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Original Research Article

Effects of weight training program on menstrual regularity and ovulation in women with polycystic ovary syndrome

Bibi Zainab[1]*, Devika Barure[2], Shaheera Usman[3], Sujatha Dhaded[1]

[1]Department of Obstetrics and Gynaecology, Khaja Banda Nawaz University, Faculty of Medicine, Karnataka, India
[2]Barure Maternity, Latur, Maharashtra, India
[3]Department of Obstetrics and Gynaecology, Dubai, UAE

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***Correspondence:**
Dr. Bibi Zainab,
E-mail: bibi@kbn.university

ABSTRACT

Background: Polycystic ovary syndrome (PCOS) affects 7-15% of reproductive-aged women, causing ovulatory dysfunction and infertility. Weight training is a promising intervention, but evidence is limited by short-term studies and challenges in ovulation assessment due to elevated luteinizing hormone levels.
Methods: This 24-week comparative study at A.B.A. Star Women's Superspeciality Hospital in Karnataka, India, involved 100 women with PCOS allocated (1:1) to a weight training group (n=50) or a no-exercise control group (n=50). Participants voluntarily chose to join, with those willing to exercise assigned to the weight training group after providing informed consent and ruling out contraindications; others joined the control group. The weight training group completed three 60-minute sessions weekly. Menstrual regularity was assessed via diaries (normal: 21-35 days; oligomenorrhea: 36-199 days; amenorrhea: >199 days). Ovulation was measured using i-Know ovulation testing strips (days 10-21), confirmed by serum progesterone (≥5.0 nmol/l). McNemar's test, paired t tests, ANOVA, and chi-square tests assessed changes ($p<0.05$).
Results: Participants (mean age 28.4±4.2 years, BMI 28.6±5.1 kg/m²) exhibited 89.2% adherence to weight training. The median OPK adherence was 85% (IQR 60%, 95%) initially, declining to 70% (IQR 50%, 90%) later. The weight training group engaged in 4.8±1.7 cycles, with 20% (10/50) improving their regularity ($p=0.01$ vs. baseline; $p=0.03$ vs. control), compared to 4.0±1.5 cycles and 5% (2/50) in the controls. Ovulation occurred in 70% (35/50) of the weight training group (2.3±1.4 cycles, $p<0.001$), while 30% (15/50) in the controls experienced ovulation (0.9±0.8).
Conclusions: Weight training significantly improves PCOS ovulation, offering a practical intervention. This study advances non-pharmacological PCOS management.

Keywords: Polycystic ovary syndrome, Weight training, Menstrual regularity, Ovulation prediction kits, i-Know ovulation testing strip, Comparative study

INTRODUCTION

Polycystic ovary syndrome (PCOS) affects 7-15% of reproductive-aged women, characterized by ovulatory dysfunction, hyperandrogenism, and polycystic ovaries, leading to irregular menstrual cycles, anovulation, and infertility.[1] These impairments significantly impact fertility and quality of life, necessitating effective interventions. Lifestyle interventions, particularly exercise, are recommended as first-line management, with evidence suggesting improvements in menstrual regularity and ovulation.[2] Weight training may enhance ovulatory function by improving insulin sensitivity and hormonal balance, but short durations and lack of control groups often limit studies.[3]

The use of ovulation prediction kits (OPKs) to assess ovulation is practical but challenging in PCOS due to

elevated luteinizing hormone (LH) levels, increasing false-positive risks.[4] The i-know ovulation testing strip offers an affordable solution, with progesterone confirmation ensuring reliability. In addition to weight training, dietary modifications have emerged as a complementary strategy for managing PCOS and enhancing reproductive health. A systematic review indicates that combining exercise with dietary interventions, particularly those focused on low glycemic index foods, can significantly improve insulin sensitivity and hormonal profiles in women with PCOS, further promoting ovulation and menstrual regularity.[5] Moreover, the integration of pharmacological treatments, such as ovulation inducers alongside lifestyle changes, has shown promising results in increasing ovulation rates, suggesting a multifaceted approach may be most effective.[5] This holistic strategy not only addresses the physiological aspects of PCOS but also empowers women by offering them various avenues for intervention, ultimately improving their quality of life and fertility outcomes.

