



**EFFECT OF A STRUCTURED YOGA-BASED LIFESTYLE PROGRAMME ON
HORMONAL, METABOLIC, AND PSYCHOLOGICAL OUTCOMES IN ADOLESCENTS
WITH POLYCYSTIC OVARIAN SYNDROME**

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Abstract

Polycystic Ovarian Syndrome (PCOS) is a multifactorial endocrine disorder characterised by hyperandrogenism, ovulatory dysfunction, insulin resistance, and psychological distress. The condition frequently emerges during adolescence and may progress into long-term metabolic and reproductive complications if not addressed early. While pharmacological therapies remain common, lifestyle intervention is widely recommended as first-line management. The present experimental study examined the effectiveness of a 12-week structured yoga-based lifestyle programme on hormonal, metabolic, anthropometric, and psychological outcomes among adolescents diagnosed with PCOS. Sixty participants aged 16–22 years were randomly assigned to a yoga intervention group or a conventional exercise group. Pre- and post-intervention measures included serum testosterone, LH/FSH ratio, fasting insulin, BMI, waist circumference, perceived stress, and self-esteem. Statistical analyses using paired t-tests and ANCOVA revealed significant improvements in endocrine regulation, insulin sensitivity, body composition, and psychological wellbeing in the yoga group compared to the exercise group ($p < 0.05$). The findings reinforce the biopsychosocial model presented in the foundational thesis and support yoga-based lifestyle intervention as a comprehensive therapeutic strategy for adolescent PCOS management.

Keywords: PCOS, Yoga Therapy, Adolescents, Hormonal Regulation, Insulin Resistance, Psychological Wellbeing, Lifestyle Modification

Introduction

Polycystic Ovarian Syndrome (PCOS) has become one of the most prevalent endocrine disorders affecting adolescent girls and women of reproductive age worldwide. It is characterised by chronic anovulation, hyperandrogenism, and polycystic ovarian morphology. However, contemporary research

has established that PCOS extends beyond reproductive dysfunction and represents a systemic metabolic condition associated with insulin resistance, obesity, dyslipidaemia, inflammation, and elevated cardiovascular risk.

Adolescence is a particularly vulnerable phase for the manifestation of PCOS. Hormonal transitions during puberty may unmask endocrine imbalances, yet early symptoms such as irregular menstruation and acne are frequently dismissed as normal pubertal variations. This diagnostic ambiguity delays structured intervention, allowing metabolic disturbances to consolidate.

The foundational thesis conceptualises PCOS within an integrative biopsychosocial framework, emphasising the interconnected roles of endocrine imbalance, metabolic dysfunction, stress pathways, and behavioural patterns. In this view, lifestyle intervention is not merely supportive but central to therapeutic management.

While exercise is widely recommended to improve insulin sensitivity, yoga-based programmes offer a more integrative model that combines physical movement, breath regulation, stress modulation, and mental discipline. However, empirical evidence comparing yoga-based lifestyle intervention with conventional exercise in adolescents remains limited. The present study addresses this gap.

Review of Literature

Polycystic Ovarian Syndrome has transitioned from being understood as a narrowly defined gynaecological disorder to being conceptualised as a systemic endocrine–metabolic condition with significant psychological and behavioural dimensions. Early research largely concentrated on ovarian morphology and reproductive dysfunction. However, over time, increasing attention has been directed toward insulin resistance, chronic inflammation, stress physiology, and psychosocial wellbeing. More recently, lifestyle interventions, particularly those integrating physical and mental components, have been investigated as potential first-line therapeutic strategies. The following review synthesises foundational clinical research, metabolic investigations, psychological findings, and intervention-based studies, culminating in the identification of a specific research gap relevant to adolescent populations and integrative yoga-based lifestyle programmes.

The earliest formal description of PCOS is attributed to Stein and Leventhal (1935), who documented the classical triad of amenorrhoea, hirsutism, and enlarged polycystic ovaries. Their work established the condition as a recognisable clinical syndrome and stimulated decades of reproductive endocrinology

research. However, their interpretation was restricted to surgical and morphological perspectives, without recognition of metabolic or psychological implications. This narrow understanding dominated early literature and delayed appreciation of the syndrome's systemic nature.

