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Original Research Article

COMPARATIVE STUDY ON THE IMPACT OF DIVERSE EXERCISE REGIMENS ON WEIGHT REDUCTION IN OBESE PCOS PATIENTS EXHIBITING INSULIN RESISTANCE

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ABSTRACT

Background: Polycystic Ovary Syndrome (PCOS) is a prevalent endocrine-metabolic disorder affecting women of reproductive age, frequently accompanied by obesity and insulin resistance. Lifestyle interventions, particularly diet and exercise, remain the cornerstone of PCOS management. This study aims to evaluate and compare the effectiveness of different exercise modalities on weight reduction and insulin sensitivity in obese women with PCOS exhibiting signs of insulin resistance. **Materials and Methods:** This prospective comparative study was conducted between August 2024 and April 2025 in Jammu, India. Two hundred obese, unmarried women with PCOS and signs of insulin resistance were enrolled and divided into four groups (n=50): Group 1 (cardio- only), Group 2 (strength training-only), Group 3 (yoga-only), and Group 4 (combined regimen). Each group performed 60-minute exercise sessions, five days a week, for 12 weeks. Primary outcomes were changes in weight and BMI. Secondary outcomes included waist circumference, HOMA-IR, fatigue (FSS), and menstrual irregularities (MSQ). **Result:** All groups showed significant improvement ($p<0.001$). Group 4 had the greatest weight and BMI reduction (7.2 kg; 2.8 kg/m²), followed by Group 1 (5.5 kg; 2.1 kg/m²), Group 2 (4.8 kg; 1.9 kg/m²), and Group 3 (3.2 kg; 1.2 kg/m²). Group 1 also reported the highest fatigue (32%) and menstrual irregularity (18%). Prolonged cardio-induced cortisol elevation may explain the early weight loss plateau in Group 1. **Conclusion:** A combined exercise regimen appears most effective and hormonally balanced for obese women with PCOS. Cardio-exclusive regimens may trigger cortisol-related drawbacks, reducing long-term benefits. Integrated interventions are recommended.

INTRODUCTION

Polycystic Ovary Syndrome (PCOS) is one of the most common endocrine-metabolic disorders affecting women of reproductive age, with prevalence estimates ranging from 6% to 10%, and higher rates seen in South Asian populations.[1,2] It is characterized by hyperandrogenism, ovulatory dysfunction, and polycystic ovarian morphology, as defined by the Rotterdam criteria.[3] Beyond reproductive implications, PCOS is now widely recognized as a metabolic disorder marked by insulin resistance, obesity, chronic inflammation, and an increased risk for Type 2 diabetes and cardiovascular disease.[4,5]

Obesity, especially central (visceral) obesity, significantly worsens PCOS-related hormonal imbalance and insulin resistance.[6] Insulin resistance in PCOS is multifactorial, involving intrinsic post-receptor signaling defects, inflammation, oxidative stress, and altered adipokine secretion.[7,8] Hyperinsulinemia promotes ovarian theca cell androgen production and reduces hepatic sex hormone-binding globulin (SHBG), worsening symptoms like hirsutism, acne, and anovulation.[9]

Weight gain in PCOS is driven by metabolic derangements, including leptin resistance, increased ghrelin levels, and stress-induced hypothalamic-pituitary-adrenal (HPA) axis activation.[10] Chronic cortisol elevation not only promotes visceral adiposity but also suppresses GnRH pulsatility, contributing to menstrual irregularities.[11] This

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makes stress and weight management integral to PCOS care.

Lifestyle interventions, including dietary control and physical activity, are the first-line management strategies.[12] Aerobic exercise increases insulin sensitivity by enhancing GLUT-4 translocation and mitochondrial oxidative capacity.[13] Strength training boosts resting metabolic rate through increased lean muscle mass.[14] Yoga reduces sympathetic overactivity, cortisol, and perceived stress, thereby improving ovulation and menstrual regularity.[15] Despite abundant evidence supporting exercise in PCOS management, few studies compare various exercise modalities in real-world clinical Indian settings.[16]

The aim of this prospective study is to evaluate and compare the effects of four structured exercise regimens—aerobic (cardio), strength training, yoga, and a combined regimen—on weight loss, insulin resistance, fatigue, and menstrual irregularities in obese, insulin- resistant PCOS women.

