

# Evaluating the Impact of Different Types of Exercise on Hormonal and Reproductive Factors in Women with Polycystic Ovarian Syndrome (PCOS) - A Literature Review

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## ABSTRACT

**Aim:** To analyze the effect of various form of exercise Interventions on the Hormonal and Reproductive Parameters of Women with Polycystic Ovarian Syndrome (PCOS).

**Purpose:** Polycystic ovarian syndrome is endocrine disorder, heterogeneous in nature which can manifest with reproductive, cardiometabolic, psychological and dermatological symptoms. Lifestyle modifications are early treatment strategies where exercise training and diet are first line of therapy. Various forms of exercises such as aerobic training, resistance training, aquatic therapy, Pilates are being practiced which help in reducing and controlling the symptoms of PCOS. All these exercises are being done at different intensities, volume and are seen to have a varying effect on the reproductive and hormonal parameters. Varied forms of exercise are available that can be practiced by women with PCOS but lack of motivation and adherence to exercise is observed. The purpose of literature review is to understand and identify which form of exercises have a better influence and helps in controlling the hormones and other reproductive parameters.

**Methodology:** A comprehensive literature review was conducted by utilising PubMed, Google scholar, MEDLINE, and EBSCOHOST. The search strategy included recent RCT, s (randomized control trail) from 2020 to 2025 to capture the most current scientific understanding and advancements in the field. Total 11 Randomized controlled trails are reviewed.

**Conclusion:** Recent evidence demonstrates that diverse variety of exercise modalities including resistance, aerobic, high-intensity interval training offer distinct advantages. Combined training protocols and vigorous intensity appear to yield the most comprehensive benefits across both metabolic and reproductive parameters, suggesting a synergistic effect of varied exercise stimuli. Significant reductions in androgens, a decrease in Anti-Müllerian Hormone (AMH), crucial increase in Sex Hormone Binding Globulin (SHBG) is seen with HIIT and combined protocols. Yoga when performed for 3months regularly has also shown improvement in the overall hormonal profile with marked improvement in Antimullerian hormone (AMH).

**Keywords:** Exercise, Physical activity, Yoga, Polycystic ovary, Strength training, Tai chi, Pilates

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## INTRODUCTION:

Polycystic ovarian syndrome is endocrine condition which is diverse in nature, impacting various stages of woman's life

from her teenage years to menopause, can present with symptoms related to reproduction, cardiometabolism, psychological health, and skin. (1,2). The WHO (World

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Health Organization) reports that >116 million women around globe are impacted by PCOS (3), with the worldwide prevalence of the condition varying from 2.2% to 26% (4). One of diagnostic criteria for PCOS is according to Rotterdam criteria established in 2003 (5). Women suffering from PCOS exhibit higher levels of insulin resistance, androgens, hyperinsulinemia and increase in androgens results from internal dysregulation of steroid hormone production and the stimulation of luteinizing hormone (LH). This rise in androgen levels contributes to insulin resistance, which in turn exacerbates insulin levels. (6) Androgens which help in measuring the androgen levels are “free testosterone (fT),” “sex hormone binding globulin (SHBG),” “dehydroepiandrosterone (DHEA),” the free androgen index (FAI),” “DHEA sulfate (DHEA-S),” and “androstenedione(A)”(7). “Anti-Müllerian hormone (AMH)” is suggested as indicator of ovarian dysfunction, and oxidative stress is generated by the ovaries in women with PCOS, who frequently exhibit a more pronounced phenotypic presentation (8). HA (hyperandrogenism) is the most prevalent presentation and is marked by increased secretion of LH. It works together with insulin, works together to boost androgen production (levels of testosterone), potentially resulting in obesity (9). SHBG is synthesized in liver, attaches to circulating sex steroids, thereby regulating the availability of active sex hormones. This regulation is useful for evaluating the severity of hyperandrogenism and also plays significant role in complications, development, and progression of PCOS.(2)

