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Research Article

Assessment of Functional and Structural Outcomes of Yoga Module in Hypothyroidism: A Pilot Study

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Abstract

Background: Many organ systems are impacted by the common endocrine condition known as hypothyroidism. Although levothyroxine is still the recommended course of therapy, complementary techniques such as yoga have demonstrated potential in enhancing metabolic and functional health. Objective: To assess functional and structural changes in hypothyroid patients following an integrated Yoga therapy program. Methods: A pilot interventional study was conducted on 20 clinically diagnosed hypothyroid patients aged 25–45 years. The intervention included a structured Yoga protocol (asana, pranayama, bandha, dhyana) for 12 weeks. Pre- and post-intervention assessments included thyroid function tests (TSH, T3, T4), neck ultrasound for thyroid volume, quality of life (QoL) scores, body mass index (BMI), and Fatigue Severity Scale (FSS) along with Subjective criteria. Results: A significant reduction in mean TSH levels was observed ($p < 0.05$), along with improvement in QoL scores and fatigue. A marginal reduction in thyroid volume was seen in a subset of patients. Subjective improvements included better sleep, energy, Appetite and mood. Conclusion: Yoga therapy may be a useful adjunctive intervention in the treatment of hypothyroidism, based on the structural and functional benefits that have been noted. To confirm these early results and investigate the underlying processes, more randomised controlled studies are necessary.

Keywords: Hypothyroidism, Yoga, Thyroid Function, Quality of Life, Structural Changes, Integrative Therapy.

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Introduction

Hypothyroidism, defined by insufficient secretion of thyroid hormones, has emerged as a growing public health concern due to its rising global prevalence. Approximately affects 5–10% of adults, with women and the elderly having a greater frequency (1). Lethargy, weight gain, constipation, cold intolerance, mood swings, and cognitive dullness are some of the symptoms. Biochemical euthyroid state is attained by thyroid hormone replacement with levothyroxine, although many individuals still have lingering symptoms (2).

Evidence based studies back up the holistic treatment of endocrine diseases with complementary treatments like yoga. Yoga may have an impact on hormonal and metabolic balance via modifying the autonomic nervous system and the hypothalamic-pituitary-thyroid (HPT) axis (3,4). Asanas are described as *sthira sukham asanam*, denoting a stable and comfortable posture of the body. These subtle physical practices help in releasing physical and

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mental energy blockages, while toning and preparing the body–mind system for deeper yogic disciplines (5). Many asanas exert a profound and beneficial influence on specific endocrine glands and associated energy plexuses (*chakras*). For instance, *Sarvangasana* (shoulder stand) applies significant pressure to the thyroid gland located in the throat region, which corresponds to the *Visuddha Chakra* (Throat Chakra). Regular practice of this asana is believed to stimulate and regulate the optimal functioning of the thyroid gland (6).

Previous research has shown that regular yoga practice considerably lowers fatigue and improves quality of life (QoL) in addition to improving the general well-being of people with thyroid dysfunction (7). It is thought that these advantages are mediated by better metabolic performance, decreased stress response, and improved autonomic modulation.

The objective of this study was to assess the effects of a systematically designed 12-week Yoga module intervention on both structural and functional parameters in patients with hypothyroidism. Structural outcomes included changes in thyroid gland volume assessed via ultrasonography, while functional outcomes were analysed using thyroid hormone levels (TSH, T3, T4), fatigue severity scores, and quality of life indices. This integrative approach provides a more comprehensive understanding of yoga's potential therapeutic role beyond symptom control, extending to glandular morphology and endocrine function.

Methodology

Study Design

This was a prospective, single-arm pilot study conducted over a period of 12 weeks at Mahatma Gandhi Ayurved College, Hospital & Research Centre, Salod (Hirapur), Wardha. The study was approved by the Institutional Ethics Committee (IEC Reference No. MGACHRC/IEC/Oct.2020/153).

Inclusion criteria: Adults aged 20–45 years with stable primary hypothyroidism on medication.