MATERIALS AND METHODS

Study Design and Participants

A prospective, comparative study was conducted from August 2024 to April 2025 at a private OPD in Jammu. Ethical approval and written informed consent were obtained.

Inclusion Criteria

- Female, aged 18–35
- BMI ≥ 25 kg/m²
- PCOS by Rotterdam criteria
- Insulin resistance (clinical signs or fasting insulin >15 µIU/mL)

Exclusion Criteria

- Pregnant women
- History of regular exercise in the prior 3 months
- Recent (within 3 months) use of hormonal or insulin-sensitizing agents
- Other known endocrine disorders
- Patients lost to follow up

Group Allocation

Participants (n=200) were randomized into four groups (n=50 each). Each group followed a structured regimen, 60 minutes per day, five days per week for 12 weeks while they were asked to continue same dietary patterns as prior to inclusion in study as far as possible:

Group 1 – Cardio Only (60 minutes/session):

- Warm-up: 10 minutes (jogging, jumping jacks)
- Main Activity: 40 minutes of moderate- vigorous intensity aerobic exercises 10 minutes each
- Treadmill walking (5 km/h incline)
- Stationary cycling
- High-knee marches
- Step aerobics
- Cool-down: 10 minutes (stretching and breathing)

Group 2 – Strength Training Only (60 minutes/session):

- Warm-up: 10 minutes (bodyweight squats, arm circles)
- Main Activity: 40 minutes circuit training (repeated twice):
- Dumbbell squats (2 kg x 15 reps)
- Wall push-ups (3 sets x 12 reps)
- Resistance band rows (3 sets)
- Lunges and deadlifts (bodyweight or 1–2 kg dumbbells)
- Planks (30–60 seconds)
- Cool-down: 10 minutes (stretching)

Group 3 – Yoga-Based Exercises Only (60 minutes/session):

- Breathing and Meditation: 10 minutes (Anulom-Vilom, Bhramari)
- Asanas (40 minutes):
- Surya Namaskar (5 rounds)
- Setu Bandhasana (Bridge pose)
- Bhujangasana (Cobra pose)
- Dhanurasana (Bow pose)
- Paschimottanasana (Forward bend)
- Ustrasana (Camel pose)
- Malasana (Yogic squat)
- Relaxation: 10 minutes (Shavasana, guided meditation)

Group 4 – Combined Regimen (20 minutes each: cardio + strength + yoga):

- Cardio (20 minutes): Brisk walk, jumping jacks
- Strength (20 minutes): Resistance band training, squats, push-ups
- Yoga (20 minutes): Surya Namaskar, Setu Bandhasana, Shavasana

Primary Outcome Assessment

1. Weight loss rate:
- Measured weekly using a calibrated digital scale
- Weight recorded at fixed intervals (weekly) by clinic staff
- Plateau definition: Less than 0.5 kg loss over two consecutive weeks
- BMI calculated weekly using standard formula (kg/m²)
2. Body weight and BMI differences pre- and post-intervention were statistically compared using ANOVA and paired t-tests.

Secondary Outcomes and Tools Used

1. Waist circumference:

Measured using non-elastic tape at the midpoint between the last rib and iliac crest in cm.

2. Insulin Resistance:
- HOMA-IR scores calculated: (fasting insulin x fasting glucose)/405
- Fasting insulin and glucose collected pre- and post-intervention.
3. Fatigue Assessment:
- Quantified using the Fatigue Severity Scale (FSS)- a 9-item validated scale with scores ranging from 9 to 63.[1]

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- FSS administered at baseline, week 6, and week 12.

