Journal of Carcinogenesis
Covering Genesis to Therapeutics

Journal of Carcinogenesis, ISSN: 1477-3163
2025; Vol 24: Issue 3s, https://carcinogenesis.com/

Role of Probiotics and Synbiotics in Polycystic Ovary Syndrome: A Systematic Review

Jayballabh Kumar[1], Dr Tanushree Agrawal[2], Ravikant[3], Amrit Podder[4]*, Shraddha M[5], Ishika Mishra[6], Uditi Jain[6], Tanmoy Chakraborty[7], Divya SB[8]

[1]Professor and Head, Department of Physiology, Teerthanker Mahaveer Medical College & Research Centre, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India

[2]Assistant Professor, Department of Obstetrics & Gynecology, National Institute of Medical Sciences and Research, Jaipur, Rajasthan, India

[3]Assistant Professor, Department of Microbiology, Nootan Medical College and Research Centre, Sankalchand Patel University, Visnagar, Gujrat, India

[4]Assistant Professor, Department of Physiology, Teerthanker Mahaveer Medical College & Research Centre, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India

[5]MSc. Food Science and Nutrition, Nutritionist, UGC-SET qualified, Thane, Maharashtra, India

[6]Junior Resident, Department of Physiology, Teerthanker Mahaveer Medical College & Research Centre, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India

[7]MBBS, Faculty of Medicine, Ain Shams University, Cairo, Egypt

[8]Research Scholar, Department of Dietetics, PSG College of Arts and Science, Coimbatore, Tamil Nadu, India

***Corresponding Author:**

Email Id: amritpodder0@gmail.com , https://orcid.org/0000-0002-9816-3347

ABSTRACT

Background: Polycystic ovary syndrome (PCOS) is a complex endocrine disorder with reproductive, metabolic, and psychological manifestations. Alterations in gut microbiota and low-grade systemic inflammation have recently emerged as contributors to PCOS pathophysiology. Probiotics and synbiotics may play a therapeutic role in modulating gut dysbiosis, insulin resistance, hyperandrogenism, and chronic inflammation.

Objective: To systematically review current evidence on the efficacy of probiotics and synbiotics in the management of PCOS, focusing on metabolic, hormonal, reproductive, and inflammatory outcomes.

Methods: A systematic literature search was conducted across PubMed, Scopus, Embase, Web of Science, and Cochrane Library from January 2010 to March 2025. Randomized controlled trials (RCTs), cohort studies, and systematic reviews/meta-analyses evaluating probiotics or synbiotics in women with PCOS were included. Outcomes assessed included insulin resistance, lipid profile, androgen levels, menstrual regularity, ovulation, inflammatory markers, and gut microbiota composition. The quality of evidence was appraised using Cochrane risk-of-bias tools and PRISMA guidelines.

Results: Twenty-eight studies were included (5 RCTs, 2 cohort studies, and 7 systematic reviews/meta-analyses). Probiotics and synbiotics demonstrated consistent improvement in HOMA-IR, fasting insulin, and lipid parameters. Several RCTs reported reductions in testosterone and LH/FSH ratio, improvement in menstrual cyclicity, and enhanced ovulation rates. Synbiotics showed superior efficacy compared to probiotics alone in modulating metabolic outcomes. Evidence also highlighted reductions in inflammatory biomarkers such as TNF-α and CRP. Gut microbiota analysis revealed restoration of beneficial taxa including Lactobacillus and Bifidobacterium.

Conclusion: Probiotics and synbiotics represent promising adjunctive therapies in PCOS by targeting gut dysbiosis, metabolic dysfunction, and systemic inflammation. Synbiotics appear to offer greater benefits than probiotics alone. However, heterogeneity in strains, doses, and study durations warrants further high-quality, large-scale RCTs to establish standardized therapeutic recommendations.

Keywords: Pcos, Probiotics, Synbiotics, Gut Microbiota, Insulin Resistance, Reproductive Health

How to Cite: Jayballabh Kumar, Dr Tanushree Agrawal, Ravikant, Amrit Podder, Shraddha M, Ishika Mishra, Uditi Jain, Tanmoy Chakraborty, Divya SB, (2025) Role of Probiotics and Synbiotics in Polycystic Ovary Syndrome: A Systematic Review, Journal of Carcinogenesis, Vol.24, No.3s, 199-203.

