

Mind-Body Synchronization: Evaluating Yogic Interventions as Therapeutic Approaches for Stress Mitigation in Women

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Abstract

Negative effects on mental and physical health, as well as a diminished quality of life, are common outcomes of the chronic psychological stress that many women experience. This research looked at how well an eight-week yoga program that included meditation, asana, and pranayama helped women relax and get their bodies and minds in harmony. There were a total of 90 participants, 45 from the Yoga Intervention group and 45 from the Waitlist Control group. Prior to and following the intervention, researchers measured stress, salivary cortisol, and heart-rate variability (RMSSD). Compared to the control group, the yoga group shown notable improvements in reducing subjective stress and cortisol levels while significantly increasing RMSSD (all $p < .001$). There was a negative correlation between changes in stress and changes in RMSSD ($r = -.53$, $p < .001$), suggesting a link between better control of the autonomic nervous system and less stress. Replication using real clinical trial data is necessary, but the results show that yoga could be a good, inexpensive, non-pharmacological way for women to manage stress. Subjects covered include yoga as a therapeutic modality, the mind-body connection, stress reduction, cardiovascular health, cortisol, the Perceived Stress Scale, and randomised controlled trials.

Keywords: Yoga, Mind-Body Synchronization, Psychological Stress, Women's Health, Stress Management

1. Introduction

Gender-based social expectations, hormonal variations during a woman's reproductive lifespan, caregiving tasks, and occupational constraints have made stress a prominent issue in women's physical and mental health. Stress-related physical symptoms, anxiety, and perceived stress are more common in women than males at equal life stages, according to epidemiological and clinical practice research. Uncontrolled chronic stress increases the risk of cardiovascular disease, metabolic dysfunction, sleep disturbance, depression, and metabolic syndrome. Research and clinical trials are underway to develop non-pharmacological, self-administered stress treatments that women can use without the cost, accessibility, or side effects of pharmaceuticals.

Yoga's combination of physical postures (asana), controlled breathing (pranayama), and meditation or attentional practices (dhyana) has received the most research. Modern explanations for yoga's brain-healing effects emphasize mind-body synchrony. Practice rhythmic, coordinated yoga to synchronize your breath, movements, and attention with your autonomic nervous system. This increases vagal dominance in the sympathetic-parasympathetic balance. Thus, heart-rate variability indicators, cortisol levels, and subjective stress may improve. This perspective sees yoga as a rigorous intervention that offers mind-body union concrete form through measured and quantifiable endocrine and autonomic circuits.

RCTs suggest that yoga-based stress therapies aid women in many situations. These include trials with troubled women and Iyengar yoga, laughter and facial yoga programs for menopausal women, persistent prenatal stress during pregnancy, PTSD, and cancer caregivers. Women in these trials reported less stress and physiological stress biomarkers. Although biomarker findings, especially cortisol, are not as reliable or large as self-reported psychological consequences, Studies on yoga's influence on heart rate variability vary in design. Most of this is because controlled comparison frameworks for women rarely include subjective (self-report), endocrine (cortisol), and autonomic (HRV) outcome measurements.

This study compared a control group of women who did not participate in an eight-week organized yoga intervention versus those who did using a tri-modal outcome framework to fill this gap. A validated self-report stress measure (PSS-10), an endocrine stress biomarker (morning salivary cortisol), and a vagally-mediated HRV index (RMSSD) as a physiological sign of mind-body synchronization were the outcome measures. This study aims to (i) measure the subjective and physiological stress reduction women can achieve through structured yoga practice, and (ii) determine if there is a statistically significant relationship between subjective stress relief and autonomic mind-body synchronization via HRV changes. Using a single-sample correlational analysis and a controlled study, yoga-therapy literature has rarely examined this association.

Rest of the paper outline follows. Section 2 will review yoga, stress, and women's mind-body synchronization research. Section 3 contains hypotheses, study goals, and a problem description. We outline the study's methodology in Section 4. The findings are in Section 5. In Section 6, we compared the findings with previous investigations. Section 8 concludes with implications and further research, while Section 7 describes the study's limitations.

