International Journal of Clinical Obstetrics and Gynaecology

ISSN (P): 2522-6614
ISSN (E): 2522-6622
**Indexing:** Embase
**Impact Factor (RJIF):** 6.71
© Gynaecology Journal
www.gynaecologyjournal.com
2026; 10(4): 1684-1688
Received: 13-05-2026
Accepted: 16-06-2026

**Vipin Chandra**
Department of Clinical and Lab Operations, Indira IVF Hospital Ltd, Udaipur, Rajasthan, India

**Kshitiz Murdia**
Department of Reproductive Medicine, Indira IVF Hospital Ltd, Udaipur, Rajasthan, India

**Nitiz Murdia**
Department of Embryology, Indira IVF Hospital Ltd, Udaipur, Rajasthan, India

**Shashank Sanagoudar**
Department of Reproductive Medicine, Indira IVF Hospital Ltd, Udaipur, Rajasthan, India

**Rina Rani**
Department of Reproductive Medicine, Indira IVF Hospital Ltd, Patna, Bihar, India

**Pratibha Binwal**
Department of Reproductive Medicine, Indira IVF Hospital Ltd, Hubli, Karnataka, India

**Amol Wankhede**
Department of Reproductive Medicine, Indira IVF Hospital Ltd, Borivali, Maharashtra, India

**Amol Lunkad**
Department of Reproductive Medicine, Indira IVF Hospital Ltd, Pune, Maharashtra, India

**Ritesh Aggarwal**
Department of Embryology, Indira IVF Hospital Ltd, Udaipur, Rajasthan, India

**Anjali Sharma**
Department of Reproductive Medicine, Indira IVF Hospital Ltd, Allahabad, Uttar Pradesh, India

**Nihar Bhoi**
Department of Reproductive Medicine, Indira IVF Hospital Ltd, Udaipur, Rajasthan, India

**Walmik Mistari**
Department of Reproductive Medicine, Indira IVF Hospital Ltd, Udaipur, Rajasthan, India

**Isha Suwalka**
Department of Research and Publication, Indira IVF Hospital Ltd, Udaipur, Rajasthan, India

**Corresponding Author:**
**Shashank Sanagoudar**
Department of Reproductive Medicine, Indira IVF Hospital Ltd, Udaipur, Rajasthan, India

# Effect of coenzyme Q10 supplementation on oocyte quality and ART outcomes in POSEIDON Groups 3 and 4: A multicentered open-label randomized controlled trial

**Vipin Chandra, Kshitiz Murdia, Nitiz Murdia, Shashank Sanagoudar, Rina Rani, Pratibha Binwal, Amol Wankhede, Amol Lunkad, Ritesh Aggarwal, Anjali Sharma, Nihar Bhoi, Walmik Mistari and Isha Suwalka**

**DOI:** https://www.doi.org/10.33545/gynae.2026.v10.i4u.2681

**Abstract**
**Background:** Women with poor ovarian reserve, classified under POSEIDON Group 3 and 4, often exhibit suboptimal oocyte quality and compromised assisted reproductive technology (ART) outcomes. Coenzyme Q10 (CoQ10), a mitochondrial nutrient and antioxidant, has been proposed to enhance oocyte competence. This study investigates the impact of CoQ10 supplementation on oocyte maturity and ART outcomes in this population.
**Objective:** To evaluate whether oral CoQ10 supplementation (300 mg twice daily for 60 days) improves the number of mature (M2) oocytes and subsequent ART outcomes in women with diminished ovarian reserve belonging to POSEIDON Group 3 and 4.
**Methods:** This multicentre, open-label, randomized controlled trial enrolled 234 women aged 25–45 years with AMH <1.2 ng/mL undergoing IVF/ICSI with their own oocytes. Participants were randomized into two groups: the intervention group received CoQ10 (300 mg twice daily) for 60 days prior to ovarian stimulation, and the control group underwent standard IVF without CoQ10. The primary outcome was the M2 oocyte rate at the time of oocyte pick-up (OPU). Secondary outcomes included follicle-oocyte index (FOI), oocyte retrieval rate, aneuploidy rate, implantation rate, clinical pregnancy rate, ongoing pregnancy rate, and live birth rate.
**Results:** [To be filled in upon completion of data analysis – placeholder for summary of key findings such as increase in M2 oocyte rate, statistical significance, improvement in pregnancy rates, etc.]
**Conclusion:** Preliminary evidence suggests that CoQ10 supplementation may enhance oocyte maturity and improve ART outcomes in women with low ovarian reserve. If confirmed, CoQ10 could represent a low-cost, non-invasive strategy to optimize fertility treatment in POSEIDON Group 3 and 4 patients.

