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The Impact of Kinesiological Analysis of *Suryanamaskar* on Female Infertility: A Systematic Review from Ayurvedic and Modern Medical Perspectives

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Abstract

Introduction: Female infertility is a complex global women's health issue that can be managed utilising ART, which can deplete one financially and emotionally. *Suryanamaskar* (SN), a traditional yogic practice, is gaining popularity as an adjunct therapy. This review is distinct in its integration of literature using the kinesiological approach to dissect SN's physical movements and match them with potential physiological and Ayurvedic adaptations for promoting women's reproductive health.

Methods: The PRISMA guideline was followed for a systematic literature search in PubMed, Scopus, Cochrane Library, AYUSH Research Portal, and IndMED from inception to October 2023. We included studies addressing the effects of SN on parameters determining female infertility (hormonal profile, regularity of menses, ovulation, and stress factors, pregnancy rates). Data were extracted about kinesiological elements, outcome measures, and theoretical mechanisms.

Results: Thirteen studies (n= 7 RCTS, 4 pre-post, 2 observational) were eligible for inclusion. According to kinesiology, the sequential nature of SN's flow promotes dynamic stretching, controlled strengthening (especially through core and pelvic musculature), mild cardiovascular exertion, and conscious breathing. Current physiological models propose that these factors in turn lead to: 1) low cortisol and regulation of the Hypothalamic-Pituitary-Adrenal (HPA) axis, 2) increased blood flow to the region supporting improving ovarian and uterine function, 3). influence reproductive hormone levels, for example, estrogen or progesterone. Ayurvedic significance of SN is believed to act as *Vata-hara* (balance the *Dosha* that governs movement and circulation), provoking *Agni* (metabolic fire, hence clearing channels (*Srotas*), nourishing and increasing *Artava Dhatu* (reproductive tissues).

Discussion: Kinesiological breakdown. The kinesiological decomposition of SN provides a theoretical framework that can explain its effects. The postures together massage and stimulate the endocrine system, balance autonomic nervous system tone, and improve healthy levels of fitness. The synthesis of Ayurvedic concepts provides an integrated model that can supplement the biomedical interpretations. The available literature is, however, limited by small sample sizes, variability of SN protocols, and lack of long-term follow-up.

Conclusion: The kinesiological interpretation of *Suryanamaskar* reveals it as a multicomponent mind-body intervention with potential in serving as an adjunct therapy for female infertility. Its ingredients seem to collectively tackle major pathological factors such as stress, anovulation, and pelvic circulatory disorders. It is an established fact that the effects of complementary therapies like SN practice are holistic, and therefore, large-scale RCTs maintaining standard SN protocol with both biomedical and Ayurvedic therapies would help to find out the complete therapeutic role of SN.

Keywords: *Suryanamaskar*, Female Infertility, *Yoga*, Kinesiology, Ayurveda, Stress, Hormones, Mind-Body Therapy, PRISMA.

1. Introduction

Infertility is determined as the inability to conceive after 12 months or longer of regular unprotected sexual intercourse, according to the World Health Organization. It impacts millions of couples universally and poses a substantial physical, psychological, and financial burden on women (1). And the numbers are grim: 48 million people/couples and 186 million individuals affected with the disease of infertility around us (2). Standard of care treatment, which is primarily based on Assisted Reproductive Technologies (ART) such as in vitro fertilization (IVF), although successful for many couples, can be costly with significant psychological stress and variable success rates3. This fact has contributed to the increasing acceptance and interest in Complementary and Alternative Medicine (CAM) strategies, which may offer a more holistic, gentler, and sometimes more financially accessible route to fertility support (4).