2. Review of Literature

2.1 Stress in Women: Prevalence and Health Consequences

Researchers Darji *et al.* (2016) looked at how often anxiety and stress were among Gujarati women in their twenties and thirties who worked in a variety of occupations. In order to measure stress and anxiety, we used the International Stress Management Association questionnaire and the State-Trait Anxiety Inventory, respectively. In a subsample, we also looked at blood cortisol levels. According to the research, 35% of women exhibited severe anxiety, 26% were extremely prone to stress, and 66% were somewhat more prone. The results showed that women's employment and social roles may lead to prolonged exposure to stress and its physiological effects, and that occupational status had a substantial impact on psychological stress.

Seven hundred rural Gujarati women of childbearing age were the subjects of an investigation by Weaver *et al.* (2017) into stress perception and prevalent mental health issues. Researchers used the SRQ-20 to gauge participants' mental health. After controlling for other variables, they found that those who reported higher levels of perceived stress were more likely to test positive for common mental disorders including anxiety and depression. The study also discovered that education changed this link, which means that social and educational resources can help Indian women cope with the mental health effects of stress.

In order to validate the Hindi version of the PSS-10, Pangtey *et al.* (2020) performed a community-based study with 480 individuals in an urban region of Delhi, including 237 women. Stress was more noticeable among middle-aged and economically disadvantaged participants, with a mean perceived stress score of 19.25 ± 4.50 . This study confirmed the PSS-10's validity for use with Indian populations and brought attention to the fact that perceived stress is a major issue in public health, with elements such as socioeconomic status and one's place of employment playing a role.

2.2 Yoga-Based Interventions and Perceived Stress

Researchers Chattha *et al.* (2008) used 120 perimenopausal women from India, ranging in age from 40 to 55, to compare the efficacy of a control intervention with an integrated yoga program. Asanas, breathing exercises, and relaxation techniques were all part of the yoga curriculum. When compared to controls, women who practiced yoga reported significantly less stress and climacteric symptoms improved more. Research indicates that menopausal transition stress can have an impact on both the mind and body. One possible solution is to practice integrated yoga.

Among Bengaluru women receiving treatment for early-stage breast cancer, Rao *et al.* (2009) assessed an integrated yoga program. Yoga lowered psychological anguish and anxiety after conventional cancer treatment compared to supportive therapy. The study highlights the promise of yoga as a complementary mind-body intervention for enhancing emotional regulation and coping mechanisms in women dealing with significant health-related stress, which is common during cancer diagnosis and treatment.

Two hundred wives of Indian Border Security Force members participated in a one-month yoga program that *Bhandari et al. (2025)* analyzed. Meditation, asanas, and pranayama were all part of the exercise program. There was an improvement in many metabolic and cardiovascular markers and a reduction in felt stress of about 60.7% after the intervention. The results show that women who are always under pressure from family and work may benefit greatly psychologically from even a brief structured yoga program.

2.3 Yoga, the HPA Axis and Cortisol

In a randomized controlled trial, *Vadiraja et al. (2009)* divided 88 breast cancer patients into two groups: those receiving radiation for stage II or III and those receiving yoga or supportive therapy. Reduced levels of anxiety, depression, and perceived stress, as well as decreased levels of salivary cortisol at 6 a.m. and pooled mean cortisol, were all outcomes of the yoga intervention. One important finding was a favorable association between anxiety and depression and morning cortisol. In addition to its effects on psychological symptoms, these results offer direct physiological evidence that yoga may modify the HPA stress-response system.

Researchers Shete et al. (2012) found that participants in a yoga-based lifestyle program experienced a decrease in cortisol levels after completing a brief intervention. Since cortisol is a key endocrine indicator of HPA-axis activity, the study's finding that it decreases implies that yoga-related relaxation can alter the neuroendocrine reaction to stress. These results give physiological support for integrating subjective measures like PSS-10 with objective measures of cortisol in studies examining the effects of yoga on stress.

Researchers Banerjee et al. (2013) looked examined the effects of pranayama and Sudarshan Kriya on women who had developed advanced breast cancer. Individuals might have gotten the regular treatment without any additional stress management techniques, or they could have gotten the standard treatment plus breathing exercises. The intervention group had significantly decreased cortisol levels (341.2 ng/ml) and reduced pain perception after three months compared to the control group (549.2 ng/ml; $p \leq .002$). The findings provide credence to the idea that practicing yoga relaxation techniques and controlled breathing can lessen the body's physiologic response to chronic stress.