**Keywords:** Coenzyme Q10, POSEIDON criteria, poor ovarian reserve, IVF, oocyte quality, M2 oocytes, ART outcomes, randomized controlled trial

## Introduction
One of the key challenges in assisted reproductive technology (ART) is the poor ovarian response to controlled ovarian hyperstimulation (COH), which affects a subset of women undergoing fertility treatment. These "poor responders" exhibit suboptimal follicular development despite gonadotropin stimulation, resulting in lower oocyte yield, compromised egg quality, and fewer embryos available for transfer. Consequently, these patients are at greater risk of cycle cancellation and repeated ART failures, which can be emotionally and financially burdensome. The reported incidence of poor ovarian response (POR) varies widely—from 5.6% to 35.1% of ART cycles—due to inconsistent diagnostic criteria across studies.
While multiple interventions have been proposed to improve outcomes in women with POR, the efficacy of these strategies remains unclear. Randomized controlled trials and systematic reviews have produced mixed or inconclusive results, leaving clinicians with few evidence-based options. As a result, many treatments are empirical and not strongly supported by high-quality clinical data.
Furthermore, traditional markers of ovarian reserve, such as Anti-Müllerian Hormone (AMH) and antral follicle count (AFC), offer limited predictive value for ART success. Adjuvant therapies like dehydroepiandrosterone (DHEA) have shown some promise in improving ovarian

response; however, results from clinical trials have been inconsistent. Although a few early studies reported improved outcomes, later investigations raised questions about the reliability and generalizability of these findings. Despite the controversy, DHEA is still commonly used, with one global survey indicating that approximately 26% of IVF clinicians incorporate it into treatment protocols for POR patients.

In recent years, attention has shifted to Coenzyme Q10 (CoQ10), a lipid-soluble molecule that plays a vital role in mitochondrial energy production and acts as a potent antioxidant. Mitochondria are essential for oocyte maturation, spindle formation, chromosomal segregation, and embryo development. As women age, mitochondrial function declines, leading to impaired oocyte competence and increased rates of aneuploidy.

Evidence suggests that CoQ10 supplementation may counteract these age-related declines. A pivotal study by Ben-Meir *et al*. (2015) demonstrated that mitochondrial dysfunction in oocytes of reproductively aged mice was associated with reduced expression of CoQ10 biosynthesis enzymes, and that supplementation with CoQ10 helped restore mitochondrial activity and improve fertility outcomes in aging females. These findings underscore the critical role of CoQ10 in maintaining oocyte mitochondrial integrity during reproductive aging.

Similarly, Yang *et al*. (2021) reported that CoQ10 enhanced meiotic maturation and mitochondrial function in porcine oocytes by reducing oxidative stress, providing further evidence of its potential in improving oocyte competence across species. Human studies have also supported these findings. A clinical trial by Bentov *et al*. (2014) observed lower rates of oocyte aneuploidy and higher pregnancy rates in women undergoing IVF/ICSI who received CoQ10 supplementation, compared to controls.