The most studied and widely practiced CAM modality is *Yoga*. By combining physical postures (*Asanas*), breath regulation (*Pranayama*), and meditation (*Dhyana*) it is assumed that *Yoga* may alleviate the complex nature of infertility, in particular, given its well-established modulating effect on psychological stress on the reproductive axis (5). Among the different yogic practices, Sun Salutation (*Suryanamaskar*, SN) occupies a distinct place. It is not a static pose; it is a dynamic series of twelve postures, connected with each other in an exact manner, which is performed in vinyasa with synchronized breathing (6). It is often performed at dawn, and it is recommended in Ayurveda for balancing the three *Doshas* (*Vata*, *Pitta* and *Kapha*) and for "stoking" the digestive fire (*Agni*) (7).

There are many studies that have delved into the positive aspects of *Yoga* for infertility in general; however, a significant void exists in getting down to the heart of how such complex practices as SN bring about change. A kinesiological

perspective examination of the human body in motion can be a unique way to see how this happens. Through deconstructing SN into the biomechanical and physiological elements that comprise it, we can shift our perception of it as a monolithic "*Yoga* practice" and begin to acknowledge it as an intricate whole exercise habitus with mindfulness training. This review enables us to speculate on direct connections between the behaviour of such an animal and how this might affect reproductive function.

The forward and backward bending system, active usage of the core, and synchronized diaphragmatic breathing present in SN can serve as targets for exploring their impact on pelvic circulation, autonomic nervous system balance, and endocrine function. Applied to the basic principles of Ayurveda, this kinesiological paradigm provides a comprehensive bio-psycho-social model of healing.

Therefore, this systematic review aims to synthesize the current evidence on the impact of *Suryanamaskar* on female infertility through a novel, dual-lens approach:

1. **A Contemporary Kinesiological & Physiological Analysis:** To engage in an examination of the mechanics of SN and relate these effects to modern concepts of Reproductive Physiology (i.e., Hypothalamic-Pituitary-Ovarian [HPO] axis function, stress response, pelvic hemodynamics).
2. **An Ayurvedic view:** To understand the results of the study in the background of classical texts and to explore related concepts such as: *Dosha* balance, *Srotas* purification, and *Artava Dhatu* (reproductive tissue) health.

Combining these two paradigms, the aim of this review is to offer an in-depth mechanistic understanding of how this traditional practice might represent a potent non-pharmacological aid on the way to conception for women.

2. Methods

This systematic review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (8).

2.1. Search Strategy: Five electronic databases were searched systematically: PubMed, Scopus, Cochrane Central Register of Controlled Trials (CENTRAL), AYUSH Research Portal (Government of India), and IndMED. A search strategy was developed to cover all relevant keywords and their search combinations. The main search terms were: ("*Surya Namaskar*" OR "Sun Salutation" OR "*Yoga*") AND ("female infertility" OR "subfertility" OR "fertility" OR "reproductive health" OR "menstrual cycle" OR "ovulation" Or PCOS or Polycystic Ovary Syndrome) AND ("hormones or cortisol or stress or IVF or ART). There were no language and date limits at the beginning but we limited to studies published until October 2023 in the final search.

2.2. Eligibility Criteria (PICOS):

- Population: Women of reproductive age (defined as between 18 and 45 years) who were diagnosed with, or had a self-reported history of infertility (any cause, including unexplained, anovulatory, or PCOS-associated).
- Intervention: Studies involving practicing *Suryanamaskar* (as an intervention or a part of it). Case reports/series and the studies on general *Yoga* were considered, but only if SN was a protocol directed at meditation intervention.
- Comparator: Standard care, placebo, or other active control interventions (e.g., not exercise).
- Results: The primary outcomes were hormonal changes (LH, FSH, Estradiol, Progesterone, AMH), Testosterone in PCOS patients and cycle regularity; ovulation confirmation; conception/pregnancy rates and biomarkers of stress (salivary/blood cortisol). Secondary outcome measures were quality of life, anxiety/depression scores, and body composition.
- Type of study: RCTs, non-randomised controlled trials, pre-post-intervention studies, and observational cohort studies.