Lifestyle changes that focus on enhancing dietary habits and boosting physical activity are initial therapeutic approaches to address symptoms associated with PCOS (10) Exercise has been exposed to improve insulin sensitivity, facilitate glucose absorption, help balance androgen levels by raising SHBG, that attach to testosterone as well as modulate its bioavailability. In addition, physical activity positively influences ovarian function by correcting hormonal imbalances.(11) and is linked to improved mitochondrial function which reflects the energy production capacity (2). Although the advantages of physical activity are widely recognized, women with PCOS often lead sedentary lifestyles. Common obstacles to exercising include time constraints, fatigue, weather conditions, poor health, lack of motivation, and feelings of self-consciousness regarding their appearance (12). Various forms of exercises has shown to be effective and every exercise practiced for PCOS is of varying intensity and volume and also has varied intervention duration (13). So the present review aims to understand which form of exercise

along with the intensity, volume, and duration has better influence and has shown improvements in the hormonal as well as reproductive parameters among women diagnosed with PCOS.

## MATERIALS AND METHODS:

Literature search methodology: A comprehensive literature review has been performed by utilising databases such as PubMed, Google scholar, MEDLINE, PEDRO, EBSCOHOST. The search strategy focused on recent RCTs from 2020 to 2025 to capture the latest scientific insights and progress in the field, utilizing keywords such as “exercise”, “aerobics”, “physical activity”, “resistance training”, “high intensity interval”, “yoga”, “strength training”, “endurance training”, “HIIT”, “Moderate intensity continuous training”, “MICT”, “Tai chi” along with related PCOS terms: “PCOS”, “polycystic ovary”, “polycystic ovarian.” Total 195 articles have been reviewed, on screening found 30 duplicates 120 articles have been excluded according to title and abstract and 45 full text articles have been evaluated for eligibility predicated on inclusion criteria and exclusion criteria. Out of which 11 RCTs have been chosen for the review as shown in [Table /Fig-1].

## STUDY SELECTION

The information gathered was tabulated based on sample size, BMI (body mass index) of the PCOS women, duration and type of intervention, and the outcomes of intervention.

### Inclusion Criteria:

(1) Full text articles in English were selected (2). Women with PCOS diagnosed by Rotterdam criteria with intervention as aerobic exercises that includes either yoga, MICT, “High intensity interval training (HIIT),” Progressive resistance training or strength training or combined exercises considering at least one outcome measure as hormonal or reproductive parameter such as menstrual regularity, hirsutism (3) The current study includes only RCTs (Randomized Control trial).

### Exclusion Criteria:

The studies that were excluded included those that (1) did not present any hormone levels following the intervention, (2) utilized an animal model, (3) consisted of case studies and case reports, (4) only offered guidelines for treating women with PCOS or overview of condition, (5) failed to confirm PCOS diagnosis utilizing established criteria, (6) didn't incorporate an exercise intervention, and (7) lacked a detailed protocol..

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Review of literature:

Table: Types of intervention with their effect on the Hormonal and reproductive System:

Author & year	Participants	Type and Duration of intervention	Outcome measures	Hormonal and reproductive Changes
Rao M, et al 2022 (9)	RCT; 50 women BMI>23 kg/m <sup>2</sup>	<p>36 sessions over 12 “weeks</p> <p>Group 1: High-Intensity Interval Training (HIIT) for 4 minutes (at 90 to 95% of maximum heart rate [HR], followed by 3mins of Moderate Intensity Continuous Training [MICT]) (at 70% of individual maximum HR)</p> <p>Group 2: Resistance training Performed thrice a week. Each session included 8 dynamic exercises (using a resistance of 60 to 70% of one repetition maximum [RM]). Each exercise was performed for three sets of 10 to 12 repetitions, with a 1-minute rest after each set.</p>	total serum testosterone levels, skinfold measurements, physical activity questionnaire	HIIT lowered testosterone and hyperandrogenism more than strength training.