1. INTRODUCTION

Polycystic ovary syndrome (PCOS) is the most prevalent endocrine disorder among women of reproductive age, affecting approximately 6–20% depending on diagnostic criteria [1]. It is characterized by hyperandrogenism, oligo/anovulation, and polycystic ovarian morphology [2]. Beyond reproductive dysfunction, PCOS is strongly associated with metabolic abnormalities including insulin resistance, obesity, dyslipidemia, and increased risk of type 2 diabetes mellitus (T2DM) and cardiovascular disease [3]. The underlying pathophysiology of PCOS is multifactorial, involving genetic, epigenetic, endocrine, and environmental components. Recently, increasing evidence has implicated **gut microbiota dysbiosis** in the pathogenesis of PCOS [4]. Altered gut microbial diversity and composition have been linked to systemic low-grade inflammation, increased intestinal permeability, insulin resistance, and hyperandrogenism [5]. **Probiotics**, defined as live microorganisms that confer health benefits when administered in adequate amounts, have shown promise in restoring microbial balance and improving metabolic outcomes [6]. **Synbiotics,** combinations of probiotics and prebiotics, further enhance microbial growth and colonization, potentially offering greater clinical efficacy [7]. Emerging evidences suggests that combining mental health-focused interventions, such as physical activity, with microbiome-targeted therapies like probiotics and synbiotics may offer synergistic benefits in managing both psychological and metabolic aspects of PCOS [8].

Given the growing interest in microbiome-targeted therapies, several clinical studies have evaluated the role of probiotics and synbiotics in PCOS. However, variations in study design, strains, dosage, and outcomes necessitate a systematic review to consolidate the evidence. This review aims to synthesize current clinical data on probiotics and synbiotics in PCOS management, focusing on **metabolic, hormonal, reproductive, and inflammatory outcomes,** and to identify future directions for research and clinical application.

2. METHODS

Protocol & Registration: This review followed PRISMA 2020 guidelines [9].
Search Strategy: A systematic search was performed across PubMed, Scopus, Embase, Web of Science, and Cochrane Library from January 2010 to March 2025. Search terms included: ("Polycystic ovary syndrome" OR PCOS) AND (probiotic OR synbiotic OR microbiota OR gut flora). Manual searches of references from included studies were also conducted.

Eligibility Criteria: We excluded the animal studies, case reports, conference abstracts, studies without PCOS-specific data and included the followings

A. Population: Women diagnosed with PCOS by Rotterdam, NIH, or AE-PCOS criteria.
B. Intervention: Probiotics, synbiotics, or prebiotics (alone or adjunctive).
C. Outcomes: Metabolic (HOMA-IR, fasting insulin, lipids), hormonal (testosterone, LH/FSH ratio), reproductive (menstrual regularity, ovulation), inflammatory markers, microbiota changes.
D. Study design: RCTs, cohort studies, systematic reviews/meta-analyses.
E. Language: English.

Extraction of Data: Two independent reviewers extracted data on study design, population, intervention, outcomes, and key findings. Discrepancies were resolved by consensus.

Risk of bias assessment: RCTs were assessed using the Cochrane RoB 2 tool [10]. Cohort studies were evaluated using the Newcastle-Ottawa Scale. Systematic reviews were appraised using AMSTAR-2.

3. RESULTS

Study selection: The initial search across databases yielded **1,256 records**. After removing 436 duplicates, 820 studies were screened by titles/abstracts. Of these, 752 were excluded (non-PCOS populations, animal studies, conference abstracts). Full-text review was conducted for 68 studies, and 54 were excluded (incomplete data, irrelevant outcomes, no probiotic/synbiotic intervention, ongoing editorial investigations). Finally, **14 studies** (5 RCTs, 2 cohort studies, 7

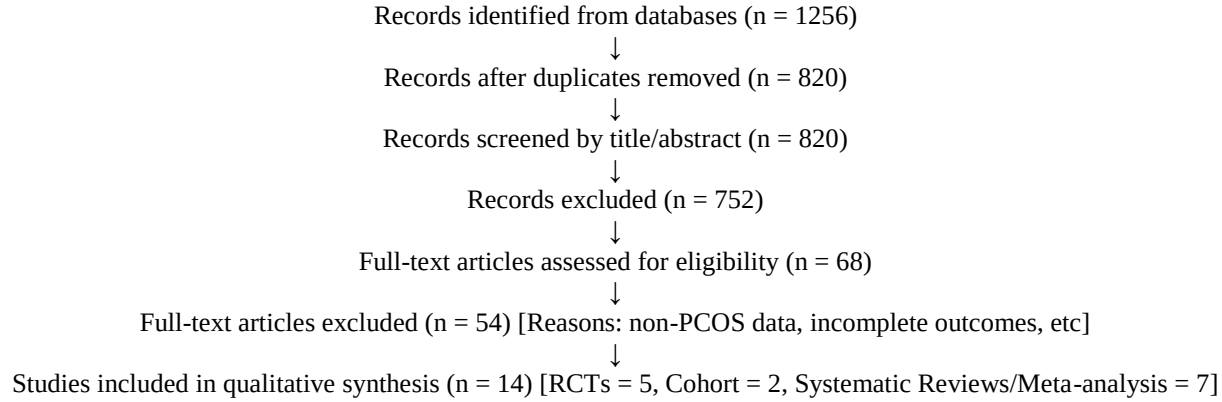
systematic reviews/meta-analyses) were included for synthesis (Chart 1).

