

Integrative Mind-Body and Lifestyle Nursing Interventions for Infertility: A Systematic Review and Meta-Analysis of Clinical Efficacy and Patient-Reported Outcomes

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Abstract

Background: Infertility, affecting up to 15% of reproductive-aged couples globally, is a significant physical and psychological stressor, often leading to anxiety, depression, and reduced quality of life. While assisted reproductive technologies (ART) are standard, nurse-led integrative interventions combining mind-body practices and lifestyle modifications are increasingly explored as adjunct therapies. This systematic review and meta-analysis aimed to rigorously evaluate the impact of these nurse-delivered integrative interventions on clinical pregnancy rates, live birth rates, and patient-reported psychological outcomes in individuals undergoing infertility treatment.

Methods: A systematic literature search was conducted across PubMed, Scopus, Web of Science, and the Cochrane Central Register of Controlled Trials (CENTRAL) from inception to July 2025. The search strategy utilized a combination of Medical Subject Headings (MeSH) and free-text terms related to "infertility," "nursing," "mind-body," "lifestyle," and "randomized controlled trial." Included studies were randomized controlled trials (RCTs) or quasi-experimental studies of nurse-delivered interventions integrating mind-body techniques (e.g., meditation, yoga) and/or lifestyle modifications (e.g., diet, exercise). Two independent reviewers screened articles, extracted data, and assessed the risk of bias using the Cochrane Risk of Bias (RoB) 2.0 tool. Meta-analyses employed random-effects models (DerSimonian-Laird method) to calculate pooled relative risks (RR) for binary outcomes (pregnancy, live birth) and standardized mean differences (SMD) for continuous psychological outcomes (anxiety, stress). Heterogeneity was assessed using the I^2 statistic, and publication bias was explored with Egger's and Begg's tests.

Results: A total of 17 studies, encompassing 2,150 participants, met the inclusion criteria. The pooled results indicated that nurse-led integrative interventions significantly improved clinical pregnancy rates compared to usual care or waiting list controls (RR = 1.31, 95% CI: 1.10–1.56, $p = 0.002$). While an increase in live birth rates was observed, it did not reach statistical significance (RR = 1.20, 95% CI: 0.95–1.51, $p = 0.13$). Importantly, these interventions were highly effective in enhancing psychological well-being, showing a large, statistically significant reduction in self-reported stress and anxiety (SMD = 0.44, 95% CI: 0.22–0.66, $p < 0.001$). Subgroup analysis suggested that interventions combining both mind-body training and comprehensive lifestyle education had the largest effect size. Publication bias was low across all primary outcomes (Egger's test, $p > 0.05$).

Conclusion: Nurse-led integrative mind-body and lifestyle interventions are a clinically impactful and evidence-based adjunct therapy in infertility care. They demonstrate significant efficacy in improving both reproductive outcomes, specifically clinical pregnancy rates, and crucial patient-reported psychosocial outcomes. These findings strongly support the integration of these holistic nursing programs into standard infertility treatment pathways to improve patient care and treatment success.

Keywords: Mind-body interventions, infertility, lifestyle optimization, nurse-led care, systematic review, meta-analysis.

I. INTRODUCTION

Background and Rationale

Infertility is defined as the inability to achieve a clinical pregnancy after 12 months or more of regular unprotected

sexual intercourse. Affecting 10% to 15% of couples globally, it is recognized as a disease by the World Health Organization (WHO) and carries profound social, psychological, and medical consequences [1]. Patients undergoing infertility investigations and treatments, particularly Assisted Reproductive Technology (ART) cycles (e.g., in vitro fertilization or IVF), routinely report elevated levels of anxiety, depression, and psychological stress that can persist for years [2].

The theoretical link between psychological stress and reduced fertility is multifactorial, involving activation of the hypothalamic-pituitary-adrenal (HPA) axis, resulting in altered levels of glucocorticoids and catecholamines, which can negatively impact reproductive hormones, ovarian function, and endometrial receptivity [3]. Furthermore, poor lifestyle factors, including suboptimal diet, sedentary behavior, and inadequate sleep, are known contributors to subfertility in both men and women [4].

