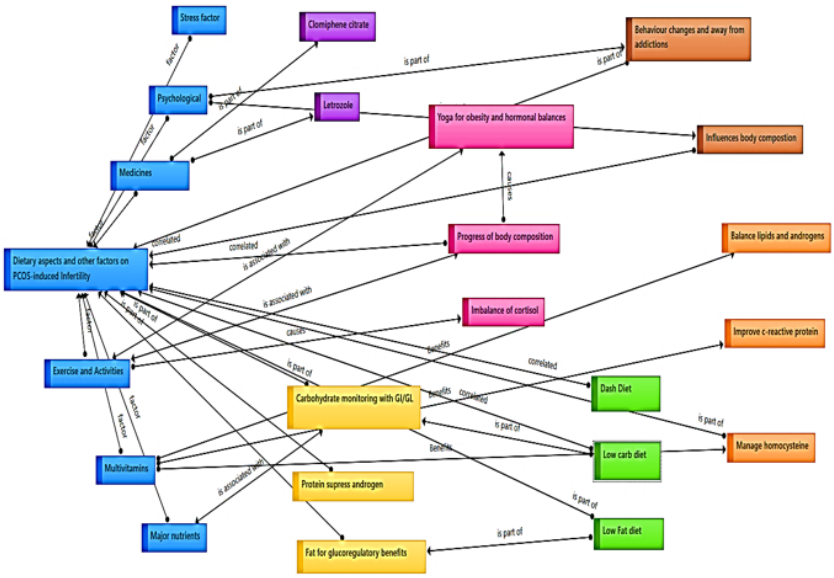

Figure 1: Diet and other factors responsible for PCOS-induced infertility

protein, and fat in a diet plan for PCOS patients.[8,20] Altering carbohydrate composition is the most researched dietary approach for PCOS management. Studies showed that a low glycemic index (GI)/glycemic load (GL) diet for at least eight weeks significantly reduces weight gain and body mass index (BMI) compared to a high GI/GL or a regular diet. This reduction was due to decreased hunger, which reduced energy intake and made it easier to follow dietary recommendations. Low GI/GL diets also improved insulin sensitivity, reproductive hormones, and risk factors for type 2 diabetes and cardiovascular disease.[8,21,22] High protein intakes may be more effective in suppressing androgen levels in women with PCOS than high carbohydrate diets. Research on postprandial glucose reported that high-protein meals reduce insulin and dehydroepiandrosterone stimulation compared to glucose-rich meals. Research in the general population also indicated that increased protein intakes are related to reduced appetite and energy intakes from low GI/GL diets. High protein diets can reduce weight, BMI, WC, weight-height ratio (WHR), and fat mass, improve mental health outcomes and reduce depression.[23–25] Fatty acid composition addressed metabolic disorders associated with polyunsaturated fatty acids (PUFA) and MUFA intakes. Studies have shown that high-fat consumption can lead to prolonged reductions in testosterone, proatherogenic inflammatory markers, and oxidative stress, worsening insulin resistance and androgens. However, studies have found no significant difference in glucoregulatory status, lipids, or androgens between walnut and almond diets. With its higher fatty acid composition. Reduced carbohydrate intake may have more glucoregulatory benefits than increased MUFA intake.[26–29]

2.6. Role of micronutrients

B-group vitamins, folic acid, and vitamins D, E, and K are crucial for metabolic and reproductive features of PCOS. B vitamins regulate homocysteine, an amino acid linked to CVD risk, in women with PCOS. Folic acid alone has been shown to improve C-reactive protein, total antioxidant capacity, and glutathione. Vitamin D supplementation has shown improvements in lipid profiles and androgens. Vitamin E has been shown to improve fertility outcomes in other populations, but no RCTs have examined its use in PCOS.[30–33]