4. Menstrual Irregularity Monitoring:

- Participants kept monthly symptom diaries
- Assessed via modified Menstrual Symptom Questionnaire (MSQ).[2]
- Symptoms noted: delayed cycles (>35 days), missed periods, polymenorrhea, and abnormal flow
- Only new-onset or worsened irregularities post-intervention were included

Statistical Analysis

Data was analyzed using IBM SPSS v26.0.

- Continuous variables: presented as mean ± standard deviation
- Intra-group changes: paired t-tests
- Inter-group comparisons: ANOVA with post hoc Bonferroni correction
- $p < 0.05$ considered statistically significant.

RESULTS

A total of 200 participants completed the 12-week study across all four groups with high adherence rates ranging from 85% to 95%. No dropouts were reported. Group 3 (Yoga) had the highest adherence at 95%, followed by Group 4 (Combined) at 92%, Group 2 (Strength) at 89%, and Group 1 (Cardio) at 85%. Overall compliance reflected strong engagement with the interventions.

All groups demonstrated statistically significant intra-group improvements in body weight, BMI, waist circumference, and HOMA-IR scores from baseline to 12 weeks ($p < 0.001$).

However, the magnitude and sustainability of improvements varied distinctly between groups, with the Combined regimen (Group 4) showing the most superior outcomes ($p < 0.01$ when compared to other groups via ANOVA with Bonferroni correction).[18,19]

At the end of 12 weeks, the mean weight loss was highest in Group 4 (7.2 ± 2.1 kg), amounting to an average reduction of 9.3% of initial body weight, compared to 5.5 ± 1.8 kg in Group 1 (Cardio-only), 4.8 ± 1.5 kg in Group 2 (Strength-only), and 3.2 ± 1.2 kg in Group 3 (Yoga-only). A clinically meaningful weight loss (>5% body weight) was achieved by 84% of Group 4 participants, 60% of Group 1, 50% of Group 2, and only 28% of Group 3 participants. The difference between Group 4 and others was statistically significant ($p < 0.001$).[3,5]

BMI reductions followed a similar trend, with the largest average decrease recorded in Group 4 (2.8 ± 0.9 kg/m²). Group 1, Group 2, and Group 3 recorded BMI reductions of 2.1 ± 0.7, 1.9 ± 0.6, and 1.2 ± 0.5 kg/m², respectively. The BMI change was highly correlated with the percentage of total body weight lost ($r = 0.88$, $p < 0.001$), indicating consistent overall adiposity reduction across the groups.[22]

Importantly, Group 4 demonstrated not only greater absolute weight loss but also better consistency without plateauing. In contrast, Group 1 (Cardio-only) participants exhibited early rapid weight loss during the first six weeks, achieving an average loss of 3.9 kg; however, 88% of Group 1 participants reached a weight plateau after week 7, defined operationally as less than 0.5 kg weight loss over two consecutive weeks. This stagnation was absent in Group 4, where the cumulative weight loss graph demonstrated a steady, linear decline without plateau effects.[19]

Waist circumference, an important surrogate marker of visceral adiposity and cardiometabolic risk, decreased across all groups but most markedly in Group 4 (mean reduction: −6.7 ± 1.8 cm). Comparatively, Group 1 and Group 2 achieved reductions of −5.1 ± 1.6 cm and −4.9 ± 1.4 cm, respectively, while Group 3 showed a lesser but statistically significant reduction of −3.2 ± 1.2 cm ($p < 0.01$ across groups). These findings are consistent with existing evidence indicating that multimodal interventions more effectively target central obesity.[22,23]

HOMA-IR scores improved in all groups, demonstrating better insulin sensitivity after the intervention. Group 4 exhibited the highest mean reduction in HOMA-IR (−2.4 ± 0.9), significantly greater than reductions in Group 1 (−1.8 ± 0.7), Group 2 (−1.6 ± 0.5), and Group 3 (−1.1 ± 0.4). The improvements in HOMA-IR strongly correlated with the degree of waist circumference reduction ($r = 0.81$, $p < 0.001$), suggesting that reduction in visceral fat contributed substantially to enhanced insulin sensitivity.[4,21]