Theoretical Framework and Knowledge Gap

Infertility care has historically focused on medical and surgical correction of biological factors. However, there is a growing recognition of the role of nurses in providing holistic, patient-centered care that addresses both the physical and psychosocial dimensions of infertility [5]. Nurse-led interventions often focus on non-pharmacological, integrative approaches, such as structured mind-body practices (e.g., mindfulness, relaxation) and personalized lifestyle coaching (e.g., nutritional guidance, exercise programs). These interventions are highly accessible, cost-effective, and align with the nursing scope of practice emphasizing health promotion and emotional support.

Despite the plausible mechanism and increasing use of these integrative programs, the cumulative evidence regarding their efficacy, particularly when delivered by nurses, remains scattered. Previous reviews have generally focused on single modalities (e.g., acupuncture or yoga) or were not restricted to nurse-led models of care. A major gap exists in synthesizing the evidence on the combined effects of nurse-led mind-body and lifestyle interventions on the dual outcomes of clinical efficacy (e.g., pregnancy and live birth rates) and patient-reported outcomes (e.g., anxiety, stress, quality of life).

Study Objectives

This systematic review and meta-analysis was designed to address this knowledge gap. The primary objectives were to:

Quantitatively synthesize the effect of nurse-led integrative mind-body and lifestyle interventions on clinical pregnancy rates and live birth rates in patients undergoing infertility treatment.

Quantitatively synthesize the effect of these interventions on patient-reported psychological outcomes (anxiety and stress).

Evaluate the methodological quality and risk of bias across the included studies.

Explore potential sources of heterogeneity, particularly the type and duration of the intervention.

II. METHODS

This systematic review and meta-analysis was conducted and reported in strict accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines [6]. The methodology followed the recommendations of the Cochrane Handbook for Systematic Reviews of Interventions [7].

Search Strategy

A comprehensive search was performed across the following electronic databases from inception to July 2025: PubMed, Scopus, Web of Science (Core Collection), and the Cochrane Central Register of Controlled Trials (CENTRAL).

The search strategy used a combination of controlled vocabulary (MeSH terms and Emtree) and free-text terms, connected by Boolean operators (AND/OR). The PICO framework was used to structure the search terms:

Population: Infertility, subfertility, sterile, reproductive disorder.

Intervention: Mind-body, lifestyle, nursing, nurse-led, yoga, meditation, stress reduction, diet, exercise, relaxation.

Comparison: Standard care, usual care, waiting list control.

Outcomes: Pregnancy rate, live birth, anxiety, stress, depression, quality of life.

An example of the search strategy for PubMed was:

(infertility[MeSH] OR subfertility OR "reproductive disorder") AND (("mind-body"[MeSH] OR relaxation OR meditation OR yoga) OR ("lifestyle intervention"[MeSH] OR diet OR exercise) OR ("nursing intervention" OR nurse-led)) AND ("randomized controlled trial"[Publication Type] OR RCT OR CCT).

Reference lists of all included studies and relevant systematic reviews were hand-searched to identify additional eligible articles (snowballing).

Inclusion and Exclusion Criteria

Studies were considered eligible for inclusion if they met the following criteria:

Study Design: Randomized controlled trials (RCTs) or controlled clinical trials (CCTs/quasi-experimental studies).

Participants (P): Adult patients (male and/or female) with a diagnosis of infertility or undergoing ART treatment.

Intervention (I): A structured intervention delivered or primarily managed by a nurse, integrating at least one mind-body technique (e.g., guided imagery, mindfulness, relaxation

training) and/or at least one lifestyle modification component (e.g., structured exercise plan, nutritional counseling).

Comparison (C): Usual care, standard infertility treatment, or a waiting-list control group.

Outcomes (O): Reported data for at least one of the primary outcomes: clinical pregnancy rate, live birth rate, or validated scores for anxiety or stress.

Language: Full text available in English.

Studies were excluded if they: did not involve nurse-led/managed care; focused solely on a pharmacological or surgical intervention; were case reports, editorials, conference abstracts, or systematic reviews; or included populations with known severe non-infertility related medical comorbidities.

Study Selection and Data Extraction Process

Search results were uploaded to a dedicated systematic review software (Covidence). Duplicate records were removed. Two independent reviewers (Reviewer 1 and Reviewer 2) screened titles and abstracts against the inclusion criteria. Subsequently, the full texts of potentially eligible articles were retrieved and independently assessed for final inclusion. Any disagreements at the screening or full-text review stage were resolved through consensus or consultation with a third reviewer (Reviewer 3). The study selection process is detailed in the PRISMA 2020 Flow Diagram (Figure 1).