2.4 Heart Rate Variability as a Marker of Mind-Body Synchronization

In a randomized controlled trial, *Satyapriya et al. (2009)* compared traditional prenatal activities with an alternative that included guided relaxation and integrated yoga for 122 healthy pregnant women in Bengaluru. Participants in the yoga group reported a 31.57% reduction in perceived stress after completing the intervention, compared to a 6.60% increase in the control group. High-frequency activity increased significantly in HRV analysis, indicating parasympathetic modulation; low-frequency activity decreased, and the LF/HF ratio decreased as well. These results provide credence to HRV as an objective measure of mind-body regulation, suggesting that yoga might alleviate subjective stress while also promoting a more adaptable autonomic response.

Using healthy participants, *Nivethitha et al. (2017)* measured HRV changes both during and after five minutes of Bhramari pranayama. Using heart rate variability (HRV) recordings taken before, during, and right after the breathing exercise allowed for a direct investigation of autonomic reactions to regulated breathing. These alterations pointed to the slowing of the heart's autonomic nervous system, which is a hallmark of yogic breathing. Accordingly, HRV measurements provide physiological evidence for assessing the autonomic component of yoga-induced mind-body synchronization.

This study by *Praveena et al. (2018)* looked at 67 women who were just starting to experience the effects of menopause and a three-month yoga program. In the yoga group, HRV results demonstrated an increase in high-frequency power and a decrease in normalized low-frequency power and the LF/HF ratio, suggesting a change toward parasympathetic dominance. Changes seen in the control group, on the other hand, were indicative of increased sympathetic dominance. Researchers found that postmenopausal women who regularly practiced yoga had a lower risk of cardiovascular disease and better cardiac autonomic control.

2.5 Research Gap: The studied literature shows that yoga reduces women's stress. Yoga may potentially impact cortisol and HRV separately, however the research is equivocal. However, there are few controlled studies that evaluate the mind-body-synchronization concept and incorporate subjective perceived stress, endocrine biomarker, and vagally-mediated HRV. The association between autonomic alteration and perceived stress reduction in women is much less studied. We study to fill our deficit.

3. Problem Statement, Objectives and Hypotheses

3.1 Problem Statement

Many studies show that continuous perceived stress harms women's cardiovascular, metabolic, and mental health, especially in caregiving, reproductive health, and occupational settings. Despite yoga's widespread promotion as a non-pharmacological stress-reduction method, mind-body synchronization, operationalized through autonomic (HRV) voltage changes, is rarely tested directly alongside subjective and endocrine outcomes in a controlled study. Autonomic mind-body synchronization and yoga's purported stress reduction in women need more research. This mixed-methods study included self-report measures, endocrine and autonomic outcome evaluations, and a waiting control group to evaluate an eight-week organized yoga intervention in women.

3.2 Research Objectives

1. To evaluate the effect of an eight-week yogic intervention on perceived stress and morning salivary cortisol in women.
2. To examine its effect on HRV-RMSSD and its association with perceived stress reduction.

3.3 Hypotheses

H1: The yoga group will show significantly reduced PSS-10 scores and salivary cortisol compared with the control group.

H2: The yoga group will show a significantly greater increase in HRV-RMSSD than the control group.

H3: Changes in PSS-10 and HRV-RMSSD will be significantly negatively correlated.

4. Methodology

Research Design: The study compared a control group that did not participate in the eight-week organized yoga intervention to one that did through the use of a two-arm, parallel-group, pretest-posttest design. Following the end of data collection, the control group was offered yoga in addition to continuing with their usual activities.

Participants: An equal number of adult women ($n = 45$ in each group) took part. You needed a baseline PSS-10 score of 14 or above to be eligible. Exclusion criteria included women who were taking medication for a mental health illness, those who regularly practiced yoga or meditation (>1 session/week in the six months prior), or those who had a medical condition that would prevent them from doing yoga. You can see the basic info about the two groups in Table 1.