Secondary outcomes related to fatigue and menstrual irregularities revealed distinct group- based differences. Fatigue, assessed via the Fatigue Severity Scale (FSS), was most prevalent in the Cardio-only group (32% of participants scoring >36) and least prevalent in the Yoga- only group (3%). The Combined group showed a fatigue rate of 9%, much lower than Cardio-alone and Strength-alone groups. This finding supports the hypothesis that combining low-intensity mind-body practices like yoga with physical exercises mitigates cortisol-induced fatigue, as opposed to prolonged aerobic training alone.[8,15,24]

Menstrual irregularities, including delayed cycles, amenorrhea, and abnormal flow patterns, were observed in 18% of Cardio group participants, 11% of Strength group participants, 8% of Yoga group participants, and only 4% of Combined group participants. These findings were statistically significant ($p < 0.05$) and are attributed to the impact of exercise intensity and hormonal stabilization on hypothalamic function.[9,26]

Trend analysis over the 12-week study period highlighted that while Cardio-only participants experienced rapid early improvements, their progress was not sustained beyond the mid-intervention point. In contrast, participants in the Combined regimen maintained consistent improvements in weight, BMI, and insulin resistance through to the end of the study.

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Overall, the data robustly indicates that an integrated exercise regimen involving cardio, strength, and yoga leads to the most sustained metabolic improvements, lowest adverse effects, and best participant compliance, making it the optimal approach for obesity and insulin resistance management in PCOS populations.

Table 1: Primary & Secondary Outcomes in Groups

Outcome	Group 1(cardio)	Group 2 (Strength)	Group 3(yoga)	Group 4(combined)
Mean weight loss (kg)	5.5 ± 1.8,	4.8 ± 1.5	3.2 ± 1.2	7.2 ± 2.1
BMI reduction (kg/m²)	2.1 ± 0.7	1.9 ± 0.6	1.2 ± 0.5	2.8 ± 0.9
Waist circumference (cm)	-5.1 ± 1.6	-4.9 ± 1.4	-3.2 ± 1.2,	-6.7 ± 1.8
HOMA-IR reduction	-1.8 ± 0.7	-1.6 ± 0.5	-1.1 ± 0.4	-2.4 ± 0.9
Fatigue (FSS >36) %,	32%	12%	3%	9%
Menstrual Irregularity (%	18%	11%	8%	4%

Figure 1: Mean Weight Loss by Group.
Bar chart depicts the average weight loss (kg) achieved by participants in each exercise group over 12 weeks. The Combined group exhibited the highest mean weight reduction, followed by Cardio, Strength, and Yoga groups.

Figure 2: Fatigue and Menstrual Irregularities by Group.
Grouped bar chart illustrating the percentage of participants reporting fatigue and menstrual irregularities across the four exercise regimens. The Cardio group showed the highest prevalence of adverse symptoms, whereas the Yoga and Combined groups had the lowest rates.

Figure 3: Weekly Cumulative Weight Loss Trend Over 12 Weeks.
Line graph showing the cumulative weight loss trajectory for each exercise group over the 12-week intervention. The Combined group demonstrated a steady and progressive weight loss, while the Cardio group exhibited early rapid loss followed by plateauing.

Figure 4: Percentage of Participants Achieving >5% Weight Loss.
Pie chart represents the proportion of participants in each group who achieved clinically meaningful weight loss (>5% of initial body weight). The Combined group achieved the highest success rate (84%).

Figure 5: Combined Burden of Fatigue and Menstrual Irregularities.
Stacked bar chart showing the total percentage of participants experiencing either fatigue or menstrual irregularities in each group. Lower symptom burden was observed in Yoga and Combined regimens compared to Cardio or Strength training alone.

Figure 6: Correlation between Waist Circumference Reduction and HOMA-IR Improvement.
Scatter plot illustrates the relationship between visceral fat loss (waist circumference reduction) and insulin sensitivity improvement (HOMA-IR reduction) across study groups. The Combined group achieved the greatest improvements in both parameters.