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<p>Rhiannon K. Patten(2023 ) (11)</p>	<p>RCT,29 women BMI 25–35 or &gt;35 kg/m<sup>2</sup>)</p>	<p>Group 1: HIIT (N=15) Group 2: MICT (N=14)12 weeks</p>	<p>Cardiorespiratory fitness Body composition Insulin sensitivity Hormonal profiles: free testosterone; DHT, dihydrotestosterone ; FAI, free androgen index; AMH, SHBG Menstrual frequency. Biochemical profile including</p>	<p>SHBG higher in HIIT group comparing with MICT, FAI significantly decreased, following HIIT.AMH, androstenedione, estradiol and DHT have not been altered by either intervention. HIIT intervention, participants were 7.8 times reported improvements in their menstrual cycle than those in the MICT” group.</p>
<p>(Kiel et al., 2020)(14)</p>	<p>64 women BMI (&lt;27 or ≥27 kg/m<sup>2</sup>),</p>	<p>16 weeks and for 36weeks homebased “exercises Group 1: High Volume - High-Intensity Training (HV-HIT) for 38 minutes (with a 10-minute warm-up at 60% to70% of HR max followed by four 4min high-intensity intervals reaching 90% to 95% of HR max, with a 3-minute active recovery of running or</p>	<p>menstruation frequency, markers of cardiovascular, metabolic and reproductive health, quality of life and adherence to and enjoyment of exercise.</p>	<p>Menstrual frequency and fertility indicators improved in HV-HIIT group.</p>

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		<p>walking at 60%–70% of HR max in between).</p> <p>Group 2: Low Volume - High-Intensity Training (LV-HIT) ten 1-minute high-intensity intervals with maximal effort, interspersed with 1 minute of either passive or low-intensity recovery, aiming to reach 60%–70% of HR max.</p> <p>Group 3: control group (Habitual physical activity)</p>		
Xia Wu et al.,2020(15)	38 women, BMI (<27 or ≥27 kg/m <sup>2</sup> )	<p>12 weeks, exercise for 1 hour</p> <p>GROUP 1: Structured ex training 1-h training (15-min warm-up, 30min aerobic phase on a bicycle ergometer 15min cool-down period.)</p> <p>group 2: control group-maintained normal lifestyle.</p>	Hormonal tests, biochemical tests, cardiopulmonary exercise tests (CPETs), Anthropometrics, oxidative stress assessments.	The AMH levels in the exercise group declined, while there were no changes in FSH, LH, TT, and DHEAS.

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Victor B. et al.,2020(16)	87 women, BMI (<30 and ≥30 kg/m <sup>2</sup> )	16 weeks, 3sessions /week (Volume of sessions was matched.)  Group 1: CAT Group 2: IAT Group 3: control group Aerobic physical training on a treadmill, 30 to 50minute sessions with intensities ranging from 60%-90%	hormonal and metabolic indicators, body composition, along with anthropometric measurements	CAT and IAT lowered body measurement indices and elevated androgen levels. Only IAT training decreased the levels. In addition, only CAT enhanced the lipid” profile.
(Patel et al., 2020)(17)	31 women BMI (20 - 48kg/m <sup>2</sup> )	12 weeks, 1 hour, 3sessions /week  GROUP 1: Mindful yoga (13) Mindful yoga classes: 1 hr, 3/week for 3 months (Included mindfulness training, breathing techniques, restorative	Fasting Blood testing for hormonal and endocrine parameters, hirsutism (mFG score), menstrual cycle history	Mindful yoga group showed a reduction in free testosterone levels. The menstrual cycle became briefer. Neither group exhibited notable enhancements in DHEA-S, A4, or mFG scores for hirsutism.