2.7. Diet planning

Dietary patterns have been explored in managing PCOS, with the Dietary Approaches to Stop Hypertension (DASH) diet being the optimal choice for reducing insulin resistance (IR). This diet is rich in fruits, vegetables, whole grains, nuts, legumes, and low-fat dairy, with a predominantly low-GI carbohydrate profile. It has been found to benefit weight, BMI, IR, and hormonal profile. Vegetarian, vegan, and pulse-based diets are high in fiber and plant proteins, which promote microbial diversity and short-chain fatty acids. The benefits of plant-based dietary patterns in PCOS may be related to increased intakes of dietary prebiotics. Eating smaller but more frequent meals, healthy breakfasts, and balanced dinners benefits insulin sensitivity and androgen reduction.[34–36]

2.8. Stress factor

Stress is one of the major responsible factors for PCOS-induced infertility. A study investigated the link between stress among women entrepreneurs and metabolic health issues caused by hormonal imbalances. Stress can be related to metabolic syndrome but does not always cause hormonal imbalances; patients should follow proper diet and exercise instead.[37] A study found that PCOS patients increased salivary cortisol levels, α-amylase activity, higher amylase activity, higher pulse rate, BMI, visceral adiposity, and waist-hip ratio compared to controls, suggesting a strong link between stress markers and body composition changes.[38]

3. Conclusions

Polycystic ovary syndrome is a hormonal disorder causing menstrual irregularities, insulin resistance, and infertility. Chronic issues of PCOS may increase the risk of infertility. Treatment options include medical treatments and lifestyle modifications. Balanced strategies, including diet, exercise, behavioral interventions, and sleep, are significant preventive approaches, while medicine is not supposed to be the first choice. PCOS treatment usually involves birth control pills, diabetes medication, and estrogen receptor modulators. Exercises like resistance training and yoga can improve body composition by reducing fat and balancing hormonal levels among PCOS patients. Lifestyle changes, including a low glycemic index diet, can improve fertility and reproductive outcomes. Vitamins like B-group vitamins are crucial for metabolic and reproductive features. Diet planning, such as the DASH diet or low carbohydrate cum low-fat diet, is recommended for reducing insulin resistance and managing PCOS. Stress is also linked to PCOS-induced infertility in women. Overall, PCOS should be taken care of for young women with the help of diet, exercise, and medication to avoid infertility.

4. Source of Funding

None.

5. Conflict of Interest

None.