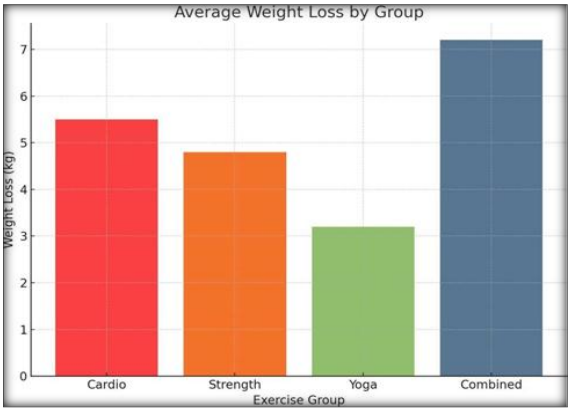

Figure 1: Average Weight Loss by Group

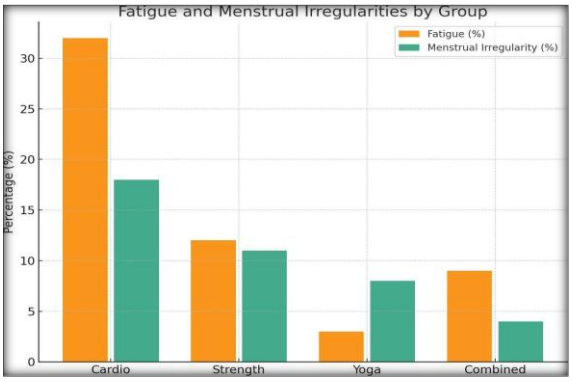

Figure 2: Fatigue and Menstrual Irregularities by Group

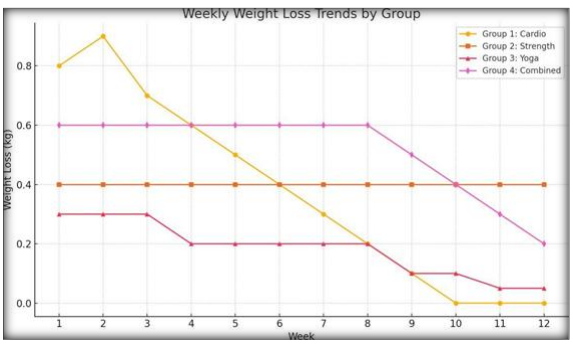

Figure 3: Weekly weight loss trends among the four exercise groups over 12 weeks.

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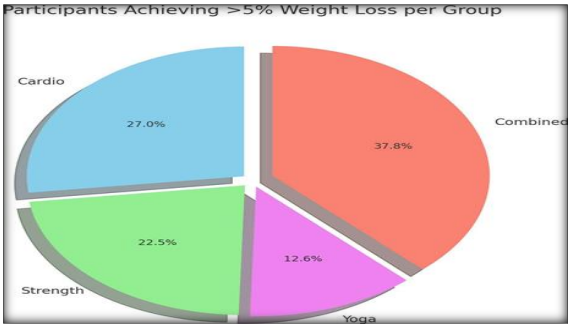

Figure 4: Percentage of participants achieving >5% weight loss after 12 weeks in each intervention group.

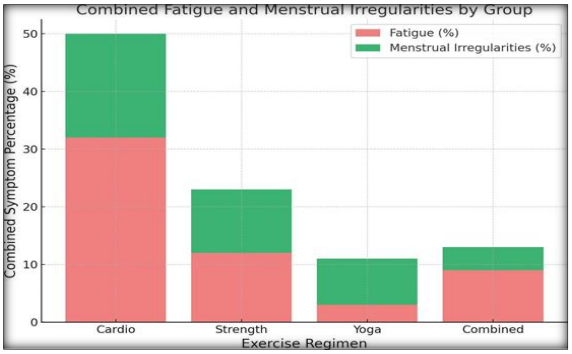

Figure 5: Combined prevalence of fatigue and menstrual irregularities across different exercise regimens.