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		yoga, and meditation)  Group 2: Control group: 9		
Maryam Mohseni, et al (2021)(18)	RCT 61 BMI 25.96 ± (3.24) kg/m <sup>2</sup>	6 WEEKS PROGRAM YOGA ,90 mins (7/week sessions)  GROUP 1 :30(YOGA) GROUP 2:31 (ROUTINE EXERCISES) 2 in hospital and 5 at home. Yoga group included exercises to relieve stress, asanas, deep relaxation exercises.	Acanthosis nigricans, alopecia (through observation) hirsutism (mFG score), menstrual cycle information, menstrual pain, duration of infertility	Marked reduction in Hirsutism & acne observed
Sumiya Nazir et al 2024 (19)	RCT (quasi-experimental), 26 young females	One group pre and post Exercises for 12 weeks, 3 sessions /week  PILATES (after every 4 weeks) progression	VAS, verbal multidimensional score system (VMSS), menstrual regularity	Pilates regularized the menstrual cycle and decreased the menstrual pain.
Patil AD et al (2023) (20)	RCT, 52 women BMI: 25.75 ± (4.1) kg/m <sup>2</sup>	12 “weeks, 7 sessions /week Group 1: yoga in each group (26) Group 2: Control group (26)	Fasting Blood testing for hormonal, biochemical parameters. QOL	AMH improved in and improvements were seen LH, serum testosterone, FAI, post glucose insulin, and cortisol have been also reduced,

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		The intervention group received 90min of structured yoga		women with long duration of infertility (2 to 10 years) conceived within 1 year after” initiation of yoga intervention. (fertility improved)
Somayeh M et al 2023 (21)	RCT - 28 BMI: 30.33 ± 3.99 kg/m <sup>2</sup>	8weeks, 3 sessions/ week GROUP 1: 14 HIIT GROUP 2: 14 (walking) The “training protocol has been performed with 100–110 maximum aerobic velocity (MAV), 4 to 6 sets, 4 laps	Body composition, Insulin sensitivity, biochemical parameters, Aerobic capacity.	HIIT testosterone to cortisol also reduced anthropometric indices, HOMA-LDL, IR, TC, androgenic and inflammatory biomarkers significantly and increased insulin sensitivity and aerobic function. in the exercise group decreased.
Nasiri M et al 2025 (22)	RCT 30 body mass index: 30.3 ± 3.9 m <sup>2</sup> )	8 weeks, 3 sessions /week Combined exercise group :15 Control group: 15 normal daily routine eight altered exercises containing large muscle groups on the machines and aerobic ex with intensity of 60%–70% THR)	fasting plasma glucose, insulin, homeostatic (HOMA-IR), (QUICKI), lipid profiles, hormonal tests total antioxidant capacity, C reactive protein	total testosterone, AMH, FAI were significantly decreased, while QUICKI (has been remarkably increased compared with the control” group.

## RESEARCH PAPER

[Table /Fig: 1] Summary of studies with various types of exercise interventions practiced by women with PCOS and their effect on the reproductive and hormonal parameters. [9,11,14-22]

Abbreviations: AMH, anti-mullerian hormone, “BMI, body mass index; CG, control group; DHEA-S, dehydroepiandrosterone sulfate; E1-S, estrone; E2, estradiol; Ex, exercise; FAI, free androgen index; FBG, fasting blood glucose; FFM, fat free mass; FI, fasting insulin; FSH, follicle stimulating hormone; fT, free testosterone; HOMA-IR, homeostatic model assessment of insulin resistance; HR, heart rate; HRR, heart rate reserve (HR<sub>max</sub>–HR<sub>rest</sub>); THR, target heart rate; IAT, intermittent aerobic training; CAT, continuous aerobic training; Ins, insulin; HIIT, High intensity interval training; IR, insulin resistance; IS, insulin sensitivity; LH, luteinizing hormone; PRT, progressive resistance training; RCT, randomized controlled trial; SHBG, sex hormone binding globulin; T, testosterone; T4, thyroxine; TSH, thyroid stimulating hormone; TT, total testosterone; QUICKI, quantitative insulin sensitivity check” index.