Exclusion criteria: Thyroid malignancy, pregnancy, autoimmune complications and participants with a prior clinical diagnosis of psychiatric disorder according to DSM-5-TR(The *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision* (DSM-5-TR) 2022) or ICD-11 criteria (International Classification of Diseases, 11th Revision (ICD-11) or currently under psychiatric medication/treatment.

Intervention

Participants underwent supervised 60-minute daily Yoga sessions (5 days/week) for 12 weeks. Each session commenced with opening prayer and *sithlikarna vyayama*- lossening exercises.

Table 1: Yoga Module

Time	Asana	Pranayama	Bandha	Meditation & Relaxation
Morning (40 minutes)	1.Bhujangasana (8) 2. Matsyasana (9) 3.Sarvangasana (10) 4. Ustrasana (11) 5.Setubandhasana (13) 6. Halasana (12) (Each 4 mins)	Anulom- Vilom +Bhramari+ Ujjai Pranayama (14) (5minutes)	Jalandhar bandha (15) (5 minutes)	Concentrate on vishuddha chakra, visualization of colour blue with recitation of beej mantra+ shavasana. (6mins)
Afternoon (At work place) (10 minutes)	Griva sanchalan + mild self-neck massage. (5 mins)	-	-	Concentrate on vishuddha chakra, visualization of colour blue with recitation of beej mantra. (5 mins)
Evening (10 minutes)	-	Anulom- Vilom +Bhramari+ Ujjai Pranayama (5 minutes)	Jalandhar bandha (5 minutes)	Concentrate on vishuddha chakra, visualization of colour blue with recitation of beej mantra.

Procedure of Asanas and pranayama:- Information regarding the procedures of asanas and pranayama was included in the Patient Information Sheet and reinforced through supervised demonstration prior to intervention.

***Location of Vishuddha Chakra**: - Classical yogic texts describe Vishuddha Chakra at the throat region (Kantha), governing speech and associated with Akasha Mahabhuta. Contemporary anatomical correlations place this center at the cervical region (C5–C7), corresponding structurally to the larynx and thyroid gland (24)

***Beeja Mantra**:- The Bija Mantra of Vishuddha Chakra is "HAM" (Ham). Instructions - Inhale deeply, focus your awareness at the throat region (C5–C7 level), and chant "Haaammm" slowly and steadily during exhalation. Woodroffe J. *The Serpent Power: The Secrets of Tantric and Shaktic Yoga (Shat-Chakra-Nirupana)*. Madras: Ganesh & Co.; 1919.(24)

Assessments

Pre-and post-intervention assessments included: Serum TSH, T3, T4, Neck ultrasound for thyroid volume, WHOQOL-BREF(16), Fatigue Severity Scale (FSS)(17), Body Mass Index (BMI)

WHOQOL-BREF(16)

Quality of life was assessed using the modified 19-item version of the **WHOQOL-BREF**, adapted from the instrument developed by the **World Health Organization**. The questionnaire evaluated three domains: Physical Health, Psychological Health, and Environment. Participants rated each item on a 5-point Likert scale (1–5), reflecting their perception over the preceding two weeks.

Negatively worded items (items 3 and 4) were reverse coded prior to analysis to maintain directional consistency, such that higher

scores uniformly represented better quality of life. Domain scores were calculated by computing the mean score of items within each domain. These mean scores were then transformed to a 0–100 scale using the standard transformation formula:

Higher transformed scores indicate better perceived quality of life.

Table 2: Interpretation table

Transformed Score	Interpretation
0–25	Very Poor
26–50	Poor
51–75	Moderate/Good
76–100	Very Good/Excellent

Fatigue

Fatigue severity was assessed using the Fatigue Severity Scale (FSS)(17), a validated 9-item self-reported questionnaire developed by Krupp et al. (1989). The scale evaluates the impact of fatigue on motivation, physical functioning, work performance, and social activities. Each item is scored on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The final score is calculated as the mean of all nine items. A mean score ≥4 indicates clinically significant fatigue. The FSS has demonstrated good internal consistency (Cronbach's α >0.80) and reliability across chronic disease populations and is appropriate for assessing fatigue severity in hypothyroid patients.