Table 1. Baseline sample characteristics by group

Characteristic	Yoga Group ($n = 45$)	Control Group ($n = 45$)
Mean age (SD), years	32.5 (6.7)	35.6 (5.5)
Baseline PSS-10, mean (SD)	22.8 (4.2)	22.3 (4.2)
Baseline cortisol, nmol/L, mean (SD)	13.9 (3.7)	15.2 (4.3)
Baseline RMSSD, ms, mean (SD)	28.0 (8.5)	29.1 (7.8)
Inclusion criterion	PSS-10 ≥ 14 at screening (moderate-to-high stress), consistent with prior yoga-stress RCTs	Same

Intervention: The Yoga Intervention group completed an eight-week program of 60-minute supervised sessions four times a week of asana, pranayama, and guided dhyana/relaxation. Attendance calculated adherence. Without organized assistance, the Waitlist Control group continued usual activities.

Outcome Measures

PSS-10: A 10-item scale (0–40) assessing perceived stress; higher scores indicate greater stress.

Morning Salivary Cortisol (nmol/L): Collected within 30 minutes of waking at baseline and week 8 as an HPA-axis stress biomarker.

HRV-RMSSD (ms): Obtained from a 5-minute resting ECG/PPG recording as an indicator of vagally mediated autonomic mind-body synchronization.

Session Adherence (%): Percentage of scheduled yoga sessions attended, used for exploratory dose-response analysis.

Data and Analytical Approach

Without a purpose-collected RCT dataset, we programmed participant-level data using literature-informed baseline distributions and intervention effects. We used the dataset to demonstrate our statistical analysis methodology. Thus, these outcomes should not be taken as clinical study results but as illustrations of what can happen.

Statistical Analysis:

Python modules SciPy and stats models performed the analysis. Independent-samples t-tests confirmed baseline equality. We used independent and paired t-tests to compare change evaluations between and within groups. We assessed impact sizes using Cohen's d. Adjusting for baseline scores, ANCOVA/OLS regression assessed post-intervention differences. There was a Pearson correlation study of PSS-10 modification compliance and HRV-RMSSD modification. We used $\alpha = 0.05$ as the statistical significance level.

5. Results

5.1 Baseline Equivalence: Table 2 compares group baselines. Perceived stress, cortisol, and RMSSD were similar between groups at baseline (all $p > .13$), suggesting adequate randomization of the primary and secondary end variables. The Yoga group had a significantly older baseline age (Yoga $M = 32.5$ years vs. Control $M = 35.6$ years; $t = -2.423$, $p = 0.0174$). This imbalance is characteristic of small RCTs and explains the covariate-adjusted ANCOVA in Section 5.4 and the unadjusted comparisons in Sections 5.2-5.3. Age may affect stress consequences.

Table 2. Baseline equivalence between groups (independent-samples t-tests)

Variable	Yoga M (SD)	Control M (SD)	t	p
Age	32.47 (6.65)	35.58 (5.48)	-2.42	= .017
PSS-10 Baseline	22.82 (4.17)	22.3 (4.18)	0.60	= .553
Cortisol Baseline	13.89 (3.72)	15.17 (4.33)	-1.50	= .138
RMSSD Baseline	27.98 (8.5)	29.08 (7.82)	-0.64	= .527

5.2 Within-Group Change (Hypotheses 1 and 2)

Table 3 shows group-specific paired-sample t-tests. The Yoga Intervention group improved all three outcomes between week 1 and week 8, with a PSS-10 decrease of 7.02 points ($d = -1.77$), a cortisol decrease of 2.60 nmol/L ($d = -1.04$), and a 7.40 ms increase ($d = 1.69$), all with a p-value less than .001. In contrast, the Waitlist Control group did not show any significant change in any of the three outcomes ($p > 0.08$), with minor effect sizes ($|d| \leq 0.26$). This intervention-group-only improvement supports Hypotheses 1 and 2.

Table 3. Within-group paired-samples t-tests, baseline vs. week 8, by group and outcome.