### Review of Literature:

• **Yoga and its impact:** Originating from ancient traditions, yoga is a mild form of exercise that promotes mindfulness which could be done by individuals of all fitness levels as well as yoga can provide enduring advantages for physical and mental well-being. (23) Total 3 RCTs were reviewed to understand how yoga affects the reproductive and hormonal health of women with PCOS. Research by Patel and colleagues (17) involved 31 women, with 13 participating in mindful yoga classes for one hour, three times a week, over three months. The sessions consisted of breathing techniques, gentle walking meditation, constructive guided visualization, tapping, self-talk, appreciative inquiry. Program began with body awareness and pranayama breathing methods, progressed to vinyasa flow and restorative yoga postures, concluded with meditation that incorporated guided imagery and positive affirmations. The study found that participants showed improvements in free testosterone levels, reduced hirsutism, and shorter menstrual cycles. Similar findings have been seen in Study done by Maryam Mohseni, et al (2021) (18) where 30 women did yoga for 6 WEEKS for 90 mins 7sessions /week 2 in hospital and 5 at home. They performed 25 minutes of exercises aimed at alleviating physical stress, followed by 45mins of asana practice, with final 20mins allocated to deep relaxation exercises. The asanas included: (a) makarasana; (b) bhujangasana; (c) dharmikasana; (d) paschimottanasana; (e) sardulasana; (f) bhadrasana; (g) matsyedrassana; (h) savasana.

Another RCT done by Patil AD et al(20) included 26 women who received 90 min of structured yoga intervention for 90 days (12 weeks) 7 sessions /week among which 3 sessions were performed with the Yoga expert and remaining were 4 done at home and were recorded for compliance. Asanas (yogic postures), pranayama, meditation, relaxation methods, and talks on stress management and a yogic lifestyle comprised the practices. There was a notable improvement in the AMH parameter but an overall improvement in the hormonal profile. The postintervention group also had lower levels of cortisol, post-glycemic insulin, FAI, serum testosterone, and LH. Fertility improved in patients. Limitations of these studies are the sample sizes were small and there was variation (heterogeneity) in study design and yoga protocols, so broader trials are needed for stronger conclusion.

### • **Aerobic exercises of varying intensities: (High intensity interval training and Moderate intensity continuous training)**

HIIT protocol is measured by relatively short bursts of vigorous activity performed at workload corresponding to 90% of HRR and at a range of 6 to 10 i.e. hard to very hard on a modified Borg Scale. Depending on the intensity of the exercise, each attempt lasts anywhere from a few seconds to several minutes, and several efforts were separated by a brief period of rest or decreased effort(24). Its dynamic quality improves sustainability and enjoyment. With an intensity of 50 to 60% HRR, or 4-6/10 on modified Borg scale, moderate intensity training, or MICT, is another type of aerobic exercise that is distinguished by consistent submaximal power production throughout entire session, that encourages high rate of fat burning(25). Study done by Kiel et al (14) consisted of 64 women randomized to 3 groups LV-HIIT, HV -HIIT and control group. They exercised for 16 weeks in which one session was supervised and 2 sessions were homebased and also took a follow up after 36 weeks where they were encouraged to do 2 sessions /week. LV-HIIT showed improvement in HOMA- IR, endothelial function along with body composition with only 10 weeks of exercise but the menstrual frequency and fertility indicators improved with HV-HIIT .Similar study done by Victor B. Ribeiro et al (16) on 87 women among which 29 women underwent IAT (intermittent aerobic training )and 28 underwent continuous aerobic training for 16 weeks concluded that CAT and IAT training reduced anthropometric indices and hyperandrogenism in PCOS, whereas only IAT training reduced FAI. From the above studies we observe HIIT and intermittent aerobic exercise along with improvement in insulin sensitivity and cardiovascular health also effectively improved reproductive and hormonal parameters, including