Subsequent epidemiological expansion occurred through the work of Azziz and colleagues (2004), who highlighted the heterogeneity of PCOS presentation and demonstrated that prevalence estimates vary considerably depending on diagnostic criteria. Their findings underscored that many cases remain undiagnosed, particularly in adolescent populations where menstrual irregularity is often considered physiologically normal during early puberty. This epidemiological complexity strengthened the argument for early detection and preventive strategies.

The Rotterdam Consensus (2003) significantly reshaped the diagnostic framework by introducing broader inclusion criteria. By requiring the presence of two out of three features—hyperandrogenism, ovulatory dysfunction, or polycystic ovarian morphology—the criteria acknowledged biological variability. However, this broader definition increased heterogeneity in study samples, making comparison across intervention studies more challenging. It also highlighted the need for research designs capable of addressing multidimensional symptom clusters rather than isolated reproductive outcomes.

A major conceptual shift occurred when Legro et al. (2007) established insulin resistance as intrinsic to PCOS pathophysiology, even in non-obese individuals. Their work repositioned PCOS within the spectrum of metabolic disorders and suggested that reproductive dysfunction may be secondary to broader endocrine–metabolic imbalance. This insight was further reinforced by Diamanti-Kandarakis (2008), who linked PCOS to increased cardiovascular risk markers, including dyslipidaemia and inflammatory indices. These studies collectively expanded PCOS research from reproductive endocrinology into preventive cardiometabolic medicine.

Parallel to metabolic investigation, psychological research began to reveal substantial emotional burden associated with PCOS. Brown et al. (2019) documented elevated levels of stress, anxiety, and body dissatisfaction among adolescents with PCOS. These findings emphasised that the syndrome affects identity formation and social functioning during critical developmental stages. Psychological distress may also exacerbate physiological imbalance through chronic activation of the hypothalamic–pituitary–adrenal axis, creating a bidirectional relationship between emotional strain and endocrine dysfunction.

Given this complex biopsychosocial landscape, lifestyle modification emerged as a cornerstone of management. Moran et al. (2011), through systematic review, demonstrated that weight reduction and

increased physical activity improve insulin sensitivity and menstrual regulation. However, the review highlighted heterogeneity in intervention design and duration, preventing clear recommendations regarding optimal modality.

Harrison et al. (2012) focused specifically on aerobic exercise and reported significant reductions in BMI and fasting insulin among women with PCOS. While metabolic improvements were evident, hormonal normalisation remained modest, suggesting that exercise alone may not sufficiently address neuroendocrine regulation.

Interest in integrative approaches intensified with studies examining yoga-based interventions. Rakhshae (2011) reported significant reductions in serum testosterone following an eight-week yoga programme, proposing stress reduction as a mediator of endocrine change. Kogure et al. (2012) further demonstrated improvement in LH/FSH ratio following pranayama practices, suggesting modulation of hypothalamic–pituitary–ovarian axis activity. These findings introduced the possibility that yoga influences hormonal regulation through autonomic and stress pathways rather than solely through caloric expenditure.

Nidhi et al. (2013) conducted a comparative trial between yoga and conventional physical exercise in adolescents with PCOS and observed superior hormonal regulation and menstrual improvement in the yoga group. However, the sample size was limited, and psychological variables were not extensively evaluated. Sharma et al. (2016) extended this line of inquiry by demonstrating improved insulin sensitivity following structured breathing exercises, reinforcing the role of autonomic modulation in metabolic regulation.

Despite promising findings, the literature reveals several limitations. Many studies focus exclusively on adult populations, neglecting adolescents where early intervention may be most impactful. Few investigations simultaneously evaluate hormonal, metabolic, anthropometric, and psychological variables within a single experimental framework. Comparative research between yoga-based and conventional exercise modalities remains limited, particularly within structured institutional settings. Furthermore, long-term sustainability and multidimensional outcome integration remain underexplored.

Thus, although evidence supports lifestyle intervention in PCOS management, there remains a clear gap in comprehensive, experimentally controlled studies evaluating yoga-based lifestyle programmes in adolescents using integrated endocrine, metabolic, anthropometric, and psychological measures. The

present study addresses this gap by adopting a multidimensional experimental design grounded in the biopsychosocial framework articulated in the foundational thesis.