Additionally, Turi *et al*. (2020) found that follicular fluid from mature oocytes and good-quality embryos contained significantly higher levels of CoQ10, indicating a possible link between intra-follicular CoQ10 concentration and developmental competence. Moreover, CoQ10 has been shown to improve ovulation, endometrial receptivity, and pregnancy rates in clomiphene-resistant PCOS patients, suggesting broader reproductive benefits beyond just mitochondrial support.

Taken together, these findings support the hypothesis that CoQ10 supplementation may enhance oocyte quality and ART outcomes, particularly in women with poor ovarian reserve or diminished response to stimulation. However, large-scale, randomized trials assessing its clinical effectiveness in POSEIDON Group 3 and 4 patients are still limited.

This study aims to investigate whether oral supplementation with Coenzyme Q10 (300 mg twice daily for 60 days) improves the number of mature oocytes (MII) retrieved and enhances ART outcomes in women classified under POSEIDON Groups 3 and 4, who are undergoing IVF/ICSI using their own oocytes

## Methodology

### Study Design

This is a randomized, controlled, open-label, parallel-group, multicenter clinical trial designed to assess the effectiveness of oral Coenzyme Q10 (CoQ10) supplementation in improving oocyte quality and assisted reproductive outcomes in women classified under POSEIDON Group 3 and Group 4. The trial is being conducted at various Indira IVF centers across India**.**

### Study Duration

The study period extends from July 2022 to December 2023. Each participant is followed from the time of enrolment through embryo transfer and until confirmation of live birth or study endpoint.

Study Population

Participants are women diagnosed with poor ovarian reserve, defined by Anti-Müllerian Hormone (AMH) levels less than 1.2 ng/mL, who are undergoing IVF or ICSI using their own oocytes.

### Inclusion Criteria

- Age between 25 to 45 years
- BMI ranging from 18.5 to 25 kg/m²
- AMH level <1.2 ng/mL
- Planned treatment with IVF/ICSI using autologous oocytes

### Exclusion Criteria

- Presence of any uncontrolled medical condition such as diabetes, thyroid disorders, or hypertension
- Smoking history within the previous 3 months
- Use of androgenic supplements (e.g., DHEA) in the last 3 months
- Structural abnormalities of the uterus
- Ovarian cysts or endometriomas
- Active pelvic or systemic infections
- Participation in strenuous physical training or extreme weight loss programs beyond routine physical activity

### Sample Size

The total number of participants is 234, with 117 women in each arm. The sample size was calculated based on the expected improvement in mature oocyte (MII) yield, with 80% power and 5% significance level, allowing for a dropout rate.

### Randomization and Allocation

Eligible participants are randomized in a 1:1 ratio into either the intervention group or the control group using a computer-generated randomization sequence. Randomization is stratified by center to maintain balance in allocation. This ensures comparability between groups and reduces selection bias.

### Blinding

The study is open-label, meaning both clinicians and participants are aware of the treatment allocation. However, embryologists and laboratory personnel responsible for evaluating oocyte maturity and embryo quality are blinded to group assignment to maintain objectivity in outcome assessment.

### Interventions

#### Intervention Arm (Arm 1)

Participants receive Coenzyme Q10 at a dose of 300 mg twice daily for 60 days before starting ovarian stimulation. The supplement is given orally.

#### Control Arm (Arm 2)

Participants undergo standard IVF/ICSI protocol without any CoQ10 supplementation.

Both groups receive ovarian stimulation, egg retrieval, fertilization, embryo transfer, and luteal phase support according to standard clinical practice.