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menstrual function and androgen reduction. So they concluded that intensity as well as the characteristic of the women needs to be considered when prescribing exercise and both the therapies can be used to treat PCOS. Study done by Rao M et al(9) on 50 women compared HIIT with strength training and have reported that free testosterone levels reduced with HIIT than strength training. Such outcomes have been also supported by a study done by Rhiannon K. Patten(11) to compare HIIT and MICT to understand which intensity of exercise has a better impact on the reproductive and cardiometabolic parameters showed that when exercises were performed for 12 weeks, 3sessions/week, HIIT showed levels of SHBG 22% than MICT, FAI significantly reduced, following HIIT but not MICT, AMH, androstenedione, estradiol as well as DHT have not been transformed by either intervention. After the completion of HIIT intervention, participants have been 7.8 several times more probable to report improvements in their menstrual cycle than those in MICT group. Study done by Xia Wu et al(15) compared Structured exercise on bicycle for 12 weeks,3 sessions /week with control group where subjects were instructed to maintain lifestyle. Among 38 women 19 did moderate intensity exercise showed AMH levels decreased significantly although there has been no change in LH, FSH, TT, DHEAS in intervention group. Study done by Somayeh Mohammadi (22)on 28 women among which 14 underwent HIIT only for 8weeks ,3sessions /week showed improvements in total testosterone and androgenic biomarkers Compared to no exercise group. Across multiple studies, HIIT consistently demonstrates stronger benefits than moderate-intensity or strength training for reducing hyperandrogenism, improving insulin resistance, and restoring menstrual function. Moderate exercise may help reduce AMH (indicating better ovulatory potential), HIIT tends to produce broader metabolic and reproductive benefits, making it a preferred training mode for PCOS when appropriately prescribed. However, individual tolerance and baseline characteristics should guide exercise intensity and duration for optimal outcomes.

## • **Combined training Protocols:**

Combined Training Protocols mainly consist of integration of both resistance and endurance (aerobic) training within a single protocol. An eight-week combined training intervention, incorporating strength training at 50% to 70% of one-repetition maximum(1RM), endurance training at 60% to 70% of target heart rate (THR), done via Nasiri M et al(23) was highly effective in significantly decreasing HOMA-IR, insulin, LDL-cholesterol, total cholesterol, AMH, total testosterone, FAI, when remarkably increasing

QUICKI(Quantitative Insulin Sensitivity Check Index). To improve insulin sensitivity, lower blood sugar, and reduce belly fat in obese PCOS patients, they found that combination training regimens are more advantageous than either aerobic or resistance exercise alone. This implies that better results are obtained by focusing on several physiological pathways at once.

- **Pilates:** Pilates is a structured exercise system grounded in eight fundamental principles: control, centering, flow, precision, concentration, breathing, isolation, and routine. The practice incorporates both mat-based exercises and movements performed using specialized apparatus, aiming to enhance strength, flexibility, and body awareness. Owing to its adaptable nature, Pilates is appropriate for individuals of all ages and varying physical abilities. These exercises do not involve any kind of impact, if carried out properly they involve no strain, stress, pain. Study done by Sumiya Nazir et al(20) 2024 on PCOS women for 3 months, 3 sessions/week showed significant improvement in menstrual regularity and decreased menstrual pain.

## **Impact of exercise on the reproductive parameters.**

Androgens:

A consistent finding across recent literature is that exercise interventions lead to significant reductions in circulating testosterone levels and FAI, measure of bioavailable testosterone. For instance, an eight-week intervention combining resistance and endurance training resulted in statistically significant reduction in both total testosterone along with FAI. HIIT has seen to be more effective for ameliorating hyperandrogenism.