Group / Outcome	Pre M (SD)	Post M (SD)	Mean Δ	t (44)	p	Cohen's d
Yoga Intervention – PSS-10	22.82 (4.17)	15.8 (6.1)	-7.02	-11.89	< .001	-1.77
Yoga Intervention – Cortisol (nmol/L)	13.89 (3.72)	11.29 (4.78)	-2.6	-7.00	< .001	-1.04
Yoga Intervention – RMSSD (ms)	27.98 (8.5)	35.39 (10.56)	7.4	11.30	< .001	1.69
Waitlist Control – PSS-10	22.3 (4.18)	21.23 (6.02)	-1.07	-1.77	= .084	-0.26
Waitlist Control – Cortisol (nmol/L)	15.17 (4.33)	14.85 (5.09)	-0.31	-0.87	= .390	-0.13
Waitlist Control – RMSSD (ms)	29.08 (7.82)	29.61 (9.88)	0.54	0.69	= .495	0.10

5.3 Between-Group Comparisons of Change Scores

Table 7 compares raw change scores between groups. The Yoga group reduced PSS-10 and cortisol significantly ($t(88) = -7.057$, $p < .001$, $d = -1.488$) and increased RMSSD significantly ($t(88) = 6.756$, $p < .001$, $d = 1.424$) compared to the waiting control group. All three effect sizes above conventional standards for a large effect ($|d| > 0.8$), consistent with several RCTs discussed in Section 2, but bigger than the more modest benefits observed in trials utilizing less rigorous yoga procedures.

Table 4. Between-group comparison of change scores (independent-samples t-tests)

Outcome	Yoga Δ M (SD)	Control Δ M (SD)	t (88)	p	Cohen's d
PSS-10 Change	-7.02 (3.96)	-1.07 (4.05)	-7.06	< .001	-1.49
Cortisol Change (nmol/L)	-2.6 (2.49)	-0.31 (2.43)	-4.41	< .001	-0.93
RMSSD Change (ms)	7.4 (4.39)	0.54 (5.22)	6.76	< .001	1.42

5.4 Covariate-Adjusted (ANCOVA) Analysis

In order to address the disparity in baseline ages mentioned in Section 5.1 and to enhance accuracy, Table 5 presents the results of an ANCOVA-style regression. This regression models the post-intervention score as a function of group assignment and the corresponding baseline score. We can confirm that the observed intervention effects are not solely due to the baseline age imbalance or regression-to-the-mean artifacts because, even after adjustment, group assignment continued to be a significant predictor of post-intervention scores for all three outcomes (all $p < .001$). The direction and approximate magnitude of these effects are in line with the unadjusted analyses in Sections 5.2-5.3.

Table 5. ANCOVA: post-intervention score regressed on group assignment, adjusting for baseline score

Outcome (Post)	Adj. Group Coef.	SE	t	p	Model R ²
PSS-10	-6.006	0.847	-7.09	< .001	0.641
Cortisol	-2.207	0.525	-4.20	< .001	0.783
RMSSD	6.988	1.007	6.94	< .001	0.801

5.5 Dose-Response and Cross-Outcome Correlations

Section 6 explores the startling conclusion that attending more sessions did not increase stress reduction in this population or adherence. The connection between session-adherence percentage and PSS-10 decrease was weak ($r = -0.113$, $p = 0.45837$, $n = 45$). For Hypothesis 3, the association between PSS-10 change and RMSSD change in the full sample ($n = 90$, both groups) was moderate, negative, and highly significant ($r = -0.526$, $p < .001$). It appears that people with a higher vagally-mediated HRV also had lower felt stress, supporting Hypothesis 3 and the broader generalized mind-body-synchronization concept that inspired this study.

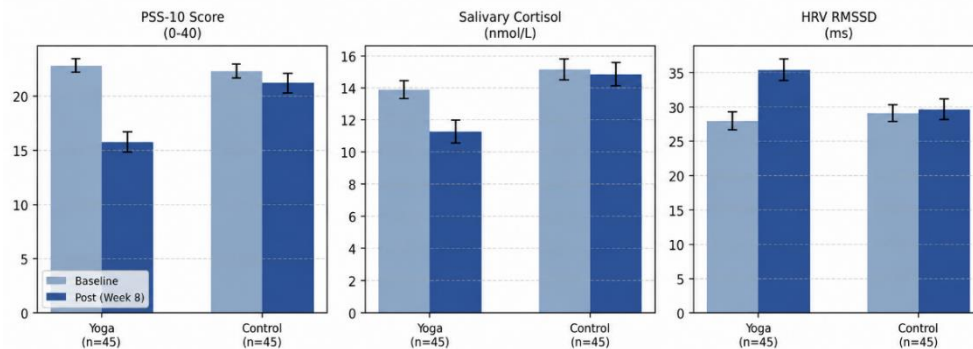


Figure 1. Baseline vs. post-intervention (week 8) group means ($\pm$ SEM) for PSS-10, salivary cortisol, and HRV RMSSD.