### Study Procedures

#### Baseline Evaluation

1. Collection of demographic and clinical data
2. Hormonal profile and transvaginal ultrasound
3. Informed consent and enrollment

**Pre-Stimulation Phase (60 Days):**
1. CoQ10 supplementation for intervention arm
2. Monitoring adherence and any side effects

**IVF/ICSI Cycle**
1. Controlled ovarian stimulation using standard protocols
2. Follicular monitoring and hormonal assays
3. Oocyte retrieval and fertilization
4. Embryo transfer (fresh or frozen based on clinical indication)

**Follow-up**
1. Monitoring for pregnancy via serum beta-hCG
2. Ultrasound for confirmation of clinical pregnancy
3. Regular follow-up for ongoing pregnancy and live birth

**Outcome Measures**
**Primary Outcome**
**MII Oocyte Rate: The percentage of mature (metaphase II) oocytes retrieved at the time of ovum pick-up**

**Secondary Outcomes**
1. Follicle-Oocyte Index on the day of retrieval
2. Oocyte Retrieval Rate (total oocytes retrieved per follicles aspirated)
3. Aneuploidy Rate (in embryos analyzed 5 days post-OPU where PGT-A is performed)
4. Implantation Rate (confirmed by gestational sac on ultrasound)
5. Clinical Pregnancy Rate (presence of fetal heartbeat at 6–8 weeks)
6. Ongoing Pregnancy Rate at 12 weeks post-transfer
7. Live Birth Rate, recorded approximately 40 weeks after embryo transfer

**Statistical Analysis**
Statistical analysis will be performed using intention-to-treat (ITT) and per-protocol approaches. Continuous variables will be summarized as means ± standard deviation or medians, and compared using independent t-tests or Mann-Whitney U tests, depending on normality. Categorical data will be expressed as frequencies and percentages, and analyzed using chi-square or Fisher's exact tests. A p-value $< 0.05$ will be considered statistically significant. Multivariate logistic regression may be applied to control for potential confounders.

**Ethical Considerations**
The study has been approved by the Institutional Ethics Committees (IEC) of all participating centers. Written informed consent is obtained from all participants before inclusion. The study is registered with the Clinical Trials Registry of India (CTRI). Participant confidentiality is maintained throughout the study, and adverse events are closely monitored and reported.

**Safety and Monitoring**
An independent Data Safety Monitoring Board (DSMB) oversees the study conduct and safety data. Participants are educated on possible side effects and are encouraged to report any symptoms or complications during the study period.

**Results**
A total of 155 patients were randomized into the Standard Arm (n = 78) and the CoQ10 Arm (n = 77). Baseline characteristics such as age (34.61 ± 4.49 vs. 34.81 ± 3.94 years, p = 0.980), BMI (25.40 ± 3.94 vs. 25.00 ± 3.55 kg/m², p = 0.516), AMH (0.70 ± 0.28 vs. 0.72 ± 0.29 ng/mL, p = 0.727), and Antral Follicle Count (6.82 ± 3.20 vs. 6.94 ± 3.62, p = 0.846) were comparable between groups.
However, the CoQ10 group experienced significantly higher dropout rates (16.9% vs. 0.0%, $p < 0.001$), loss to follow-up at stimulation (27.3% vs. 0.0%, $p < 0.001$), and stimulation cancellation rates (13.0% vs. 2.6%, p = 0.017) compared to the Standard Arm.
Among participants who completed treatment (Standard Arm, n=76; CoQ10 Arm, n=33), the CoQ10 group showed:
- A non-significant increase in the total duration of ovarian stimulation (11.81 ± 1.92 vs. 11.27 ± 2.27 days, p = 0.292),
- A significantly higher total gonadotropin dose used (2652.27 ± 1041.56 vs. 2288.00 ± 928.37 IU, p = 0.039),
- Higher expected number of oocytes (6.25 ± 3.23 vs. 4.98 ± 2.93, p = 0.042),
- Greater number of oocytes retrieved (6.93 ± 3.85 vs. 5.06 ± 3.88, p = 0.011),
- Significantly increased number of mature (MII) oocytes (5.45 ± 3.48 vs. 3.56 ± 2.84, p = 0.005),
- More embryos formed (3.46 ± 3.01 vs. 2.28 ± 2.22, p = 0.045).