The objective of this study is to determine whether a structured 24-week weight training program can significantly improve menstrual regularity and ovulation frequency in women with PCOS compared to a no-exercise control group, using reliable ovulation assessment methods.[6]

METHODS

Study design

This 24-week, single-center comparative study was conducted at A.B.A. Star Women's Superspeciality hospital, Karnataka, India, from June 1, 2024, to November 16, 2024. It involved 100 women with PCOS, with 50 in a supervised weight training group and 50 in a no-exercise control group. The outcomes measured were menstrual regularity and ovulation frequency, assessed at baseline (previous 6-month menstrual history and one cycle with i-know OPK testing) and during the intervention (up to six cycles). The design aligns with prior outpatient feasibility studies. The inclusion of a control group strengthens causal inferences. The study was approved by the ethical committee of A.B.A. Star Women's Superspeciality Hospital, and written informed consent was obtained, adhering to the declaration of Helsinki. Participants were recruited from outpatient gynecology clinics using clinician referrals and social media, ensuring a diverse representation of women with PCOS.

Participants

One hundred women were recruited from outpatient gynecology clinics using clinician referrals, flyers, and social media. Inclusion criteria included ages 18 to 40 years, a confirmed PCOS diagnosis per Rotterdam criteria (at least two of the following: oligo-ovulation or anovulation, clinical/biochemical hyperandrogenism, polycystic ovaries on ultrasound), and a BMI of ≥18.5 kg/m^2. Exclusion criteria included pregnancy or plans for pregnancy, other endocrine disorders (e.g., thyroid disease, Cushing's syndrome), use of hormonal contraceptives or ovulation-affecting medications (e.g., metformin, clomiphene, letrozole) within the past 3 months, contraindications to exercise (e.g., cardiovascular disease, musculoskeletal injuries), and participation in regular weight training (>40 min/week) within the past 6 months. Participants were stratified by BMI (< or ≥28 kg/m^2) to balance the groups. The sample size (n=100) aimed for 80% power to detect a 0.4 difference in ovulation rate proportion (70% in the weight training group vs. 30% in the control) with α=0.05, accounting for 20% attrition. The study's design and methodology provide a robust framework for evaluating the impact of weight training on reproductive outcomes in women with PCOS.

Group allocation

Participants chose to join the study after being informed of its purpose and procedures. Those willing to participate in the exercise program provided informed consent and were screened for contraindications; if eligible, they were assigned to the weight training group. Participants who were unwilling to exercise but still wanted to participate were assigned to the control group. This non-randomized allocation was chosen as weight training was not generally an accepted method of training for women in the small city. Balance was maintained through BMI stratification and baseline menstrual regularity/ovulation status, conducted by an independent coordinator after baseline assessments. The control group maintained usual activity levels, providing a baseline for comparison. The intervention's design and methodology were meticulously crafted to ensure valid comparisons between the weight training and control groups.

Intervention

The weight training group completed a 24-week supervised program, with three 60-minute sessions per week on non-consecutive days, supervised by certified trainers, following exercise and sports science Australia guidelines. The protocol included a 5–10-minute warm-up of light aerobic activity (e.g., treadmill walking or cycling), followed by a full-body workout targeting major muscle groups (leg press, chest press, Pfizer stock price lat pulldown, seated row, shoulder press, bicep curls, tricep extensions, planks, abdominal curls). Participants performed 3 sets of 8-12 repetitions, starting with 2 sets for the first 2 weeks, progressing to 3 sets from week 3, with weights at 60% of one-repetition maximum (1 RM) at baseline, progressing to 80% by week 24. Rest periods were 1-5 minutes between sets, followed by a 10-minute stretching cool-down. Weights increased by 5-10% weekly for progressive overload. Both groups maintained usual dietary habits. Weight training adherence was monitored via attendance logs, targeting ≥80% (≥58 of 72

sessions). OPK adherence was supported by training, weekly WhatsApp reminders, and a study coordinator.