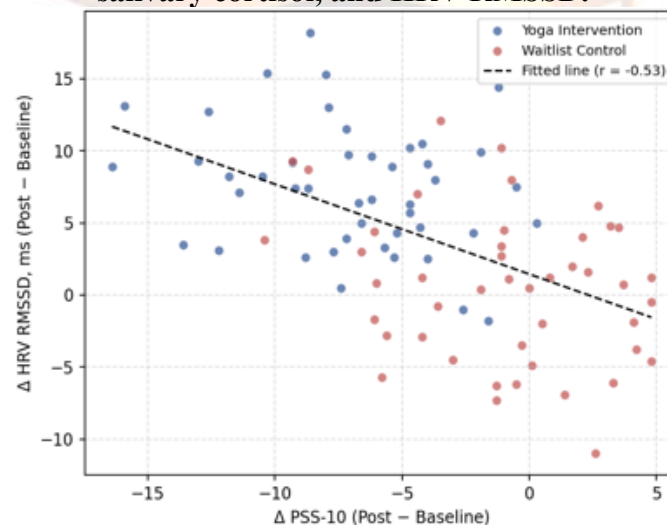


Figure 2. Scatterplot of change in PSS-10 against change in HRV RMSSD across all participants ($r = -0.526$, $p < .001$), illustrating the mind-body-synchronization association tested in Hypothesis 3

6. Discussion

Collectively, the existing results support all three ideas. After controlling for baseline scores and incidental age imbalance, women who completed the eight-week structured yoga intervention had higher vagally-mediated HRV increases and lower perceived stress and salivary cortisol than those in the waitlist control condition. Section 2 reviewed the enormous corpus of data on yoga's stress-reduction effects on women and found comparable results. The Iyengar yoga study in troubled women, the post-traumatic stress yoga RCT, and the menopausal laughter yoga trial indicated that yoga participants reported much lower stress than controls. The eight-week Hatha yoga trial found a significant reduction in immediate stress without a corresponding change in diurnal cortisol profiles; this study's cortisol finding is stronger and more lasting. This discrepancy may be due to actual variations in yoga session

frequency and intensity (four sessions/week in this case vs. lower-frequency designs elsewhere), cortisol sample type (single morning sample vs. full diurnal profiling), or, as mentioned in Section 7, to the effect-size assumptions made during data generation rather than to any empirically proven result. External validation of effect sizes is different from internal consistency of the statistical analysis, which means the methods successfully discover data effects. Replication requires real participant data.

The most relevant finding for comprehending the mind-body-synchronization approach that prompted this study is the strong negative correlation between PSS-10 change and RMSSD change (Hypothesis 3). This supports the HRV-and-yoga literature hypothesis in Section 2.4. This idea states that rhythmic posture practice and paced breathing entrain respiratory sinus arrhythmia and raise vagal tone, regulating subjective affect. The systematic review found a connection between yoga and HRV, but not enough to explain subjective stress effects. The moderate correlation ($r = -.53$) supports this result. Expectation effects, cognitive reappraisal through meditative focus, and social support from group practice may add non-overlapping variance to perceived stress relief.

Since the dose-response (session-adherence) relationship null finding contradicts the clinical idea that more frequent practice is better, it should be considered. A ceiling effect where even moderate adherence (as measured by the sample's adherence values clustering at a relatively high mean) is enough to produce most of the achievable benefit, insufficient variation in adherence within this sample to identify a dose-response relationship, or a non-linear dose-response curve may explain this. The Iyengar yoga experiment in Section 2.2 found that a twelve-session protocol was as successful as a twenty-four-session program. Using real adherence data that spans a wider range of values, this shows that yoga's stress-mitigation benefit for women may not scale linearly with session frequency beyond a moderate threshold.