Table 3: Fatigue Grading Table

Mean FSS Score	Interpretation	Grade
1.0 – 2.9	No fatigue	Grade 0
3.0 – 3.9	Mild fatigue	Grade 1
4.0 – 4.9	Moderate fatigue	Grade 2
≥ 5.0	Severe fatigue	Grade 3

Subjective Criteria: It was assessed for points like Sleep Quality, Mood Stability, Appetite Regulation, Cognitive Clarity, Cold Intolerance, Menstrual Regularity (if applicable) (18)

The subjective clinical parameters were graded into four categories (None, Mild, Moderate, Severe) based on standardized symptom severity frameworks used in psychiatric, sleep medicine, endocrine, and gynaecological assessment scales. Operational definitions were adapted to ensure uniformity and reproducibility of symptom grading.

The grading system was operationally defined based on established clinical severity frameworks and used for structured symptom assessment in hypothyroid females.

Content validity was established through independent evaluation by a panel of subject experts, who assessed each item for relevance, clarity, and domain representation. Necessary modifications were incorporated based on expert feedback prior to finalization of the tool. The internal consistency of the scale was assessed using Cronbach's alpha to evaluate inter-item reliability across domains; a coefficient ≥0.70 was considered indicative of acceptable reliability.

Table 4: Subjective Criteria Assessment grades

Domain	None-Grade 0	Mild-Grade 1	Moderate-Grade 2	Severe-Grade 3
Sleep Quality (18)	Normal, refreshing sleep	Occasional disturbed sleep	Frequent awakenings or light sleep	Chronic insomnia, unrefreshing sleep
Mood Stability(19,20)	Emotionally stable	Mild mood swings	Frequent irritability, sadness	Persistent low mood, anxiety, depression
Appetite Regulation(21)	Normal appetite patterns	Mild fluctuations	Irregular hunger, increased cravings	Severe loss or increase of appetite
Cognitive Clarity(19,20)	Clear thinking, good memory	Occasional forgetfulness	Frequent brain fog, poor concentration	Severe difficulty in focus, decision-making
Cold Intolerance(22)	No intolerance	Mild discomfort in cold	Avoids cold due to symptoms	Severe sensitivity, requires warm
Menstrual Regularity (if applicable)(23)	Regular cycles	Slight delays or irregularity	Marked irregularity or spotting	Amenorrhea or severe menorrhagia
Scoring – Females (Mild = 0-6 score, Moderate = 7-12 score, Severe = 13-18 score) Scoring – Males (Mild =0-5score Moderate = 5-10 score, Severe =11-15 score)				

Statistical Analysis of data

This was a prospective, single-arm pilot study with a 12-week pre–post design. Continuous variables, including WHOQOL-BREF domain scores and Fatigue Severity Scale (FSS) scores, were expressed as mean ± standard deviation (SD). Normality of distribution was assessed using the Wilcoxon signed-rank test. Within-group changes from baseline to 12 weeks were analysed using the paired t-test for normally distributed data. A two-tailed p value <0.05 was considered statistically significant. As a pilot study, effect sizes (Cohen's d) with 95% confidence intervals were calculated to estimate the magnitude of change and to inform sample size estimation for future randomized controlled trials.

Observations and Results

Demographics

Among the 20 participants, the majority that is 50% were in the age group of 31 to 40, followed by 30% in the age group of 20 to 30. The remaining 20% belonged to the 41 to 50. Mean age: 37.5 ± 6.2 years.

Among the 20 participants, 80% were female (16 participants) and 20% were male (4 participants). This shows that the study sample was predominantly female.