Outcome measures

Outcomes focused on reproductive health. Menstrual regularity was assessed via self-reported menstrual diaries, recording the number and length of menstrual periods during the 24-week intervention, categorizing cycles as normal (21-35 days), oligomenorrhea (36-199 days), or amenorrhea (>199 days). Up to six months, cycles were tracked. Baseline regularity was established from past 6-month menstrual history. Ovulation frequency was measured using i-Know ovulation testing strips (sensitivity >99% for LH ≥10 mIU/ml), with daily urine testing (3 drops, 5-minute results) from day 10 to day 21 of each cycle, at baseline (one cycle) and during the intervention (up to six cycles). Positive results (two colored lines) were verified by digital photographs via secure messaging and confirmed with serum progesterone (≥5.0 nmol/l) 7 days post-positive OPK.

Data collection

Data collection occurred at baseline (May 2024) and during intervention (June 1, 2024-November 16, 2024). Baseline included past 6-month menstrual history and one cycle of i-Know OPK testing (day 10 to 21), with digital photograph submission. During intervention, diaries recorded period dates for up to 6 months, and i-Know OPKs used per cycle, with result verification. Participants received weekly reminders and coordinator support to maintain adherence. Weight training adherence was monitored, and weekly checks recorded adverse events and medication changes. Progesterone samples were analyzed at local laboratories using standardized assays.

Statistical analysis

Data were analyzed using SPSS version 28.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics (mean, standard deviation, median, IQR) summarized characteristics and adherence. McNemar's test analyzed within-group changes in menstrual regularity (proportion with improved cycle categories) and ovulation frequency (proportion with ≥1 ovulatory cycle). Paired t tests or Wilcoxon signed-rank tests compared cycle numbers within groups. Between-group differences were assessed using ANOVA for continuous outcomes (e.g., mean cycles) and chi-square tests for proportions (e.g., % improved). Significance was set at $p<0.05$. Intention-to-treat analysis included all participants, with baseline data carried forward for dropouts. Per-protocol analyses included participants completing ≥75% OPK tests.

Ethical considerations

The study received approval from the ethical committee of A.B.A. Star Women's Superspeciality Hospital. Written informed consent detailed the study's purpose, procedures, risks (e.g., muscle soreness), and benefits. Participants could withdraw from the study at any time. Data were anonymized and stored securely.

Materials

Equipment included menstrual diaries, i-Know ovulation testing strips, and gym equipment (weight machines, free weights). Personnel comprised certified trainers, clinical researchers, and a study coordinator. Facilities included an outpatient clinic, gym, and clinical laboratory.

RESULTS

Of 200 women screened, 120 were eligible, and 100 were enrolled and allocated to either the weight training group (n=50) or the control group (n=50). In the weight training group, 45 completed the intervention, with 5 dropouts due to time constraints (3) and loss to follow-up (2). In the control group, 48 completed, with 2 dropouts due to loss to follow-up. All 90 completers were included in the intention-to-treat analysis.

Baseline characteristics were balanced between groups, as shown in Table 1. The mean age was 28.4 ±4.2 years, and BMI-28.6±5.1 kg/m². At baseline, 10% (5/50 per group) had normal cycles, 76% (38/50) had oligomenorrhea, and 14% (7/50) had amenorrhea, with i-Know OPKs confirming ovulation in 8% (4/50 per group).

Table 1: Baseline characteristics of study participants.

Characteristic	Weight training group, (n=50)	Control group, (n=50)
Age (in years, mean±SD)	28.5±4.3	28.3±4.1
BMI (kg/m², mean±SD)	28.7±5.2	28.5±5.0
Normal cycles (%)	10% (5/50)	10% (5/50)
Oligomenorrhea (%)	76% (38/50)	76% (38/50)
Amenorrhea (%)	14% (7/50)	14% (7/50)
Ovulation at baseline (%)	8% (4/50)	8% (4/50)

In the weight training group, participants attended a mean of 64.2±6.8 sessions (89.2% adherence), as shown in Table 2. OPK testing adherence was high initially but decreased over time in both groups (Table 3). Median adherence was 97% (IQR 88%, 99%) at baseline, 85% (IQR 60%, 95%) in the first 12 weeks, and 70% (IQR 50%, 90%) in the last 12 weeks, with 80% and 64% completing ≥75% tests in the respective periods.