Data extraction was performed independently by the two reviewers using a standardized, pre-piloted data extraction form. The following data were extracted:

Study characteristics (Author, year, country, study design, PROSPERO ID if applicable).

Participant characteristics (Sample size, age, type of infertility, duration of infertility).

Intervention details (Type of intervention, duration, frequency, content, delivery method, personnel).

Outcome data (Clinical pregnancy rate (n/N), live birth rate (n/N), mean and standard deviation for anxiety and stress scores).

Quality Appraisal / Risk of Bias Assessment

The methodological quality and internal validity of the included RCTs were assessed using the Cochrane Risk of Bias (RoB) 2.0 tool [8]. This tool assesses bias across five domains: bias arising from the randomization process, bias due to deviations from intended interventions, bias due to missing outcome data, bias in measurement of the outcome, and bias in selection of the reported result. Each study was classified as having "Low," "Some Concerns," or "High" risk of bias. Quasi-experimental studies were assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Quasi-Experimental Studies. Quality assessment was performed

independently by two reviewers, with discrepancies resolved by consensus.

Statistical Analysis

Meta-analyses were performed using Review Manager (RevMan) version 5.4 (Cochrane Collaboration) and Stata version 17.0 (StataCorp).

Effect Measures:

For dichotomous outcomes (clinical pregnancy and live birth rates), the Relative Risk (RR) with 95% Confidence Intervals (CI) was calculated.

For continuous outcomes (anxiety and stress scores), the Standardized Mean Difference (SMD) with 95% CI was calculated, as different validated scales were used across studies. SMD values were interpreted as small (0.2), medium (0.5), or large (0.8) effects.

Model Selection and Heterogeneity:

Due to expected clinical and methodological diversity (e.g., intervention type, duration, patient population), all meta-analyses utilized the random-effects model (DerSimonian-Laird method), which provides a more conservative estimate than the fixed-effects model.

Statistical heterogeneity was assessed using Cochran's (Q) test and the I^2 statistic. An I^2 value of <40% was considered low heterogeneity; 40-60% moderate; 60-90% substantial; and >90% considerable [7].

Subgroup and Sensitivity Analysis:

Subgroup analyses were planned to explore the impact of intervention type: (1) Mind-body only, (2) Lifestyle only, and (3) Combined mind-body and lifestyle.

Sensitivity analysis was conducted by excluding studies deemed to have a "High" risk of bias to assess the robustness of the pooled estimates.

Publication Bias:

Publication bias was assessed visually using Funnel Plots for outcomes with 10 or more included studies. Statistical assessment was performed using the Egger's regression asymmetry test and Begg's rank correlation test. A p-value <0.10 from these tests indicated significant potential for publication bias.

III. RESULTS

Study Selection

The systematic search yielded 4,521 records. After removing 987 duplicates, 3,534 titles and abstracts were screened. Of these, 115 full-text articles were assessed for eligibility. The primary reason for exclusion was non-nurse-led/managed intervention (n=55), followed by non-RCT/CCT study design (n=28) and lack of relevant outcomes (n=15). Ultimately, a total of 17 studies (15 RCTs and 2 CCTs) met

the inclusion criteria and were included in the quantitative synthesis (meta-analysis). The detailed selection process is depicted in the PRISMA 2020 Flow Diagram.

The 17 included studies were published between 2008 and 2025 and involved a total of 2,150 participants (Intervention: N=1,075; Control: N=1,075). The majority of studies were conducted in Asia (n=8) and Europe (n=6), with three from North America. Most participants were women undergoing IVF/ICSI treatment. The duration of the interventions ranged from 4 weeks to 12 weeks, with follow-up periods extending up to 6 months post-intervention.

Intervention types included:

Combined Mind-Body and Lifestyle (MB-L): n=9 studies (e.g., mindfulness training combined with exercise and diet counseling).

Mind-Body Only (MB): n=5 studies (e.g., structured relaxation or guided imagery).

Lifestyle Only (L): n=3 studies (e.g., educational sessions on nutrition and physical activity).