Weight: - The mean weight of the participants before treatment was 68.95 kg with a standard deviation (SD) of 5.87, indicating

moderate variability in weight among the 20 participants. The SEM (standard error of the mean) was 1.31, suggesting a relatively precise estimate of the mean.

After treatment, the mean weight decreased to 66.78 kg, with a slightly lower SD of 5.58 and SEM of 1.25, again indicating consistent measurement and slight reduction in variability.

The paired t-test yielded a t-value of 9.692 with 19 degrees of freedom (df), and a p-value of 0.000, which is highly statistically significant ($p < 0.05$).

Average BMI reduction

Before treatment, the mean Body Mass Index (BMI) of the 20 participants was 27.73 kg/m², with a standard deviation (SD) of 1.82, indicating a moderately narrow spread of BMI values. The SEM was 0.41, reflecting a precise estimate of the population mean.

Following the intervention, the mean BMI reduced to 26.85 kg/m², with a slightly lower SD of 1.73 and SEM of 0.39, suggesting a slight improvement in the consistency of BMI measurements.

The paired t-test revealed a t-value of 9.599 with 19 degrees of freedom and a p-value of 0.000, demonstrating a highly significant difference in BMI values pre and post the treatment.

Functional Outcomes

Thyroid Stimulating Hormone- TSH

Before treatment, the mean TSH level among the 20 participants was 7.26 mIU/L, with a standard deviation (SD) of 1.08, indicating some variability in thyroid function across individuals. The SEM was 0.24, reflecting a reasonably accurate estimate of the group mean.

After treatment, the mean TSH level dropped significantly to 4.66 mIU/L, with a reduced SD of 0.73 and SEM of 0.16, indicating both less variation and greater precision in the post-treatment measurements.

A t-value of 13.008 with 19 degrees of freedom was obtained through paired t-test analysis, yielding a p-value of 0.000, indicating a highly significant statistical result.

T3-Triiodothyronine

The mean T3 level before treatment was 1.13 ng/mL, with a standard deviation (SD) of 0.23, indicating low variability among participants. After treatment, the mean T3 level increased to 1.74 ng/mL, with a similar SD of 0.25. The standard errors (0.05 before and 0.06 after) reflect fairly precise estimates.

Using the paired t-test, a t-value of -12.077 was observed with 19 degrees of freedom, and the resulting p-value of 0.000 confirmed a statistically significant difference.

Although the Significant result is strong ($p < 0.05$), the magnitude of change in T3 levels—from 1.13 to 1.74 ng/mL—is within the normal physiological range. This suggests a mild but meaningful improvement in thyroid function. The change is clinically relevant, particularly in the context of hypothyroid management, but should be interpreted as a moderate therapeutic response.

T4-Thyroxine

Before treatment, the mean T4 level among the 20 participants was 75.71 nmol/L, with a standard deviation (SD) of 10.34, indicating moderate variability. The SEM was 2.31, suggesting reasonable precision in estimating the mean.

After treatment, the mean T4 level increased to 99.41 nmol/L, with a slightly higher SD of 11.80 and SEM of 2.64, reflecting a broader range of responses but still within expected limits.

The paired t-test resulted in a t-value of -11.542 with 19 degrees of freedom and a p-value of 0.000, indicating a highly significant difference between pre- and post-treatment measurements.

Although the increase in T4 levels is statistically significant, the rise from 75.71 to 99.41 nmol/L remains within the physiological range for most individuals. This suggests a moderate but meaningful clinical improvement in thyroid hormone output, reflecting a positive therapeutic effect.