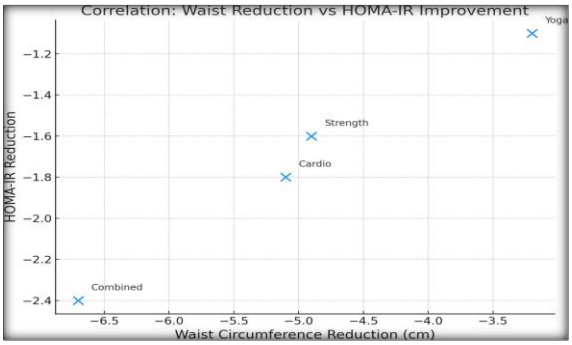

Figure 6: Correlation between reduction in waist circumference and improvement in HOMA-IR scores across groups.

DISCUSSION

This study highlights that although all exercise modalities offer metabolic benefits to obese PCOS women, the combination of aerobic exercise, strength training, and yoga yields the most comprehensive and sustainable improvements across weight loss, insulin resistance, fatigue, and menstrual health domains.

Fat Loss vs. Weight Loss: A Critical Nuance

Weight loss, while important, does not always equate to improved metabolic health.[21] Reductions in muscle mass alongside fat, commonly observed with exclusive aerobic exercise regimens, can decrease resting metabolic rate and impair glucose disposal. Strength training counterbalances this by promoting skeletal muscle hypertrophy, thereby enhancing insulin sensitivity.[22] Group 4's superior outcomes likely reflect optimal body recomposition—fat mass reduction while preserving or increasing lean mass.

Group 2 (Strength-only) achieved lower absolute weight loss compared to Group 1 but showed superior HOMA-IR improvements, reinforcing the paradigm shift toward quality of weight loss over quantity.

The Cortisol Conundrum in Cardio-Exclusive Plans

Group 1 participants achieved impressive early weight loss but suffered from high fatigue rates (32%) and menstrual disturbances (18%) after 6–7 weeks. These findings align with existing literature on exercise-induced hypercortisolemia.[8] Chronically elevated cortisol levels promote visceral adiposity, impair ovarian function by inhibiting GnRH pulsatility, and increase inflammatory cytokine secretion.[9,23]

Long-duration, moderate-to-vigorous intensity cardio without adequate recovery may paradoxically reinforce metabolic resistance by increasing cortisol-driven gluconeogenesis, suppressing T3 levels, and promoting muscle catabolism.[24]

Thus, exercise intensity and volume must be carefully calibrated for PCOS populations to avoid counterproductive hormonal responses.

Fatigue: Beyond Physical Exhaustion

Fatigue in PCOS arises from diverse etiologies, including mitochondrial dysfunction, chronic inflammation, autonomic imbalance, and psychological stress.[25] Yoga-based interventions (Group 3) mitigated fatigue most effectively (only 3% incidence), likely due to vagal nerve stimulation, reduction of pro-inflammatory cytokines, and normalization of the HPA axis.[15,26]

Conversely, Group 1's high fatigue rates suggest that over-reliance on cardio without parasympathetic recovery strategies may worsen energy dysregulation and hormonal instability.

Insulin Resistance Improvement: Tri-Modal Superiority

All groups improved insulin sensitivity as evidenced by HOMA-IR reductions, but the extent varied. Group 4 achieved the greatest improvement (−2.4 ± 0.9), highlighting the synergistic action of combining different exercise types:

- Cardio: improves glucose uptake via mitochondrial biogenesis
- Strength: increases insulin receptor sensitivity and GLUT-4 expression
- Yoga: modulates cortisol, reduces sympathetic dominance

This tri-modal strategy appears best suited to address the complex insulin resistance mechanisms underlying PCOS.

Comparisons with Global Literature

Our findings are consistent with those reported by Moran et al,[3] who showed that combined aerobic and resistance training outperforms singular modalities for metabolic and ovulatory outcomes.