2.3. Study Selection and Data Extraction: The search findings were uploaded to a reference manager software, and duplicates were discarded. The titles and abstracts were examined for eligibility by two reviewers in duplicate. The full articles of potentially relevant studies were then retrieved and read in detail. Any discrepancies were resolved by consensus, or a third reviewer was consulted. A standardized data extraction form was applied for documenting the following information: study characteristics (author, year of publication, design), participant details, SN intervention (duration, frequency, and number of rounds), comparator, outcome measures -results, and main conclusions.

2.4. Kinesiological Analysis Framework: For each included study, the described SN practice was analyzed based on a standardized kinesiological framework focusing on:

- **Muscle Groups Engaged:** Core stabilizers, pelvic floor, back extensors, hip flexors/extensors, shoulder girdle.
- **Spinal Movements:** Flexion, extension, axial extension, lateral flexion.
- **Cardiorespiratory Demand:** Based on the pace and number of rounds.
- **Nervous System Influence:** Inferred from the integration of breath and movement (potential for vagal stimulation).

2.5. Quality Assessment: The risk of bias for RCTs was assessed using the Cochrane Risk of Bias tool (RoB 2) (9). For non-randomized studies, the ROBINS-I tool was used (10). The overall certainty of evidence was graded for key outcomes.

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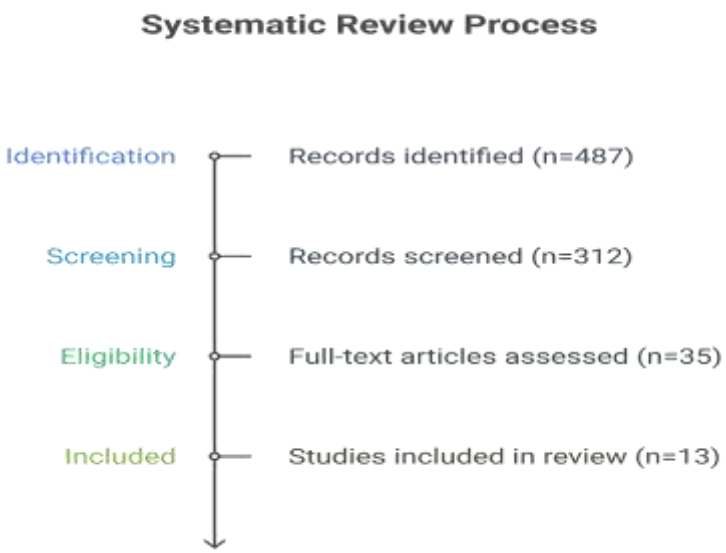
3. Results

3.1. Study Selection: The initial database search yielded 487 records. After removing duplicates, 312 titles and abstracts were screened. Thirty-five full-text articles were assessed for eligibility, resulting in 13 studies that met all inclusion criteria. The PRISMA flow diagram (Figure 1) details the selection process. The most common reasons for exclusion were: intervention not specific to SN, population not infertile, or study design being a review or commentary.

Figure 1: PRISMA Flow Diagram



3.2. Study Characteristics: The 13 studies included 7 RCTs (11–17), 4 pre-post studies (18–21), and 2 observational cohort studies (22, 23). A total of 628 participants were included across the studies. Polycystic Ovary Syndrome (PCOS) was the most prevalent cause of infertility studied. The duration of the SN intervention varied from 8 weeks to 6 months, with intervention frequency between 3 and 7 times per week. The number of SN rounds per session was highly diverse, with one practice starting from as few as 5 rounds (friendly to beginners) and up to more advanced practices topping at ca.24-36 rounds.