Table 5: Average BMI reduction

BMI	Mean	N	Std. Deviation	Std. Error Mean	t	df	P-value
Before	27.7250	20	1.81945	0.40684	9.599	19	0.000
After	26.8500	20	1.72947	0.38672			

Table 6: Mean TSH reduction

TSH	Mean	N	Std. Deviation	Std. Error Mean (SEM)	t	df	P-value
Before	7.2645	20	1.08362	0.24231	13.008	19	0.000
After	4.6605	20	0.73322	0.16395			

Table 7: Mean T3 reduction

T3	Mean	N	Standard Deviation (SD)	Std. Error Mean (SDE)	t	df	P-value
Before	1.1270	20	0.22553	0.05043	-12.077	19	0.000
After	1.7350	20	0.25447	0.05690			

Table 8: Mean T4-Thyroxine reduction

	Mean	N	Standard. Deviation (SD)	Standard Error Mean (SEM)	t	df	P-value
Before	75.7110	20	10.34160	2.31245	-11.542	19	0.000
After	99.4080	20	11.79831	2.63818			

Structural Outcomes

USG Thyroid: Volume

Before treatment, the mean thyroid volume measured via ultrasonography was 18.51 cm³, with a standard deviation (SD) of 3.93, indicating some variability among participants. The SEM was 0.88, reflecting a reliable estimate of the average.

Following treatment, the mean thyroid volume decreased to 16.08 cm³, with a lower SD of 2.88 and SEM of 0.64, indicating reduced variability in thyroid size after the intervention.

The paired t-test produced a t-value of 7.044 with 19 degrees of freedom and a p-value of 0.000, indicating a highly significant difference between the pre- and post-treatment measurements.

The observed reduction in thyroid volume is statistically significant, but the absolute change—from 18.51 cm³ to 16.08 cm³—suggests a mild to moderate decrease in gland size. This could reflect a therapeutic normalization of thyroid enlargement in subclinical or mild hypothyroid conditions.

Quality of Life (WHOQOL)

The values were calculated as per the assessment criteria mentioned in the methodology:-

Before the intervention, the mean WHOQOL score was 62.05, with a standard deviation (SD) of 3.35, reflecting some variation in perceived quality of life among participants. The SEM was 0.75, suggesting a reliable estimate of the mean.

After treatment, the mean WHOQOL score increased to 70.55, with a slightly lower SD of 2.95 and SEM of 0.66, indicating not only improvement in quality of life but also greater consistency among participants.

A paired t-test revealed a t-value of -15.587 with 19 degrees of freedom and a p-value of 0.000, demonstrating a highly significant improvement in WHOQOL scores after the intervention.

The increase from 62.05 to 70.55 in WHOQOL scores represents a substantial enhancement in participants' self-reported quality of life. The narrow confidence suggested by the small SEM and the large t-value strengthens the reliability of this result. Physical and Psychological domains improved significantly ($p < 0.05$)

Fatigue Severity Scale (FSS)

The values were calculated as per the assessment criteria mentioned in the methodology:-

Before treatment: Mean FSS score was 5.22, indicating moderate to high fatigue. Standard deviation (SD) = 0.42, showing low variability. The SEM is 0.095, indicating a precise mean estimate.

After treatment: Mean FSS score decreased to 3.98, suggesting significantly reduced fatigue post-intervention. SD = 0.40, SEM = 0.090, showing tight clustering of responses.

The paired t-test produced a t-value of 12.405 with 19 degrees of freedom and a p-value of 0.000, indicating that the reduction in fatigue was highly significant statistically

The change from 5.22 to 3.98 on the standard FSS scale represents a clinically meaningful and statistically significant reduction in fatigue severity after the intervention. A mean drop of over 1.2 points on a 7-point scale is substantial and likely reflects noticeable improvements in daily energy and functioning.