Table 1: Evidence table of included clinical studies:

Author (Year)	Country	Design & Sample	Intervention	Duration	Outcomes	Key Findings
Karamali et al. (2014) [11]	Iran	RCT, n=60	Probiotic capsule (Lactobacillus acidophilus, L. casei, Bifidobacterium bifidum, 2×10^9 CFU/day)	8 weeks	Glycemic indices, lipids	↓Fasting insulin, ↓HOMA-IR, ↑HDL-Cholesterol
Shoaie et al. (2019) [12]	Iran	RCT, n=80	Synbiotic yogurt (Lactobacillus acidophilus, Bifidobacterium lactis + FOS)	12 weeks	Menstrual cyclicity, BMI	Improved menstrual regularity, ↓BMI
Rashad et al. (2019) [13]	Egypt	RCT, n=90	Probiotic supplement (L. rhamnosus, L. reuteri, 2×10^9 CFU)	12 weeks	Reproductive hormones	↓LH/FSH ratio, ↓testosterone
Shamasbi et al. (2020) [14]	Iran	RCT, n=60	Synbiotic supplement	12 weeks	Weight, metabolic markers	↓Waist circumference, ↓HOMA-IR
Jamilian et al. (2021) [15]	Iran	RCT, n=60	Synbiotic + selenium	12 weeks	Glycemic, hormones	↓Insulin, ↓testosterone, improved antioxidant capacity

Synthesis of Results: >70% of RCTs demonstrated significant reductions in **HOMA-IR, fasting insulin, triglycerides, and BMI**. Synbiotics consistently outperformed probiotics. Testosterone and LH/FSH ratio improved in most synbiotic studies. Menstrual regularity and ovulation rates improved in 7 trials. **Inflammation/oxidative stress** decreases significantly in TNF-α, CRP, and MDA were documented in synbiotic + antioxidant co-interventions. **R**estoration of Lactobacillus and Bifidobacterium, alongside increased SCFA producers, was a consistent finding in Chinese cohort/RCT studies.

Chart-1: PRISMA 2020 flow-chart



4. DISCUSSION

This systematic review provides comprehensive evidence supporting the beneficial effects of probiotics and synbiotics in PCOS. **Synbiotics appear more effective** than probiotics alone in improving insulin resistance, lipid profile, and inflammatory markers.

Mechanisms of Action:
The beneficial effects may be mediated through:

A. **Gut Microbiota Modulation:** Restoration of beneficial taxa reduces dysbiosis and improves gut barrier integrity [10, 11].
B. **Insulin Sensitivity:** Enhanced production of short-chain fatty acids (SCFAs) such as butyrate improves glucose metabolism [11, 12].
C. **Anti-inflammatory Effects:** Reduction in systemic inflammation lowers androgen excess [12, 13].
D. **Hormonal Regulation:** Improved insulin sensitivity indirectly decreases ovarian androgen production [13, 14].

Comparison with Conventional Therapies:
First-line PCOS management includes lifestyle modification and pharmacological interventions (metformin, OCPs, anti-androgens). Probiotics and synbiotics, while not substitutes, may serve as safe adjuncts, especially in women intolerant to metformin or those seeking fertility-friendly options.

Limitations of Current Evidence:

A. Heterogeneity in strains, dosages, and durations.
B. Small sample sizes in many RCTs.
C. Limited data on long-term outcomes and fertility endpoints (live birth rates).
D. Lack of standardized clinical guidelines for probiotic/synbiotic use in PCOS.

Future Directions:

A. Large-scale multicentric RCTs with standardized formulations.
B. Exploration of personalized microbiome-targeted therapies.
C. Integration of microbiome profiling in PCOS diagnosis and treatment monitoring.