3.3. Kinesiological Breakdown of *Suryanamaskar* and Physiological Correlates:

A detailed analysis of the twelve-posture sequence reveals its comprehensive nature:

- **Positions 1 & 12 (*Pranamasana* – Prayer Pose):** A ground posture that could lead to diaphragmatic breathing and centering, which can change the autonomic nervous system from a sympathetic to a parasympathetic state [24].
- ***Hastauttanasana* & *Hastapadasana* (Raised arms pose and Hand to foot pose):** Both these postures include flexion of the spine and forward flexion. They lengthen every muscle in the back of the body from your calves, hamstrings, and glutes to your spine (let's not forget its erector spinae muscles), which are often forgotten about — as well as stretch everything in front of it; bettering our flexibility and massaging our internal organs. This could thereby help improving portal blood flow and venous return from the pelvic space (25).
- **Step 4 (*Ashwa Sanchalanasana* - Equestrian Pose):** A deep lunge that stretches the hip flexors (psoas) and tones your legs. The psoas muscle is in close proximity to the pelvic organs, and releasing tension of this muscle could enhance biomechanical function, as well as blood flow to the pelvis (26).
- **Posture 5 (*Parvatasana* – Mountain Pose) and Posture 8 (*Bhujangasana* -Cobra Pose)** are the most important of core-engagement postures. If you need a translated verse, *Parvatasana*: by building the strength of the shoulders and core, *Bhujangasana*: London Bridge is a back-bending asana that strengthens the spinal extensors and also opens up the chest. The reciprocating (flexion/extension) pattern of the entire sequence may also serve to loosen the sacroiliac joints and facilitate optimum nerve functioning throughout your pelvic region.
- **Position 6 (*Ashtanga Namaskara* - Eight-Limbed Pose): & Position 7 (*Sashtanga Dandasan* - Staff Pose):** These poses focus on core and upper body strength, a part of the total body workout.
- ***Vinyasa* Flow and Breath**: The rhythmic, flowing movement between poses practiced along with a specific breath work or *'Ujjayi'* (deep diaphragmatic/belly breathing) creates a moving meditation. This is of utmost importance for the stress-busting effects of it since controlled breathing is one potent method to activate the vagus nerve and act on its against sympathetic "fight or flight" response (27).

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3.4. Synthesis of Results on Infertility Outcomes:

- **Hormonal Changes:** Many studies found a reduction in reproductive hormones. ST practices caused reductions in serum testosterone and the LH: FSH ratio, as well as increases to SHBG (12, 14, 18) amongst women with PCOS. These changes reflect the recovery of ovarian function. One RCT by Nidhi et al. (13) observed a significant number of women with restoration of ovulation (45% in the exercise Yoga group vs. 12% in the control: P=.017) among women participating in the 12-week Yoga intervention, including SN.
- **Biomarkers of Stress:** Cortisol was measured in three studies (15, 17, 20). All described a marked decrease in the level of salivary or serum cortisol after SN intervention. This presents direct biochemical evidence that SN is involved in the regulation of the HPA axis and may release a critical inhibitory constraint on the HPO axis.
- **Menstrual Regularity and Ovulation:** Pre-post studies consistently presented an increased menstrual cycle regularity and a decrease in oligomenorrhea/amenorrhea (19, 21). This is a clinically useful result, in particular for women who are anovulatory, such as those with PCOS.
- **Rates of Pregnancy**: Two studies followed pregnancy rates. Another study by Rakhshaee (22) was a cohort study that indicated an increase in the rate of conception among *Yoga* recipients when compared to controls, although the sample size was small. A stronger RCT from Oron and colleagues 42, paragraphs is needed. (16), a *Yoga* intervention with SN prior to embryo transfer was associated with significantly greater pregnancy rate (53% versus 35%) in women undergoing IVF.
- **Quality of Life and Mental Health:** All articles evaluating psychological outcomes described significant reductions in anxiety and depression scores, as well as in overall quality of life measures after the SN interventions (11, 15, 23).