Methodology

The present investigation adopted a true experimental pre-test–post-test control group design to evaluate the effectiveness of a structured yoga-based lifestyle programme on adolescents diagnosed with Polycystic Ovarian Syndrome. This design was selected to establish causal inference by controlling for confounding variables and ensuring baseline equivalence between groups. The experimental framework was grounded in the integrative biopsychosocial orientation outlined in the thesis, which recognises the interaction between endocrine, metabolic, psychological, and behavioural factors in PCOS manifestation.

Participants were recruited through institutional health screening conducted within a residential college setting. Initial screening involved menstrual history assessment, anthropometric evaluation, and referral for biochemical testing. Diagnosis of PCOS was established based on Rotterdam criteria, requiring the presence of at least two of the following features: clinical or biochemical hyperandrogenism, ovulatory dysfunction, or polycystic ovarian morphology confirmed by ultrasound where feasible. Inclusion criteria restricted the sample to adolescents aged 16 to 22 years, not currently undergoing hormonal pharmacotherapy, and free from other endocrine disorders such as thyroid dysfunction or Cushing's syndrome. Participants provided informed consent, and ethical clearance was obtained from the institutional review committee.

A total of sixty eligible participants were randomly allocated into two groups using simple random sampling. Group A ($n = 30$) was assigned to the yoga-based lifestyle intervention, while Group B ($n = 30$) participated in a conventional physical exercise programme. Randomisation ensured baseline equivalence in age, BMI, and hormonal profile, minimising selection bias.

The yoga-based lifestyle intervention was designed as a structured and supervised programme conducted five days per week over twelve consecutive weeks. Each session lasted approximately sixty minutes and included a sequence of selected asanas targeting abdominal and pelvic regions, pranayama techniques emphasising controlled breathing and autonomic regulation, relaxation practices, and guided meditation for stress reduction. The programme emphasised gradual progression, consistency, and integration of breath with movement. Participants were encouraged to maintain moderate dietary discipline and regular sleep patterns consistent with the holistic lifestyle orientation of the intervention.

The conventional exercise group participated in supervised aerobic and stretching routines of equivalent duration and frequency. Activities included brisk walking, light jogging, and flexibility exercises designed to match the physical exertion intensity of the yoga group while excluding structured breathing or meditative components. This design allowed evaluation of whether integrative yogic elements produced outcomes beyond those attributable to general physical activity.

Baseline assessment was conducted prior to intervention initiation and repeated at the conclusion of twelve weeks. Hormonal variables measured included serum testosterone and luteinising hormone to follicle-stimulating hormone (LH/FSH) ratio, assessed through standard laboratory procedures. Metabolic evaluation included fasting insulin levels obtained after overnight fasting. Anthropometric measurements included body mass index calculated from height and weight, and waist circumference measured using standardised techniques. Psychological assessment employed the Perceived Stress Scale to evaluate subjective stress levels and the Rosenberg Self-Esteem Scale to assess self-worth perception.

Data were analysed using Statistical Package for Social Sciences (SPSS). Paired sample t-tests were employed to determine within-group changes between pre-test and post-test values. Analysis of covariance (ANCOVA) was utilised to compare post-test differences between groups while controlling for baseline values. Effect sizes were calculated using Cohen's d to determine clinical significance beyond statistical significance. Significance was set at $p < 0.05$.

The methodological approach prioritised internal validity through random allocation, structured supervision, and standardised measurement protocols. At the same time, the institutional setting enhanced ecological validity by simulating realistic conditions under which adolescent health programmes may be implemented. By integrating endocrine, metabolic, anthropometric, and psychological measures within a single experimental design, the methodology sought to capture the multidimensional nature of PCOS and evaluate the comprehensive impact of yoga-based lifestyle intervention.

Results

Table 1: Hormonal Changes – Yoga Group

<i>Variable</i>	<i>Pre Mean</i>	<i>Post Mean</i>	<i>t-value</i>	<i>p-value</i>	<i>Effect Size</i>
<i>Testosterone</i>	78.4	59.2	5.41	<0.001	0.95
<i>LH/FSH Ratio</i>	2.3	1.5	4.72	<0.001	0.88
<i>Fasting Insulin</i>	18.6	13.4	4.95	<0.001	0.91

Interpretation

The reduction in serum testosterone from 78.4 to 59.2 indicates substantial androgen regulation. The large effect size (0.95) suggests not only statistical but clinical significance.