The weight training group had a significant increase in the mean number of menstrual cycles from 3.2±1.5 to 4.8±1.7 ($p<0.01$, paired t test), while the control group showed a non-significant increase to 4.0±1.5 ($p=0.22$). The between-group difference was significant ($p=0.04$, ANOVA). Similarly, 20% of the weight training group improved

menstrual regularity compared to 5% in the control group (p=0.03, chi-square test), (Table 4).

Table 2: Adherence to weight training program (Weight training group only).

Metrics	Value
Sessions attended (mean±SD)	64.2±6.8
Adherence rate (%)	89.2%

Table 3: Adherence to OPK testing.

Period	Median adherence (IQR)	≥75% tests completed (%)
Baseline	97% (88%, 99%)	-
First 12 weeks	85% (60%, 95%)	80%
Last 12 weeks	70% (50%, 90%)	64%

Table 4: Menstrual regularity outcomes.

Outcome	Weight training group	Control group	P value (Between groups)
Mean cycles (mean±SD)	4.8±1.7	4.0±1.5	0.04
Improved regularity (%)	20% (10/50)	5% (2/50)	0.03

For ovulation frequency, 70% of the weight training group had at least one ovulatory cycle compared to 30% in the control group (p<0.001, chi-square test), with a mean of 2.3±1.4 vs. 0.9±0.8 ovulatory cycles (p<0.001, ANOVA). Within-group changes were significant for both groups (p<0.001 for weight training group, p=0.04 for control, paired t-test), as shown in Table 5.

Table 5: Ovulation frequency outcomes.

Outcome	Weight training group	Control group	P value (Between groups)
Ovulation rate (%)	70% (35/50)	30% (15/50)	<0.001
Mean ovulatory cycles	2.3±1.4	0.9±0.8	<0.001

The master chart, containing individual data for all 100 participants, includes variables such as participant ID, group assignment, age, BMI, baseline menstrual cycle category, baseline ovulation status, number of menstrual cycles during the intervention, menstrual regularity improvement, number of ovulatory cycles, ovulation occurrence, adherence to weight training (weight training group only), adherence to OPK testing, adverse events, and dropout status. Due to space constraints, a summary table of key outcomes is presented (Table 6), with the complete master chart available upon request from the corresponding author.

Table 6: Summary of key outcomes by group.

Outcome	Weight training group	Control group
Improved regularity (%)	20% (10/50)	5% (2/50)
Ovulation rate (%)	70% (35/50)	30% (15/50)
Mean cycles (mean±SD)	4.8±1.7	4.0±1.5
Mean ovulatory cycles	2.3±1.4	0.9±0.8

DISCUSSION

This 24-week comparative study provides robust evidence that a structured weight training program significantly enhances menstrual regularity and ovulation frequency in women with PCOS compared to a no-exercise control group. The weight training group demonstrated a 20% improvement in menstrual regularity (p=0.03 vs. control) and a 70% ovulation rate (p<0.001 vs. control), with mean menstrual cycles increasing from 3.2±1.5 to 4.8±1.7 (p<0.01) and mean ovulatory cycles at 2.3±1.4. In contrast, the control group showed minimal improvement, with only 5% improving regularity and a 30% ovulation rate, with mean cycles at 4.0±1.5 (p=0.22). These results suggest that weight training, likely through improving insulin sensitivity and hormonal balance, offers a practical and effective non-pharmacological intervention for PCOS management. The use of i-Know ovulation testing strips with progesterone confirmation addressed challenges in ovulation assessment, ensuring reliable outcomes despite elevated luteinizing hormone levels common in PCOS.[4]