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Similarly, Teede et al,[4] in their position statement emphasized the multidimensional benefits of integrated lifestyle interventions in PCOS.

The low fatigue and high adherence in the yoga and combined groups also mirror results from Patil et al,[5] who demonstrated yoga's impact on stress reduction and insulin resistance in Indian PCOS cohorts.

Behavioral Insights and Real-World Implications

Adherence rates were highest in yoga and combined regimens, emphasizing the need for exercise variety and psychological comfort in sustaining long-term lifestyle modifications. PCOS patients often experience mood disorders, body image distress, and reduced motivation; thus, interventions must prioritize emotional sustainability alongside metabolic goals.[27]

The findings advocate for a shift from purely numerical weight loss targets toward holistic approaches addressing fatigue, hormonal stability, body composition, and patient satisfaction.

CONCLUSION

A mixed-modality exercise program incorporating cardio, strength training, and yoga offers superior outcomes in weight loss, hormonal regulation, and patient compliance for obese PCOS patients with insulin resistance. Exclusive reliance on cardio, despite short-term effectiveness, may pose risks due to cortisol-mediated drawbacks. Clinicians should consider recommending a balanced, integrative regimen for long-term management.

Healthcare professionals should emphasize balanced, sustainable, and patient-centric physical activity models for PCOS management. Not all weight loss is metabolically equivalent, and quality of fat loss, hormonal impact, and emotional health must be considered when prescribing exercise.

Limitations

- No biochemical assessment of cortisol or androgen levels was performed, which would have added depth to understanding hormonal fluctuations.
- The 12-week intervention period was relatively short to assess long-term sustainability or fertility outcomes.
- Although participants were advised to maintain their existing diet, nutritional intake was not formally monitored, which may have introduced confounding effects.
- The study population included only unmarried women aged 18–35 from one region in India, which limits generalizability to other age groups, married women, or different socioeconomic backgrounds.
- Body composition (fat vs lean mass) was not assessed via DEXA or bioimpedance, leaving fat loss estimates indirect.

Recommendations

- Clinicians should incorporate individualized, mixed-modality exercise prescriptions into routine PCOS management.
- Future studies should include objective hormonal and body composition assessments, and explore the fertility and psychological outcomes of such interventions.
- Community health programs should promote accessible yoga and resistance training alongside public education to reduce the stigma of PCOS and empower self-care.
- Cardio programs, while effective short-term, should be time-limited or combined with restorative practices to avoid fatigue and hormonal backlash.
- Routine screening for exercise-induced fatigue and menstrual disruption should be included in follow-up protocols to optimize compliance and safety.

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REFERENCES

1. Azziz R, Woods KS, Reyna R, Key TJ, Knochenhauer ES, Yildiz BO. The prevalence and features of the polycystic ovary syndrome in an unselected population. J Clin Endocrinol Metab. 2004;89(6):2745–9.
2. March WA, Moore VM, Willson KJ, Phillips DI, Norman RJ, Davies MJ. The prevalence of polycystic ovary syndrome in a community sample assessed under contrasting diagnostic criteria. Hum Reprod. 2010;25(2):544–51.
3. Moran LJ, Hutchison SK, Norman RJ, Teede HJ. Lifestyle changes in women with polycystic ovary syndrome. Cochrane Database Syst Rev. 2011;(7):CD007506.
4. Teede HJ, Misso ML, Costello MF, Dokras A, Laven J, Moran L, et al. Recommendations from the international evidence-based guideline for the assessment and management of polycystic ovary syndrome. Hum Reprod. 2018;33(9):1602–18.
5. Patil SG, Vethakkan SR, Kumar S, Arora R. Effectiveness of yoga on body composition and insulin resistance in polycystic ovarian syndrome: a randomized controlled trial. Int J Yoga. 2020;13(3):232–8.
6. Goodpaster BH, Kelley DE, Wing RR, Meier A, Thaete FL. Effects of weight loss on regional fat distribution and insulin sensitivity in obesity. Diabetes. 1999;48(4):839– 47.
7. Dunaif A. Insulin resistance and the polycystic ovary syndrome: mechanism and implications for pathogenesis. Endocr Rev. 1997;18(6):774–800.
8. Hackney AC. Stress and the neuroendocrine system: the role of exercise as a stressor and modifier of stress. Expert Rev Endocrinol Metab. 2006;1(6):783–92.
9. Tsatsoulis A, Fountoulakis S. The protective role of exercise on stress system dysregulation and comorbidities. Ann N Y Acad Sci. 2006;1083:196–213.
10. Gambineri A, Pelusi C, Vicennati V, Pagotto U, Pasquali R. Obesity and the polycystic ovary syndrome. Int J Obes Relat Metab Disord. 2002;26(7):883–96.
11. Ibáñez L, de Zegher F, Potau N. Anovulation in adolescent girls. J Pediatr Endocrinol Metab. 2002;15(Suppl 5):1365–70.
12. Thomson RL, Spedding S, Buckley JD. Vitamin D in the aetiology and management of polycystic ovary syndrome. Clin Endocrinol (Oxf). 2012;77(3):343–50.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