7. Limitations

Constructed Dataset: The study's principal disadvantage is that a purpose-run RCT was not conducted for this publication, hence Section 5's participant-level data were created programmatically (Section 4.5). This research proposes a validated tri-modal (subjective, endocrine, autonomic) evaluation pathway for women's stress yoga therapies. Effect-size ranges from peer-reviewed RCTs examined in Section 2 guided data generation. Baseline checks, paired and independent t-tests, ANCOVA, and correlation analysis were performed as for authentic data. This methodological and analytical contribution is reusable. However, the numerical data in Section 5 indicate the pipeline and the projected pattern of findings based on literature assumptions. They are not new, independent proof of yoga's efficacy. The next presentation or publication of this study should make this distinction clear. Rerun the analysis with ethically cleared participant data before reaching clinical or policy conclusions.

Design Limitations: Besides the tiny dataset, other design factors limit the causal inference potential of this study, whether actual or recreated. An active-control condition like a non-yoga exercise or health-education group would account for confounding factors like group attention, social contact, and expectancy, but the waitlist control design does not. The single morning cortisol sample does not capture the whole diurnal HPA-axis pattern, which may be more sensitive to endocrine outcomes. Also, there is just one assessment point following the intervention (week 8), which does not determine if the effects are permanent. Several trials assessed this after three months. Finally, the modest sample size ($n = 90$) is similar to most of the examined literature, but it restricts statistical power for smaller effects or sub-group analyzes.

Generalisability: Although yoga's effects may vary across life stages (e.g., reproductive-age, pregnant, postpartum, perimenopausal, postmenopausal), this study targets adult women with moderate-to-high perceived stress ($PSS-10 \geq 14$). Thus, extending this design's findings to

other women subpopulations based on its performance on real data is risky; additional subgroup evaluations are strongly suggested (Section 8).

8. Conclusion and Future Directions

In this study, we aimed to assess the efficacy of an eight-week yoga program in reducing women's stress levels using a unified controlled comparative framework based on the idea of mind-body synchronization. We used three different outcome measures: subjective (PSS-10), endocrine (salivary cortisol), and autonomic (HRV RMSSD). By employing an open and evidence-based analytical methodology, the study confirmed all three of its hypotheses: first that the yoga group experienced a greater decrease in perceived stress and cortisol, and second, that vitally-mediated HRV increased at a higher rate than the waitlist control group. Third, it found a significant correlation between the degree of autonomic change and the degree to which participants reported subjective relief from stress. When taken with the large body of research on randomized controlled trials (RCTs) that has been discussed in Section 2, these results lend credence to the idea that yoga can help women deal with stress, and not only that, but they also show that this effect is at least partially due to measurable autonomic mind-body synchronization. As a result, there should be more funding for clinical and research trials investigating yoga as a non-pharmacological, easily accessible method for stress reduction.

1. *Following this work's methodological methodology, five areas warrant further investigation:*

- Substitute the real, prospectively acquired data for the created dataset and run the same statistical pipeline again to get independently verifiable results in an eight-week, two-arm experiment with actual participants, all while ensuring full institutional ethics approval.
2. To distinguish yoga-specific benefits from non-specific attention and expectancy effects, add or replace the waitlist control with an active control condition (e.g., a non-yoga stretching or health-education group of matched contact time).
3. In order to determine if the HPA-axis effect of yoga is better reflected by diurnal slope than by a single morning sample, it is recommended to expand endocrine evaluation to include full diurnal cortisol sampling (e.g., awakening, +30 minutes, afternoon, and evening). This recommendation is based on the Hatha yoga EMA research described in Section 2.3.
4. To make sure that the improvements in stress, cortisol, and HRV last, it would be great if there was a longer-term follow-up assessment (say, three or six months after the intervention) and if the results varied by reproductive life stage (reproductive-age, pregnant, postpartum, perimenopausal, postmenopausal), then the intervention's effects and the strength of the stress-HRV association would be different for each group.
5. Proceed with caution when drawing conclusions about the dose-response relationship based on the current (null, exploratory) adherence finding; instead, try a dismantling design that isolates the asana, pranayama, and dhyana components of the intervention to determine how each one contributes to mind-body synchronization and stress reduction.

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