The findings align with prior research but extend the evidence by addressing limitations such as short study durations, lack of control groups, and inconsistent ovulation assessment methods. A randomized controlled trial by Shah and Tahakik found that resistance training improved BMI and menstrual regularity more effectively than aerobic exercise or lifestyle modification, supporting the current study's 20% improvement in regularity.[7] However, their study did not quantify ovulation rates, and its smaller sample size limits direct comparisons. Similarly, a systematic review by Hakimi and Cameron suggested that resistance training improves ovulation and menstrual cycles, consistent with the 70% ovulation rate observed here, but emphasized the need for research on optimal training parameters, which this study's detailed 24-week protocol partially addresses.[8]

In contrast, some studies suggest other exercise modalities may be more effective. Patten et al reported that high-intensity interval training (HIIT) elicited greater improvements in menstrual cyclicity compared to moderate-intensity continuous training (MICT) in a randomized clinical trial, but resistance training was not directly compared.[9] The current study's significant between-group difference in menstrual regularity (p=0.04)

suggests weight training may be comparably effective, though direct comparisons with HIIT are needed. A systematic review by Butt et al found that exercise interventions, including resistance training, improved reproductive outcomes, but methodological variations across studies limited conclusive comparisons.[10] The current study's standardized protocol and control group strengthen its findings relative to these reviews.

The importance of dietary interventions as a complement to exercise is evident from prior research, which this study did not control for, potentially influencing outcomes. Ruiz-González et al and Mohamed et al highlighted that low glycemic index diets combined with exercise significantly enhance insulin sensitivity and menstrual regularity, suggesting a synergistic effect that could amplify the benefits observed here.[5,11] For example, Palomba et al found that structured exercise combined with a hypocaloric diet outperformed exercise alone, achieving greater reductions in BMI and improvements in ovulation, whereas the current study's lack of dietary intervention may have moderated its effect size.[3]

Psychological benefits also play a role in the efficacy of weight training. Tucker and Maxwell demonstrated that weight training improves emotional well-being and body image, which may enhance adherence and amplify reproductive health benefits, as seen in the 89.2% adherence rate in this study.[12] Social support, as noted by Rohloff, further supports adherence through group training dynamics, a factor likely contributing to the high compliance observed here.[13] However, Wright et al. emphasized the need for larger, adequately powered trials to confirm resistance training's benefits and determine optimal dosing, a limitation this study partially mitigates with its 100-participant sample but does not fully resolve due to its single-center design.[14]

Compared to earlier studies, this study's longer duration (24 weeks) and inclusion of a control group provide stronger evidence for causality. Giallauria et al reported improved autonomic function and inflammatory patterns with exercise in PCOS, but their study was shorter and lacked ovulation-specific outcomes.[6] Kuchenbecker and Hoek found lifestyle interventions resumed ovulation in anovulatory women, but their focus on obesity and broader lifestyle changes makes direct comparison challenging.

The current study's specific focus on weight training and ovulation, with a 70% ovulation rate compared to 30% in controls, highlights its unique contribution to the literature.

Limitations

This study has several limitations. The lack of dietary control may have influenced outcomes, as diet significantly affects reproductive function in PCOS. The non-randomized allocation, based on participant choice, may introduce selection bias, despite balancing BMI and baseline characteristics. Self-reported menstrual diaries could lead to reporting bias, although they were verified by study staff. The phenotype of PCOS was not considered. Larger, multi-center trials with dietary interventions and alternative ovulation assessment methods are needed to confirm these findings. Furthermore, while the positive impact of weight training on menstrual regularity and ovulation rates is evident, the broader implications of integrating lifestyle modifications into PCOS management warrant further exploration.

CONCLUSION

This study demonstrates that a 24-week weight training program significantly improves menstrual regularity and ovulation frequency in women with PCOS, offering a practical, non-pharmacological intervention that outperforms no-ex sugarcane stock price excise controls. By achieving a 20% improvement in menstrual regularity and a 70% ovulation rate, it provides robust evidence for weight training's role in enhancing reproductive health. The use of the i-Know ovulation testing strip with progesterone confirmation ensures reliable ovulation assessment, addressing a key challenge in PCOS research. This work advances knowledge by isolating weight training's effects over a longer duration than prior studies, supporting its integration into clinical practice, particularly in resource-constrained settings, and highlighting the need for further research to optimize PCOS management strategies.

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