References

1. Zhuang S, Jing C, Yu L, Liu JL, Hu W. The relationship between polycystic ovary syndrome and infertility: a bibliometric analysis. *Ann Transl Med*. 2022;10(6):318.
2. Mccartney CR, Marshall JC. Polycystic Ovary Syndrome. *N Engl J Med*. 2016;375(1):54–64.
3. Lizneva D, Suturina L, Walker W, Brakta S, Jordan LG, Azziz R. Criteria, prevalence, and phenotypes of polycystic ovary syndrome. *Fertil Steril*. 2016;106(1):6–15.
4. Hanson B, Johnstone E, Dorais J, Silver B, Peterson CM, Hotaling J. Female infertility, infertility-associated diagnoses, and comorbidities: a review. *J Assist Reprod Genet*. 2017;34(2):167–77.
5. Cunha A, Póvoa AM. Infertility management in women with polycystic ovary syndrome: a review. *Porto Biomed J*. 2021;6(1):116. doi:10.1097/j.pbj.0000000000000116.
6. Escobar-Morreale HF. Polycystic ovary syndrome: definition, aetiology, diagnosis and treatment. *Nat Rev Endocrinol*. 2018;14(5):270–84.
7. Rees DA, Jones SJ, Morgan CL. Contemporary Reproductive Outcomes for Patients With Polycystic Ovary Syndrome: A Retrospective Observational Study. *J Clin Endocrinol Metab*. 2016;101(4):1664–72.
8. Cowan S, Lim S, Alycia C, Pirotta S, Thomson R, Gibson-Helm M, et al. Lifestyle management in polycystic ovary syndrome - beyond diet and physical activity. *BMC Endocrine Dis*. 2023;23(1):14. doi:10.1186/s12902-022-01208-y.
9. Joham AE, Teede HJ, Ranasinha S, Zoungas S, Boyle J. Prevalence of infertility and use of fertility treatment in women with polycystic ovary syndrome: data from a large community-based cohort study. *J Womens Health (Larchmt)*. 2015;24(4):299–307.
10. Mirdha R, Patidar M, Mahadik K. Study of Polycystic Ovarian Syndrome in Infertile Women in a Rural Hospital in Central India, Prospective Design. *J Surg*. 2023;8:1798.
11. Shah D. Patil M; National PCOS Working Group Consensus statement on the use of oral contraceptive pills in polycystic ovarian syndrome women in India. *J Hum Reprod Sci*. 2018;11:96–118.
12. Homburg R. Clomiphene citrate–end of an era? A mini-review. *Hum Reprod*. 2005;20(8):2043–51.
13. Tanbo T, Mellembakken J, Bjercke S, Ring E, Åbyholm T, Fedorcsak P. Ovulation induction in polycystic ovary syndrome. *Acta Obstet Gynecol Scand*. 2018;97(10):1162–7.
14. Banerjee S. Interactions between common foods and drugs - a narrative review. *Asian J Pharm Res*. 2020;10(3):188–94.
15. Banerjee S. Study on Yoga Intervention along with Diet on Hypothyroidism Associated with Obesity among Sedentary Working Women in West Bengal. 2019;8:18–23.
16. Geier L, Bekx M, Connor E. Factors contributing to initial weight loss among adolescents with polycystic ovary syndrome. *J Pediatr Adolesc Gynecol*. 2012;25(6):367–70.
17. Teede HJ, Misso ML, Costello MF, Dokras A, Laven J, Moran L. Recommendations from the international evidence-based guideline for the assessment and management of polycystic ovary syndrome. *Hum Reprod*. 2018;33(9):1602–20.
18. Banerjee S, Kumar S, Begum R, Das S, Sharma P. A case study on the assessment of perception towards body image and nutritional status among girl students studying in a district college in West Bengal. *Res J Top Cosmet Sci*. 2021;13(2):67–78.
19. Roessler KK, Glintborg D, Ravn P, Birkebaek C, Andersen M. Supportive relationships-psychological effects of group counselling in women with polycystic ovary syndrome (PCOS). *Commun Med*. 2012;9(2):125–31.
20. Moran LJ, Tassone EC, Boyle J, Brennan L, Harrison CL, Hirschberg AL. Evidence summaries and recommendations from the international evidence-based guideline for the assessment and management of polycystic ovary syndrome: Lifestyle management. *Obes Rev*. 2020;21(10):13046. doi:10.1111/obr.13046.
21. Zhang X, Zheng Y, Guo Y, Lai Z. The Effect of Low Carbohydrate Diet on Polycystic Ovary Syndrome: A Meta-Analysis of Randomized Controlled Trials. *Int J Endocrinol*. 2019;p. 4386401.
22. Kazemi M, Mcbreairty LE, Zello GA, Pierson RA, Gordon JJ, Serrao SB. A pulse-based diet and the Therapeutic Lifestyle Changes diet in combination with health counseling and exercise improve health-related quality of life in women with polycystic ovary syndrome: secondary analysis of a randomized controlled trial. *J Psychosom Obstet Gynecol*. 2020;41(2):144–53.