No significant differences were observed between groups in the number of good-quality blastocysts (1.31 ± 1.25 vs. 1.17 ± 1.14, p = 0.424), oocyte retrieval rate (117.53 ± 55.56% vs. 108.60 ± 56.31%, p = 0.466), MII oocyte rate (77.25 ± 20.32% vs. 75.35 ± 21.61%, p = 0.721), blastocyst formation rate (61.16 ± 46.11% vs. 60.67 ± 41.36%, p = 0.957), and good-quality blastocyst rate (25.13 ± 24.23% vs. 32.44 ± 30.45%, p = 0.285).
Follicle-to-oocyte index (FOI) (1.00 ± 0.51 vs. 0.89 ± 0.82, p = 0.051) and follicle output rate (FORT) (0.87 ± 0.40 vs. 0.78 ± 0.58, p = 0.094) trended higher in the CoQ10 group but did not reach statistical significance.
A total of 109 participants were analyzed in this study, with 76 in the standard treatment arm and 33 in the Coenzyme Q10 (CoQ10) intervention arm. The impact of CoQ10 supplementation on various ovarian stimulation and embryological parameters was assessed and compared between the two groups.
The total duration of ovarian stimulation was comparable between the two groups. The mean stimulation period in the CoQ10 arm was 11.81 ± 1.92 days, slightly higher than the 11.27 ± 2.27 days observed in the standard arm; however, this difference was not statistically significant (p = 0.292).
Notably, the total gonadotropin dose required was significantly higher in the CoQ10 group (mean: 2652.27 ± 1041.56 IU) compared to the standard arm (2288.00 ± 928.37 IU), with a statistically significant p-value of 0.039. Despite the increased gonadotropin usage, the CoQ10 arm demonstrated superior ovarian response. The expected number of oocytes was higher in the CoQ10 group (6.25 ± 3.23) than in the standard group (4.98 ± 2.93), with this difference reaching statistical significance (p = 0.042).
Consistent with this finding, the actual number of oocytes retrieved was significantly greater in the CoQ10 arm (6.93 ± 3.85) than in the standard arm (5.06 ± 3.88) (p = 0.011). Similarly, the number of mature oocytes at metaphase II (MII) stage was significantly higher in the CoQ10 group (5.45 ± 3.48)

compared to the standard group (3.56 ± 2.84), yielding a p-value of 0.005.

Embryological outcomes also showed improvements with CoQ10 supplementation. The number of embryos formed was significantly higher in the CoQ10 arm (3.46 ± 3.01) than in the standard arm (2.28 ± 2.22) (p = 0.045). However, while the number of good-quality blastocysts was numerically higher in the CoQ10 group (1.31 ± 1.25) compared to the standard group (1.17 ± 1.14), the difference did not reach statistical significance (p = 0.424).

When evaluating oocyte retrieval efficiency, both the oocyte retrieval rate and MII oocyte rate showed no significant differences between the groups. The oocyte retrieval rate was slightly higher in the CoQ10 group (117.53 ± 55.56%) than in the standard group (108.60 ± 56.31%), but this was not statistically significant (p = 0.466). The MII oocyte rate was also comparable between the two groups (77.25 ± 20.32% in the CoQ10 arm vs. 75.35 ± 21.61% in the standard arm, p = 0.721).

Rates of blastocyst formation were nearly identical between the groups, with a mean rate of 61.16% in the CoQ10 arm and 60.67% in the standard arm (p = 0.957). The proportion of good-quality blastocysts was lower in the CoQ10 group (25.13 ± 24.23%) compared to the standard group (32.44 ± 30.45%), but this difference was not statistically significant (p = 0.285).

Two key indices related to follicular efficiency—Follicle-to-Oocyte Index (FOI) and Follicle Output Rate (FORT)—showed trends favoring CoQ10 supplementation. The mean FOI was slightly higher in the CoQ10 arm (1.00 ± 0.51) than in the standard arm (0.89 ± 0.82), with a p-value approaching statistical significance (p = 0.051). Similarly, the FORT value was higher in the CoQ10 group (0.87 ± 0.40) compared to the standard group (0.78 ± 0.58), although this difference did not reach statistical significance (p = 0.094).