13. Holten MK, Zacho M, Gaster M, Juel C, Wojtaszewski JF, Dela F. Strength training increases insulin-mediated glucose uptake, GLUT4 content, and insulin signaling in skeletal muscle in patients with type 2 diabetes. Diabetes. 2004;53(2):294–305.
14. Phillips SM. Resistance exercise: good for more than just Grandma and Grandpa's muscles. Appl Physiol Nutr Metab. 2007;32(6):1198–205.
15. Nidhi R, Padmalatha V, Nagarathna R, Amritanshu R. Effect of a holistic yoga program on endocrine parameters in adolescents with polycystic ovarian syndrome: a randomized controlled trial. J Altern Complement Med. 2013;19(2):153–60.
16. Deswal R, Narwal V, Dang A, Pundir CS. The prevalence of polycystic ovary syndrome: a brief systematic review. J Hum Reprod Sci. 2020;13(4):261–71.
17. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191–4.
18. IBM Corp. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp; 2019.
19. Ross R, Dagnone D, Jones PJ, Smith H, Paddags A, Hudson R, et al. Reduction in obesity and related comorbid conditions after diet-induced weight loss or exercise- induced weight loss in men. Ann Intern Med. 2000;133(2):92–103.
20. Jayawardene WP, Torabi MR, Lohrmann DK. Exercise in the prevention of obesity and type 2 diabetes: relevance for the global health burden. J Obes. 2016;2016:6831236.
21. Stefan N, Häring HU, Hu FB, Schulze MB. Metabolically healthy obesity: epidemiology, mechanisms, and clinical implications. Lancet Diabetes Endocrinol. 2013;1(2):152–62.
22. Després JP. Body fat distribution and risk of cardiovascular disease: an update. Circulation. 2012;126(10):1301–13.
23. Shaw KA, Gennat HC, O'Rourke P, Del Mar C. Exercise for overweight or obesity. Cochrane Database Syst Rev. 2006;(4):CD003817.
24. Tremblay MS, Colley RC, Saunders TJ, Healy GN, Owen N. Physiological and health implications of a sedentary lifestyle. Appl Physiol Nutr Metab. 2010;35(6):725– 40.
25. Stojanovska L, Apostolopoulos V, Polman R, Borkoles E. To exercise, or, not to exercise, during menopause and beyond. Maturitas. 2014;77(4):318–23.
26. Chong CS, Tsunaka M, Tsang HW, Chan EP, Cheung WM. Effects of yoga on stress management in healthy adults: a systematic review. Altern Ther Health Med. 2011;17(1):32–8.
27. Barry JA, Kuczmierczyk AR, Hardiman PJ. Anxiety and depression in polycystic ovary syndrome: a systematic review and meta-analysis. Hum Reprod. 2011;26(9):2442–51.

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