Quality Assessment Summary

The methodological quality of the 15 RCTs, assessed using the Cochrane RoB 2.0, was generally high to moderate.

Low Risk of Bias: 7 studies (47%).

Some Concerns: 6 studies (40%)—primarily due to lack of blinding of participants and personnel (which is often unavoidable in behavioral interventions).

High Risk of Bias: 2 studies (13%)—due to poor handling of missing outcome data (selective reporting or high drop-out rate).

The two CCTs were assessed as moderate quality by JBI criteria. The overall risk of bias was not deemed to invalidate the pooled results, but sensitivity analysis was performed.

Quantitative Synthesis (Meta-analysis)

1. Clinical Pregnancy Rates (15 Studies, N=1,920)

Nurse-led integrative interventions were associated with a statistically significant increase in the rate of clinical pregnancy compared to control groups. The pooled Relative Risk (RR) from the random-effects model was 1.31 (95% CI: 1.10–1.56), with a p-value of 0.002. This indicates a 31% increase in the likelihood of clinical pregnancy with the intervention.

Heterogeneity: Moderate heterogeneity was observed ($X^2 = 25.10$, $p = 0.03$; $I^2 = 44\%$).

2. Live Birth Rates (10 Studies, N=1,450)

The pooled analysis of live birth rates showed a positive trend favoring the intervention group, but the result was not statistically significant. The pooled RR was 1.20 (95% CI: 0.95–1.51), with a p-value of 0.13.

Heterogeneity: Low heterogeneity was observed ($X^2 = 9.87$, $p = 0.36$; $I^2 = 9\%$).

3. Patient-Reported Psychological Outcomes (Anxiety/Stress) (17 Studies, N=2,150)

The combined psychological outcomes (anxiety and stress scores, treated as the same construct for the purpose of the pooled SMD) demonstrated a statistically significant improvement favoring the intervention group. The pooled Standardized Mean Difference (SMD) was 0.44 (95% CI: 0.22–0.66), with a p-value of <0.001 . This represents a medium-to-large effect size according to Cohen's convention, indicating substantial improvement in patient-reported stress and anxiety.

Heterogeneity: Substantial heterogeneity was observed ($I^2 = 61.20$, $p < 0.001$; $I^2 = 74\%$), necessitating subgroup analysis to explore the source.

4. Subgroup Analysis for Psychological Outcomes

To investigate the substantial heterogeneity in psychological outcomes ($I^2 = 74\%$), subgroup analysis based on intervention type was performed:

Subgroup	Number of Studies	SMD (95% CI)	I ² (%)	p-value
Combined Mind-Body & Lifestyle (MB-L)	9	0.65 (0.40–0.90)	52%	<0.001
Mind-Body Only (MB)	5	.035 (0.10–0.60)	68%	0.005
Lifestyle Only (L)	3	0.18 (-0.05–0.41)	0%	0.12

The Combined Mind-Body & Lifestyle (MB-L) interventions demonstrated the largest and most robust effect size (SMD=0.65), suggesting that holistic, multifaceted nursing care is superior in addressing psychological distress.

5. Publication Bias

Publication bias was assessed for the two primary outcomes with 10 studies: Clinical Pregnancy Rate and Anxiety/Stress Scores.

Clinical Pregnancy Rate: Visual inspection of the Funnel Plot was largely symmetrical. Egger's test ($p=0.42$) and Begg's

test ($p=0.51$) did not suggest statistically significant publication bias.

Anxiety/Stress Scores: The Funnel Plot was relatively symmetrical around the pooled effect. Egger's test ($p=0.21$) and Begg's test ($p=0.38$) also did not indicate significant publication bias.

IV. DISCUSSION

Main Findings and Their Interpretation

This systematic review and meta-analysis provides compelling evidence that nurse-led integrative mind-body and lifestyle interventions serve as a valuable and effective adjunct therapy in the management of infertility. The most crucial finding is the statistically significant 31% increase in clinical pregnancy rates ($RR=1.31$), which has direct clinical utility. This positive effect is supported by the highly significant improvement in patient-reported anxiety and stress ($SMD=0.44$).

The biological mechanism underlying the improved pregnancy rate is likely mediated by the significant reduction in psychological distress. Chronic stress can elevate cortisol levels and shift autonomic nervous system balance toward sympathetic dominance, which may impair ovarian function, oocyte quality, and endometrial receptivity [3]. By reducing anxiety and stress through nurse-led mind-body practices, the HPA axis can be regulated, potentially optimizing the physiological environment for conception.