In summary, CoQ10 supplementation was associated with a statistically significant improvement in the number of oocytes retrieved, number of MII oocytes, and number of embryos formed. While some other parameters such as blastocyst formation and quality were numerically better or similar in the CoQ10 group, these differences were not statistically significant. The findings suggest that CoQ10 may enhance ovarian response and early embryonic development, particularly in terms of oocyte maturation and fertilization potential.

## Discussion

This study demonstrates that Coenzyme Q10 (CoQ10) supplementation in women with diminished ovarian reserve (DOR) leads to significantly improved ovarian response during controlled ovarian stimulation (COS). Specifically, the CO-Q10 arm showed greater numbers of retrieved oocytes, mature (MII) oocytes, and embryos formed, compared to the standard arm. These findings are supported by emerging evidence suggesting that CoQ10 may restore mitochondrial function in aging oocytes, thereby enhancing reproductive outcomes.

Mitochondrial dysfunction is a key hallmark of reproductive aging and is directly linked to reduced oocyte quality and competence (Ben-Meir *et al*., 2015). As oocytes age, they exhibit impaired mitochondrial activity, decreased ATP production, and increased oxidative stress—all of which contribute to meiotic errors and developmental arrest (Moghadam *et al*., 2022). CoQ10, a vital component of the mitochondrial electron transport chain, has been shown to enhance mitochondrial function, reduce reactive oxygen species (ROS), and improve meiotic spindle integrity (Yang *et al*., 2021).

In a landmark animal study, Ben-Meir *et al*. (2015) demonstrated that CoQ10 supplementation could restore oocyte mitochondrial activity in aged mice, leading to improved fertility outcomes. Similarly, Bentov *et al*. (2014) showed that CoQ10 supplementation was associated with a lower rate of post-meiotic aneuploidy in human oocytes during IVF-ICSI cycles, suggesting potential benefits in improving oocyte genomic stability.

Our findings also align with results from a systematic review by Florou *et al*. (2020), which reported that CoQ10 supplementation in women undergoing ART was associated with increased oocyte yield and improved fertilization rates. While most studies, including ours, consistently show improved quantitative outcomes (e.g., oocyte number), evidence on embryo quality and live birth rates remains less conclusive.

Interestingly, despite the higher number of oocytes and embryos in the CO-Q10 group, we did not observe a significant increase in the number of good-quality blastocysts or blastocyst formation rates. This suggests that while CoQ10 may enhance mitochondrial efficiency and early oocyte development, its impact on later stages of embryogenesis may be limited. This is consistent with prior reports that CoQ10's effects are more pronounced at the level of oocyte maturation rather than post-fertilization development (Yang *et al*., 2021; Bentov *et al*., 2014).

Moreover, although the CO-Q10 group required significantly higher doses of gonadotropins, the enhanced ovarian response may justify the increased stimulation burden in poor responders. It is also worth noting that the Follicle-to-Oocyte Index (FOI) and Follicle Output Rate (FORT) trended higher in the CO-Q10 group, although not reaching statistical significance—indicating a possible improvement in follicular efficiency.

## Limitations

This study is limited by its relatively small sample size and lack of randomization. Additionally, pregnancy and live birth outcomes were not assessed, which limits the ability to fully determine clinical efficacy. Larger, randomized trials with long-term follow-up are necessary to validate these findings.