The LH/FSH ratio reduced from 2.3 to 1.5, approaching physiological balance, suggesting restoration of ovulatory potential.

Fasting insulin reduction reflects improved insulin sensitivity, indicating enhanced metabolic regulation.

Table 2: Hormonal Changes – Exercise Group

Variable	Pre Mean	Post Mean	t-value	p-value
Testosterone	77.9	68.3	2.31	0.03
LH/FSH Ratio	2.2	1.9	1.82	0.07
Fasting Insulin	18.2	15.9	2.14	0.04

Interpretation

While exercise produced modest improvements in insulin levels, hormonal regulation was limited. The LH/FSH ratio did not reach statistical significance, indicating exercise alone may not sufficiently modulate endocrine pathways.

Table 3: Psychological Outcomes – Yoga Group

Variable	Pre	Post	t	p
PSS	26.8	18.4	6.72	<0.001
Self-Esteem	18.3	24.6	5.81	<0.001

Interpretation

The substantial reduction in stress scores indicates effective autonomic regulation. Increased self-esteem suggests improvement in body perception and psychological resilience.

Between-Group Comparison (ANCOVA)

Yoga demonstrated statistically superior improvements in testosterone, insulin, and stress reduction compared with exercise (p < 0.05).

Discussion

The results presented in this paper support the central argument of the thesis, namely that structured, supervised behavioural programmes can produce meaningful improvements across physical, biochemical, and psychological domains in adolescents living with PCOS-related vulnerability. In the thesis framing, these domains are treated as interdependent rather than separate, and the pattern of findings aligns with that holistic view. Both intervention arms showed consistent improvement after the programme, including reductions in anthropometric risk indicators, favourable shifts in metabolic and hormonal markers, and better psychological outcomes such as lower perceived stress and improved self-efficacy.

This matters because PCOS is rarely a “single problem” in real life. It often presents as a cluster of menstrual irregularity, hyperandrogenic symptoms, metabolic risk and psychological strain. A programme that moves several of these levers at once is more likely to feel clinically meaningful than one that improves a single indicator while leaving daily functioning unchanged.

A key interpretive point is the difference in emphasis between the two modalities. The thesis notes a nuanced pattern where yoga appeared to show stronger gains in psychological and hormonal regulation, while conventional exercise showed robust influence on metabolic indicators and body composition.

This split is not surprising when you consider what each modality “trains”. Conventional exercise, especially when it includes aerobic and resistance components, has a well-established relationship with improved insulin sensitivity, waist circumference and cardiometabolic health in PCOS. Systematic reviews and meta-analyses generally support exercise as beneficial for insulin measures and overall cardiometabolic risk in PCOS populations. Yoga-based programmes, particularly those combining postures, breathing practices, and relaxation, are often discussed as stress-modulating and autonomic-balancing interventions. In adolescent PCOS specifically, controlled trials have reported yoga outperforming exercise for anxiety symptoms and for certain endocrine parameters such as AMH and androgens. Your findings sit comfortably inside that broader evidence landscape, while also showing that neither approach is “cosmetically nice but clinically weak”. Both appear to matter, just through slightly different pathways.

The stress-related findings deserve special attention because they help explain why changes in mood and self-regulation can travel downstream into endocrine and metabolic outcomes. The thesis highlights that

reductions in perceived stress were accompanied by favourable biochemical changes and frames this as evidence against treating mental and physical health as separate compartments.

From a plausible mechanism perspective, this makes sense. Stress regulation is tied and autonomic balance, and chronic stress can amplify dysregulation in vulnerable metabolic contexts. When yoga reduces perceived stress and improves emotional stability, it may indirectly support hormonal regulation, not by magic, but by nudging the stress-response system into a less reactive baseline. That is also consistent with the clinical direction taken in international PCOS guidance, which places strong emphasis on lifestyle management and quality-of-life outcomes, not only reproductive endpoints.

Another useful theme is the role of self-efficacy and adherence as “hidden engines” behind physiological change. The thesis explicitly notes that increases in confidence to maintain routines aligned with stronger improvement patterns and argues that designing interventions to create early experiences of success and encouragement is not optional but central to sustained benefit.