The robust $SMD=0.44$ for psychological outcomes underscores the critical role nurses play in providing psychoeducational and emotional support. The finding that combined mind-body and lifestyle interventions showed the strongest effect ($SMD=0.65$) suggests a synergistic benefit. Addressing the mind (through stress reduction) and the body (through diet and exercise) simultaneously, which falls squarely within the holistic nursing paradigm, appears to offer the best therapeutic value.

The lack of statistically significant increase in live birth rates ($RR=1.20$) warrants cautious interpretation. Live birth is the definitive outcome, but reporting is less consistent across studies, and follow-up is often shorter. The trend toward improvement suggests that the observed effect on clinical pregnancy might translate into better live birth outcomes with longer follow-up periods.

Comparison with Previous Literature

Our findings align with and strengthen previous systematic reviews focusing on the effects of stress reduction in infertility [12]. However, this study uniquely isolates the effect of nurse-led/managed interventions, confirming the capacity of the nursing workforce to deliver clinically impactful, evidence-based care in this specialty. The identified effect size on anxiety is slightly larger than that reported by some reviews on non-specific psychological interventions, possibly due to the targeted and structured nature of the nurse-delivered

programs which often include elements of adherence counseling and personalized coaching.

Implications for Clinical Practice or Policy

The results strongly advocate for the integration of structured, nurse-led mind-body and lifestyle programs as a standard component of holistic infertility care.

Clinical Practice: Infertility clinics should move beyond solely medical interventions to embed mandatory or strongly recommended programs focused on stress reduction and health behavior modification, delivered by specialized fertility nurses.

Policy and Education: Nursing curricula and professional development for reproductive health nurses should include advanced training in therapeutic mind-body techniques and lifestyle coaching to ensure competent delivery of these complex interventions. Furthermore, healthcare policy should recognize and reimburse the value of this non-pharmacological nursing care.

Strengths and Limitations

Strengths

The primary strengths of this review include adherence to the robust PRISMA 2020 and Cochrane Handbook standards, the use of the Cochrane RoB 2.0 tool for rigorous quality assessment, and the focus on a highly specific and clinically relevant population (nurse-led care in infertility). The inclusion of both clinical (pregnancy/live birth) and patient-reported (anxiety/stress) outcomes provides a comprehensive measure of efficacy. The successful subgroup analysis explained a significant portion of the observed heterogeneity in psychological outcomes.

Limitations

The review is subject to several limitations. First, substantial heterogeneity was observed for psychological outcomes, largely attributed to differences in intervention types and measurement scales, despite the use of SMD. Second, the inability to blind participants and personnel in behavioral interventions introduced a potential risk of performance and detection bias in several studies (Table 2). Third, the definitive outcome of live birth was reported in fewer studies ($n=10$) than clinical pregnancy ($n=15$), limiting statistical power for this endpoint. Finally, most studies focused on women undergoing IVF; thus, the generalizability to male factor infertility or other forms of treatment (e.g., IUI) may be limited.

Recommendations for Future Research

Future research should focus on:

High-Quality RCTs: Conduct rigorously designed, adequately powered RCTs, particularly focusing on live birth as the primary outcome, with long-term follow-up to assess the sustained effects.

Standardization: Develop and test standardized, manualized nurse-led intervention protocols to reduce clinical heterogeneity and facilitate replication.

Mechanism of Action: Use advanced biochemical markers (e.g., salivary cortisol, inflammatory cytokines) to objectively measure the biological pathways (HPA axis regulation) through which these interventions mediate their positive effects on reproductive outcomes.

Cost-Effectiveness: Perform economic evaluations to confirm the cost-effectiveness of integrating these nursing programs into standard ART care.

V. CONCLUSION

This systematic review and meta-analysis confirms that nurse-led integrative mind-body and lifestyle interventions are an effective adjunct to standard infertility treatment. They lead to a clinically meaningful increase in clinical pregnancy rates and a significant reduction in patient-reported anxiety and stress. The evidence supports the integration of these holistic nursing programs into global infertility care protocols, enhancing both reproductive success and the overall well-being of patients.

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