**Table 1:** Comparison of Baseline Clinical Characteristics Between Standard Arm and CO-Q10 Arm (Intention-to-Treat Population, *n* = 155)

| Characteristic | Statistic | Standard Arm (*n* = 78) | CO-Q10 Arm (*n* = 77) | p value |
|---|---|---|---|---|
| Age (years) | Mean ± SD | 34.61 ± 4.49 | 34.81 ± 3.94 | .980* |
| | 95% CI (Mean) | (33.60, 35.62) | (33.92, 35.71) | |
| Body Mass Index (kg/m²) | Mean ± SD | 25.40 ± 3.94 | 25.00 ± 3.55 | .516** |
| | 95% CI (Mean) | (24.51, 26.28) | (24.20, 25.81) | |
| Anti-Müllerian Hormone (ng/mL) | Mean ± SD | 0.70 ± 0.28 | 0.72 ± 0.29 | .727* |
| | 95% CI (Mean) | (0.64, 0.77) | (0.65, 0.78) | |
| Antral Follicle Count | Mean ± SD | 6.82 ± 3.20 | 6.94 ± 3.62 | .846* |
| | 95% CI (Mean) | (6.09, 7.54) | (6.12, 7.77) | |

**Note.** Values are presented as Mean ± Standard Deviation (SD) with 95% Confidence Intervals (CI).
*p* values marked with * were calculated using the Mann–Whitney U test.
*p* values marked with ** were calculated using the Independent Samples *t*-test.

**Table 2:** Comparison of Baseline and Early Treatment Discontinuation Variables Between Standard Arm and CO-Q10 Arm (Intention-to-Treat Analysis, *n* = 155)

| Characteristic | Statistic | Standard Arm (*n* = 78) | CO-Q10 Arm (*n* = 77) | p value |
|---|---|---|---|---|
| Dropout Rate | *n* (%) | 0 (0.0%) | 13 (16.9%) | <.001*** |
| Lost to Follow-up (LFU) at Stimulation | *n* (%) | 0 (0.0%) | 21 (27.3%) | <.001*** |
| Stimulation Cancellation Rate | *n* (%) | 2 (2.6%) | 10 (13.0%) | .017*** |
| Note. Values are presented as number and percentage (*n* (%)). ***p* values computed using Fisher's Exact Test. | | | | |

**Table 3:** Comparison of Outcomes Between Standard Arm and CO-Q10 Arm ( *n* = 109)

| Characteristic | Statistic | Standard Arm (*n* = 76) | CO-Q10 Arm (*n* = 33) | p value |
|---|---|---|---|---|
| Total Duration of Ovarian Stimulation (days) | Mean ± SD | 11.27 ± 2.27 | 11.81 ± 1.92 | .292* |
| | 95% CI (Mean) | (10.72, 11.81) | (11.11, 12.50) | |
| Total Gonadotropin Dose Used (IU) | Mean ± SD | 2288.00 ± 928.37 | 2652.27 ± 1041.56 | .039* |
| | 95% CI (Mean) | (2075.85, 2500.00) | (2282.94, 3021.59) | |
| Expected Number of Oocytes | Mean ± SD | 4.98 ± 2.93 | 6.25 ± 3.23 | .042* |
| | 95% CI (Mean) | (4.28, 5.68) | (5.08, 7.41) | |
| Number of Oocytes Retrieved | Mean ± SD | 5.06 ± 3.88 | 6.93 ± 3.85 | .011* |
| | 95% CI (Mean) | (4.17, 5.95) | (5.57, 8.30) | |
| Number of Mature Oocytes (MII Stage) | Mean ± SD | 3.56 ± 2.84 | 5.45 ± 3.48 | .005* |
| | 95% CI (Mean) | (2.91, 4.21) | (4.21, 6.68) | |
| Number of Embryos Formed | Mean ± SD | 2.28 ± 2.22 | 3.46 ± 3.01 | .045* |
| | 95% CI (Mean) | (1.75, 2.81) | (2.38, 4.55) | |
| Number of Good-Quality Blastocysts | Mean ± SD | 1.17 ± 1.14 | 1.31 ± 1.25 | .424* |
| | 95% CI (Mean) | (0.89, 1.14) | (0.85, 1.76) | |
| Oocyte Retrieval Rate (%) | Mean ± SD | 108.60 ± 56.31 | 117.53 ± 55.56 | .466* |
| | 95% CI (Mean) | (95.73, 121.47) | (97.82, 137.23) | |
| No MII Retrieved | *n* (%) | 6 (7.9%) | 1 (3.0%) | .673*** |
| MII Oocyte Rate (%) | Mean ± SD | 75.35 ± 21.61 | 77.25 ± 20.32 | .721* |
| | 95% CI (Mean) | (70.20, 80.51) | (69.93, 84.58) | |
| Blastocyst Formation Rate (%) | Mean ± SD | 60.67 ± 41.36 | 61.16 ± 46.11 | .957* |
| | 95% CI (Mean) | (50.81, 70.53) | (46.11, 76.21) | |
| Good-Quality Blastocyst Rate (%) | Mean ± SD | 32.44 ± 30.45 | 25.13 ± 24.23 | .285* |
| | 95% CI (Mean) | (25.18, 39.70) | (16.39, 33.87) | |
| Follicle-to-Oocyte Index (FOI) | Mean ± SD | 0.89 ± 0.82 | 1.00 ± 0.51 | .051* |
| | 95% CI (Mean) | (0.69, 1.08) | (0.81, 1.18) | |
| Follicle Output Rate (FORT) | Mean ± SD | 0.78 ± 0.58 | 0.87 ± 0.40 | .094* |
| | 95% CI (Mean) | (0.64, 0.92) | (0.72, 1.01) | |
| **Note.** Values are presented as Mean ± Standard Deviation (SD), 95% Confidence Interval (CI), or *n* (%). *p* values: *Mann–Whitney U test; **Independent Samples *t*-test; ***Fisher's Exact Test; $Pearson Chi-Square Test.* | | | | |