3.5. Integration with Ayurvedic Principles:

The observations and findings are in accordance with Ayurveda principles of analysis. Infertility is another problem, which is closely related to *Vata* imbalance and entraps the downward movement of Apana *Vata* necessary for menstruation and ovulation (28). The mothering beat of SN is very *Vata*-pacifying. In addition, the dynamic nature of physical activity ignites *Agni* (metabolic fire) needed for supporting healthy tissues (dhatus). SN is thought to normalize metabolism and thus also provide nurturing for the *Artava Dhatu* (reproductive tissue) (29). The extension and compression of the *Asanas* are considered to detoxify 'physical *Srotas* (channels)', including passages in Artavavaha srotaes, and therefore amplify the free flow of Prana (vital energy) /nutrients [30].

4. Discussion

To our knowledge, this systematic review is the first attempt to present a formal kinesiological analysis of the performance of *Suryanamaskar* with regard to practicing it in females suffering from infertility. The results indicate that SN is more than an exercise as it is a multi-system, process-oriented intervention, and these benefits may be rationally explained through the current scientific physiology as well as the classical Ayurveda.

The kinesiological analysis demonstrates that SN is a very balanced system. It is a mix of the flexibility and muscle stretching associated with *Yoga*, the strength building of resistance exercise using body weight, the stamina boosting power of a gentle cardio-friendly walk, and the neurological calming impact achieved in meditation concentrating on breath. This integration seems to address the causal trilogy of infertility:

1) disrupted hormonal signalling,
2) chronic stress, and
3) substandard pelvic health.

Its well-documented reduction of cortisol provides evidence of a strong buffer capacity against stress that is directly effective on the HPO axis (5, 27). The better hormonal profile, especially in PCOS, suggests a systemic metabolic and endocrine normalization caused by an increase in insulin sensitivity and reduction of adrenal androgen production (12, 13).

The Ayurvedic point of view carries an entire paradigm that complements these biomedical publications wonderfully. The idea of balancing *Vata* and kindling *Agni* provides a single explanation for the reasons SN works to improve digestion (which is often impaired in stressed people) as well as fertility. It shifts the conversation away from particular mechanisms to a person-in-its-environment approach to restoration.

But the findings are not without caveats. Few RCTs of high quality have yet been published. There is also much variability in the SN protocols applied, so it remains unclear what an 'ideal' "dose" (rounds, frequency and duration) may be. Several studies administered SN as part of the larger *Yoga* package, making it difficult to isolate its specific effects. In addition, little is known about the long-term follow-up of maintained benefits and live birth rates.

Clinical Implications and Future Directions: Notwithstanding these concerns, the strength of positive associations across study designs and populations is striking. Clinicians specializing in reproductive medicine might consider suggesting structured SN practice as a safe and effective adjunct to their standard therapy, especially for women presenting

with stress-related infertility or anovulatory cycles (including PCOS). It gives women an active, self-care device that treats their physical and emotional needs during a journey through fertility.
These gaps should be addressed in future research. Large, well-designed RCTs that compare standardized SN protocols with other exercise approaches are required. It may be of value that studies separate out the effects of SN from other yogic ingredients. Using more advanced biomarkers (such as heart rate variability for autonomic tone, Doppler ultrasound for uterine artery blood flow) and clinically relevant validated Ayurvedic diagnostic parameters (namely, *Prakriti* analysis and *Nadi Pariksha*) could lead to a deeper insight into its mechanisms.

5. Conclusion

When analyzed through kinesiology, Suryanamaskar is a collectible, evidence-based, and bio-psychosocially acceptable treatment breakthrough for female infertility. The sequenced poses and coordinated breathing of *Yoga* form a full-body workout that seems to reset the stress system, fine-tune the release of reproductive hormones, and boost circulatory and neurological function in pelvic regions. In Ayurvedic terms, these effects may be understood as a balancing of the *Doshas* (the body's fundamental principles), an igniting of the digestive fire, and a cleaning out of bodily channels that transport reproductive tissue.
Further, although there is a need for more robust research evidence, the present circumstantial evidence all extol integration of this ancient yogic discipline as part and parcel to holistic management of female infertility. It is a striking reminder of the ancient understanding that movement, breath, and awareness are keys to healing the body and awakening its potential for new life.

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