23. Kasim-Karakas SE, Cunningham WM, Tsodikov A. Relation of nutrients and hormones in polycystic ovary syndrome. *Am J Clin Nutr*. 2007;85(3):688–94.
24. Mehrabani HH, Salehpour S, Amiri Z, Farahani SJ, Meyer BJ, Tahbaz F. Beneficial effects of a high-protein, low-glycemic-load hypocaloric diet in overweight and obese women with polycystic ovary syndrome: a randomized controlled intervention study. *J Am Coll Nutr*. 2012;31(2):117–42.
25. Sorensen LB, Soe M, Halkier KH, Stigsby B, Astrup A. Effects of increased dietary protein-to-carbohydrate ratios in women with polycystic ovary syndrome. *Am J Clin Nutr*. 2012;95(1):39–48.
26. Ebrahimi-Mamaghani M, Saghafi-Asl M, Pirouzpanah S, Jafarabadi A. Effects of raw red onion consumption on metabolic features in overweight or obese women with polycystic ovary syndrome: A randomized controlled clinical trial. *J Obstet Gynaecol Res*. 2014;40(4):1067–76.
27. González F, Considine RV, Abdelhadi OA, Xue J, Acton AJ. Saturated fat ingestion stimulates proatherogenic inflammation in polycystic ovary syndrome. *Am J Physiol Endocrinol Metab*. 2021;321(5):689–701.
28. Wong JM, Gallagher M, Gooding H, Feldman HA, Gordon CM, Ludwig DS. A randomized pilot study of dietary treatments for polycystic ovary syndrome in adolescents. *Pediatr Obes*. 2016;11(3):210–30.
29. Yahay M, Heidari Z, Allameh Z, Amani R. The effects of canola and olive oils consumption compared to sunflower oil, on lipid profile and hepatic steatosis in women with polycystic ovarian syndrome: a randomized controlled trial. *Lipids Health Dis*. 2021;20(1):1–12.
30. Asbaghi O, Ghanavati M, Larky DA, Bagheri R, Kelishadi R, Nazarian M. Effects of Folic Acid Supplementation on Oxidative Stress Markers: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Antioxidants (Basel)*. 2021;10:1–6.
31. Bahmani F, Karamali M, Shakeri H, Asemi Z. The effects of folate supplementation on inflammatory factors and biomarkers of oxidative stress in overweight and obese women with polycystic ovary syndrome: a randomized, double-blind, placebo-controlled clinical trial. *Clin Endocrinol*. 2014;81(4):582–9.
32. Miao CY, Fang XJ, Chen Y, Zhang Q. Effect of vitamin D supplementation on polycystic ovary syndrome: A meta-analysis. *Exp Ther Med*. 2020;19(4):2641–50.
33. Izadi A, Ebrahimi S, Shirazi S, Taghizadeh S, Parizad M, Farzadi L. Hormonal and Metabolic Effects of Coenzyme Q10 and/or Vitamin E in Patients With Polycystic Ovary Syndrome. *J Clin Endocrinol Metab*. 2019;104(2):319–46.
34. Ganie MA, Sahar T, Rashid A, Wani IA, Nisar S, Sathyapalan T. Comparative Evaluation of Biomarkers of Inflammation Among Indian Women With Polycystic Ovary Syndrome (PCOS) Consuming Vegetarian vs. Non-vegetarian Diet. *Front Endocrinol (Lausanne)*;10:699. doi:10.3389/fendo.2019.00699.
35. Kazemi M, Mcbreairty LE, Zello GA, Pierson RA, Gordon JJ, Serrao SB. A pulse-based diet and the Therapeutic Lifestyle Changes diet in combination with health counseling and exercise improve health-related quality of life in women with polycystic ovary syndrome: secondary analysis of a randomized controlled trial. *J Psychosom Obstet Gynecol*. 2020;41(2):144–53.
36. Giampaolino P, Foreste V, Filippo D, Gallo C, Mercorio A, Serafino A. Microbiome and PCOS: state-of-art and future aspects. *Int J Mol Sci*. 2021;22(4):2048.
37. Banerjee S, Bera P. A study on the relationship between stress-associated lifestyles disorders and essential preventive therapy among women entrepreneurs. *Panacea J Me Sdci*. 2023;13(2):269–76.

38. Basu BR, Chowdhury O, Saha SK. Possible Link Between Stress-related Factors and Altered Body Composition in Women with Polycystic Ovarian Syndrome. *J Hum Reprod Sci*. 2018;11(1):10–8.

Cite this article: Banerjee S. Polycystic ovary syndrome increases risks of infertility: Role of a well-planned diet and other factors. *IP J Nutr Metab Health Sci* 2024;7(1):1-6.

Author biography

Swapan Banerjee, Research Scholar https://orcid.org/0000-0001-5781-5436