## Conclusion

CoQ10 supplementation appears to significantly improve ovarian response in women with diminished ovarian reserve by increasing the number of retrieved and mature oocytes, as well as embryos formed. These results are biologically plausible given CoQ10's role in enhancing mitochondrial function and reducing oxidative stress in aging oocytes. However, further research is warranted to determine whether these improvements translate into higher implantation and live birth rates.

## References


1. Ben-Meir A, Burstein E, Borrego-Alvarez A, *et al*. Coenzyme Q10 restores oocyte mitochondrial function and fertility during reproductive aging. Aging Cell. 2015;14(5):887–895. doi:10.1111/acel.12322.
2. Moghadam ARE, Moghadam MT, *et al*. Oocyte quality and aging. JBRA Assist Reprod. 2022.
3. Yang CX, Liu S, Miao JK, Mou Q, Liu XM, Wang PC. CoQ10 improves meiotic maturation of pig oocytes through enhancing mitochondrial function and suppressing oxidative stress. Theriogenology. 2021;175:115–123. doi:10.1016/j.theriogenology.2021.05.012.
4. Bentov Y, Hannam T, Jurisicova A, *et al*. Coenzyme Q10 supplementation and oocyte aneuploidy in women undergoing IVF-ICSI treatment. Clin Med Insights Reprod Health. 2014;8:43–49. doi:10.4137/CMRH.S13762.
5. Florou P, Anagnostis P, Theocharis P, *et al*. Does coenzyme Q10 supplementation improve fertility outcomes in women undergoing assisted reproductive technology procedures? A systematic review and meta-analysis. J Assist Reprod Genet. 2020;37(11):2629–2642. doi:10.1007/s10815-020-01886-6.
6. https://journals.co.za/doi/full/10.7196/SAJOG.2024.v30i1.1595



**How to Cite This Article**
Chandra V, Murdia K, Murdia N, Sanagoudar S, Rani R, Binwal P, *et al*. Effect of Coenzyme Q10 Supplementation on Oocyte Quality and ART Outcomes in POSEIDON Groups 3 and 4: A Multicentered Open-Label Randomized Controlled Trial. International Journal of Clinical Obstetrics and Gynaecology. 2026;10(4):1684-1688.



**Creative Commons (CC) License**
This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non-Commercial-Share Alike 4.0 International (CC BY-NC-SA 4.0) License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.