## **Anti-Müllerian Hormone (AMH) and Sex Hormone Binding Globulin (SHBG):**

It is produced by granules in ovaries, functions to inhibit recruitment and development of follicles. Women having PCOS typically have AMH levels that are 2-3 times higher than those of women with healthy ovaries, increased AMH levels are often linked to more severe forms of PCOS. Fluctuations in AMH as well as SHBG act as important markers for assessing ovarian reserve and the availability of androgens, respectively. A study demonstrated that an eight-week combined training regimen alongside an hour of yoga for 12 weeks resulted in a substantial reduction in AMH levels. SHBG is essential as it binds with testosterone, which in turn lowers the levels of free, biologically active testosterone in the bloodstream. An increase in SHBG levels directly contributes to reduction of hyperandrogenism, signifying that exercise not only diminishes androgen

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production but also enhances the body's capacity to neutralize circulating free androgens, thus contributing to a more balanced hormonal milieu.

## Gonadotropins:

The immediate effect of physical activity on regulation of gonadotropins, particularly Follicle-Stimulating Hormone (FSH) and LH, in individuals with PCOS is not as frequently documented in the existing literature when compared to its influence on androgens. A more focused understanding of how exercise directly influences these pituitary hormones in women is crucial. The current literature has shown changes in gonadotropins with HIIT for 16 weeks and yoga every day for 12 weeks but there is a gap in fully elucidating precise mechanisms through that exercise contributes to the restoration of hypothalamic-pituitary-gonadal (HPG) axis balance in human subjects.

## Impact on the Menstrual Cycle regulation:

Very few studies reviewed here have menstrual pain and menstrual length duration as outcome measure but from the available studies we conclude that yoga, HIIT and Pilates have shown to be effective in reducing the length of the menstrual cycle as well as pain thereby regularizing the cycle.

## Conclusion

For women with PCOS, exercise is potent and essential first-line intervention for improving reproductive parameters. According to recent research, primarily from 2020 to 2025, a variety of exercise modalities, including resistance, aerobic, high-intensity interval training, provide unique benefits. However, vigorous intensity and combined training regimens seem to provide the most extensive benefits across metabolic and reproductive parameters, indicating a synergistic effect of varied exercise stimuli. Significant decreases in androgens like testosterone and the FAI, a drop in AMH, and critical rise in SHBG are among the hormonal changes linked to exercise. Latest research on the impact of exercise scheduling and cutting-edge techniques like Pilates have also shown that modalities should be tailored to each individual. However, the current literature reviewed is marked by heterogeneity in study designs and occasional inconsistent inconsistencies in specific hormonal outcomes, arises the critical need for more standardized, rigorously designed, and long-term randomized controlled trials. Crucially, future efforts must also extend beyond defining optimal physiological protocols to focus on developing highly personalized exercise prescriptions that account for the diverse PCOS phenotypes. Equally important is the implementation of effective strategies to overcome

adherence barriers, ensuring that the proven and multifaceted benefits of exercise are translated into sustained improvements in the reproductive health, overall quality of life for women living with PCOS.

## Limitations:

- Inconsistencies and Heterogeneity in Study Designs and Outcomes, methodological variability poses significant challenges for direct comparisons across studies and for drawing definitive conclusions.
- The optimal exercise volume, intensity, and duration for PCOS management also remain to be fully identified as does the optimal timing of exercise for maximizing long-term reproductive health benefits.

## Future Recommendations:

- Integrate behavioral science principles into exercise prescription and research as lack of motivation among the women is observed.
  - Develop and test strategies to improve exercise uptake and adherence, including
  - Providing targeted patient education on exercise benefits
  - Designing feasible, home-based exercise programs
  - Creating supportive environments to address psychological and social challenges
- This approach is vital for translating research into sustained enhancements in health along with quality of life of women with PCOS.
- Short-term benefits are increasingly evident from interventions lasting several weeks or months, PCOS is chronic condition influencing reproductive health across a woman's lifespan, from menarche to menopause therefore long-term interventional studies are required.

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