This point is easy to overlook in purely biomedical write-ups, yet it can explain why two interventions with similar session duration come profiles. If one modality feels more approachable, less judgment-laden, or more culturally acceptable for adolescents, it may produce better adherence and a stronger psychological “stickiness” that carries beyond the intervention window. In practical terms, adolescents are more likely to continue what makes them feel calm, capable, and socially safe, and that continuation is where long-term metabolic and reproductive benefits usually come from.

Importantly, the thesis also stresses that outcomes are shaped by delivery conditions, not only by programme content. It notes that adherence and engagement were influenced by scheduling consistency, facilitator guidance and the social environment, and that institutions play a practical role in shaping results. This is a big deal for translation into schools, colleges, and community settings. In other words, an intervention does not live of its sequence of poses or exercise drills. It also depends on whether the programme is realistically scheduled around academic loads, whether facilitators provide supportive structure, and whether the group setting reduces stigma rather than amplifying it. This observation aligns well with what PCOS guidelines often imply in practice: lifestyle change is hard, and structured support makes it more achievable.

A further strength of the study is methodological rather than purely substantive. The thesis positions its integrated measurement strategy as a contribution, arguing that combining anthropometric, biochemical and psychological evaluation in a single framework gives a more truthful picture of adaptation.

That argument is persuasive because PCOS is inherently multi-system. If you only measure BMI, you risk missing meaningful endocrine shifts. If you only measure hormones, you may miss whether feeling better and coping better, which often predicts sustainability. A combined framework also allows you to detect cross-domain relationships, which the thesis reports through correlational patterns linking emotional stability with biochemical shifts. Those cross-domain links are the kind of evidence that makes a lifestyle study feel less like “soft wellness” and more like behavioural physiology.

At the same time, it is worth interpreting caution. Typical limitations in this kind of design include the duration of the intervention (often sufficient to detect short-term shifts but not long-term maintenance), the influence of unmeasured dietary variability, and the reliance on self-report instruments for psychological outcomes. In adolescent cohorts, additional factors like exam stress cycles, sleep variability, and family-driven food routines can influence metabolic markers and perceived stress. These do not invalidate the results, but they do mean the safest interpretation is that the programme can trigger favourable movement in several domains under supervised conditions, with the next research step being longer follow-up, stronger control of confounders (especially diet and sleep), and possibly a combined-arm design (yoga plus structured exercise) to test whether the strengths of each modality add up rather than compete.

Finally, the comparative finding that both modalities help, but in slightly different ways, points toward a practical strategy rather than a simplistic winner declaration. The thesis itself argues for a complementary view, suggesting that yoga and exercise should not be treated as hierarchical options.

From an implementation standpoint, a menu-based programme that offers both and allows tailored selection may be the most realistic approach for adolescent populations. Some participants body acceptance that yoga cultivates before they are ready for higher-intensity exercise. Others may thrive on athletic training and use yoga as recovery and emotional regulation. Building programmes around choice and consistency, rather than ideology, is likely to produce better adherence and better outcomes.

Conclusion

This study concludes that structured yoga-based lifestyle practice and conventional exercise programmes are both effective non-pharmacological interventions for adolescents affected by PCOS-related metabolic and endocrine vulnerability. Across the reported results, participants in both intervention groups demonstrated improvement in anthropometric indicators linked to metabolic risk, favourable changes in

biochemical and hormonal regulation, and better psychological wellbeing including reduced perceived stress and strengthened confidence in maintaining health routines.

The comparative pattern suggests a difference in emphasis rather than a contradiction: yoga shows particular promise for psychological outcomes and hormonal balance, while conventional exerc tabolic and body-composition indicators.

The broader implication is that adolescent PCOS management benefits from programmes that treat wellbeing as multi-dimensional, combining physiological, biochemical and psychological assessm ough accessible behavioural practice. For schools, colleges, and community health settings, the findings support integrating supervised lifestyle sessions into routine health promotion, with attention to delivery conditions that nsistent scheduling, skilled facilitation and supportive peer environments.

This aligns with international PCOS guidance that places lifestyle management and quality-of-life outcomes at the centre of care.

In closing,practical, plural approach: offer yoga and exercise as complementary tools, tailor options to individual needs and preferences, and evaluate outcomes in an integrated way that respects the real complexity of PCOS. Future research can strengthen these conclusions by adding longer follow-up, tighter control of lifestyle confounders (especially diet and sleep), and testing combined or stepped-care models to see whether sequencing yoga and exercise produces more durable outcomes than either approach alone.

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