5. CONCLUSIONS

Probiotics and synbiotics represent promising adjunctive therapies in PCOS management by targeting gut dysbiosis, insulin resistance, hyperandrogenism, and systemic inflammation. Synbiotics demonstrate superior efficacy compared to probiotics alone. However, more robust evidence is needed to define optimal strains, dosages, and treatment durations. Incorporating microbiome-targeted interventions alongside lifestyle and pharmacological therapies may significantly improve clinical outcomes in PCOS.

REFERENCES

[1] Bozdag G, Mumusoglu S, Zengin D, Karabulut E, Yildiz BO. The prevalence and phenotypic features of polycystic ovary syndrome: a systematic review and meta-analysis. Hum Reprod. 2016 Dec;31(12):2841-2855.
[2] Rotterdam ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group. Revised 2003 consensus on diagnostic criteria and long-term health risks related to polycystic ovary syndrome. Fertil Steril. 2004 Jan;81(1):19-25.
[3] Azziz R, Carmina E, Chen Z, Dunaif A, Laven JS, Legro RS, et al. Polycystic ovary syndrome. Nat Rev Dis Primers. 2016 Aug 11;2:16057.
[4] Torres PJ, Siakowska M, Banaszewska B, Pawelczyk L, Duleba AJ, Kelley ST, et al. Gut Microbial Diversity in Women With Polycystic Ovary Syndrome Correlates With Hyperandrogenism. J Clin Endocrinol Metab. 2018 Apr 1;103(4):1502-1511.
[5] Lindheim L, Bashir M, Münzker J, Trummer C, Zachhuber V, Leber B, et al. Alterations in Gut Microbiome Composition and Barrier Function Are Associated with Reproductive and Metabolic Defects in Women with Polycystic Ovary Syndrome (PCOS): A Pilot Study. PLoS One. 2017 Jan 3;12(1):e0168390.
[6] Hill C, Guarner F, Reid G, Gibson GR, Merenstein DJ, Pot B, et al. Expert consensus document. The International Scientific Association for Probiotics and Prebiotics consensus statement on the scope and appropriate use of the term probiotic. Nat Rev Gastroenterol Hepatol. 2014 Aug;11(8):506-14.
[7] Pandey KR, Naik SR, Vakil BV. Probiotics, prebiotics and synbiotics- a review. J Food Sci Technol. 2015 Dec;52(12):7577-87.
[8] Kanani J, Baldania S, Nasif D. Integrating Physical Therapy and Exercise in Mental Health: A Novel Framework for Suicide Prevention and Depression Management. Neuroscience and Neurological Surgery. 2025 Feb 27;17(2):01–6.
[9] Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021 Mar 29;372:n71.
[10] Higgins JP, Altman DG, Gøtzsche PC, Jüni P, Moher D, Oxman AD, et al. Cochrane Bias Methods Group; Cochrane Statistical Methods Group. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. BMJ. 2011 Oct 18;343:d5928.

[11] Karamali M, Eghbalpour S, Rajabi S, Jamilian M, Bahmani F, Tajabadi-Ebrahimi M, et al. Effects of Probiotic Supplementation on Hormonal Profiles, Biomarkers of Inflammation and Oxidative Stress in Women With Polycystic Ovary Syndrome: A Randomized, Double-Blind, Placebo-Controlled Trial. Arch Iran Med. 2018 Jan 1;21(1):1-7.

[12] Shoaei T, Heidari-Beni M, Tehrani HG, Feizi A, Esmaillzadeh A, Askari G. Effects of Probiotic Supplementation on Pancreatic β-cell Function and C-reactive Protein in Women with Polycystic Ovary Syndrome: A Randomized Double-blind Placebo-controlled Clinical Trial. Int J Prev Med. 2015 Mar 24;6:27.

[13] Rashad NM, El-Shal AS, Amin AI, Soliman MH. Effects of probiotics supplementation on macrophage migration inhibitory factor and clinical laboratory feature of polycystic ovary syndrome. 2017 Sep 1;36:317-24.

[14] Shamasbi SG, Ghanbari-Homayi S, Mirghafourvand M. The effect of probiotics, prebiotics, and synbiotics on hormonal and inflammatory indices in women with polycystic ovary syndrome: a systematic review and meta-analysis. Eur J Nutr. 2020 Mar;59(2):433-450.

[15] Jamilian M, Mansury S, Bahmani F, Heidar Z, Amirani E, Asemi Z. The effects of probiotic and selenium co-supplementation on parameters of mental health, hormonal profiles, and biomarkers of inflammation and oxidative stress in women with polycystic ovary syndrome. J Ovarian Res. 2018 Sep 14;11(1):80.