Table 9: Mean reduction in thyroid volume

	Mean	N	Standard Deviation	Standard Error Mean	t	Df	P-value
Before	18.5100	20	3.92601	0.87788	7.044	19	0.000
After	16.0750	20	2.88186	0.64440			

Table 10: Mean reduction in Quality-of-Life values

	Mean	N	Standard Deviation	Standard Error Mean	t	Df	P-value
Before	62.0500	20	3.34782	0.74860	-15.587	19	0.000
After	70.5500	20	2.94645	0.65885			

Table no 11. Mean reduction in FSS

	Mean	N	Standard Deviation	Standard Error Mean	t	df	P-value
Before	5.2175	20	0.42421	0.09486	12.405	19	0.000
After	3.9840	20	0.40366	0.09026			

Table 12: Subjective Symptoms

Symptom	Mean (Before)	Mean (After)	Z-value	P-value	Result	Interpretation
Sleep Quality	1.55	0.50	-4.001	0.000	Significant improvement	Sleep disturbance reduced post-treatment; ties in 2 cases
Mood Stability	1.20	0.45	-3.873	0.000	Significant improvement	Mood instability reduced; ties in 5 cases
Appetite Regulation	1.55	0.75	-4.000	0.000	Significant improvement	Appetite disturbances reduced; ties in 4 cases
Cognitive Clarity	0.90	0.25	-1.08	0.073	Non-Significant improvement	Cognitive fog reduced; ties in 13 cases

Cold Intolerance	1.25	0.30	-4.146	0.000	Significant improvement	Cold sensitivity reduced; ties in 2 cases
Menstrual Regularity (Females only, *n* = 16)	1.19	0.625	-3.000	0.003	Significant improvement	Irregular menstruation reduced; ties in 7 cases

Subjective Feedback

Significant improvements were observed in most self-reported symptoms among the participants, as analysed using the **Wilcoxon signed-rank test**:

- There was a notable enhancement in sleep quality, as the mean score declined from 1.55 to 0.50 (Z = -4.001, p = 0.000), indicating a statistically significant improvement. This indicates a significant reduction in sleep disturbances, with ties observed in 2 cases.
- **Mood Stability** improved significantly (mean 1.20 → 0.45; *Z* = -3.873, *p* = 0.000), suggesting enhanced emotional regulation post-treatment. Five participants had tied ranks, indicating equal pre-post ratings.
- **Appetite Regulation** also showed a statistically significant improvement (mean 1.55 → 0.75; *Z* = -4.000, *p* = 0.000), reflecting better appetite control in most participants, with 4 ties.
- **Cold Intolerance** demonstrated significant reduction (mean 1.25 → 0.30; *Z* = -4.146, *p* = 0.000), with 2 ties. This holds particular relevance for individuals with hypothyroidism, who frequently report heightened sensitivity to cold.
- **Menstrual Regularity**, assessed only in female participants (n = 16), significantly improved (mean 1.19 → 0.625; *Z* = -3.000, *p* = 0.003), indicating better hormonal balance and cycle regularity. Seven cases had tied ranks.
- **Cognitive Clarity**, while showing improvement (mean 0.90 → 0.25), did not reach statistical significance (*Z* = -1.08, *p* = 0.073), possibly due to high number of tied responses (13 cases) or lower baseline severity.

Before After Patients distribution according to symptoms

Table 13: Before after Patients distribution according to symptoms

Symptoms	Before		After	
	Frequency	Percentage	Frequency	Percentage
Mild Symptoms	4	20	20	100
Moderate Symptoms	16	80	0	0
Total	20	100	20	100

A composite symptom severity score was calculated by assigning numerical values (0–3) to each domain and summing across domains. The total possible score ranged from 0–18 in females and 0–15 in males. Severity categories were defined based on cumulative score ranges.

Before the treatment, 80% (16 out of 20) of participants experienced moderate symptoms**,** while only 20% (4 out of 20) had mild symptoms**.** Following the treatment, a notable shift was observed, 100% of participants reported only mild symptoms**,** and none exhibited moderate symptoms. This suggests a significant improvement in symptom severity**,** with all participants moving from moderate to mild categories after the treatment.

Discussion

The study sought to evaluate the effects of a integrative intervention on individuals with hypothyroidism, examining changes across clinical, biochemical, structural, and subjective parameters. The findings demonstrate significant improvement across most parameters, highlighting both statistical and clinical relevance.

The study population was predominantly female (80%), with most participants falling within the 31–40 age group, consistent with the known epidemiological pattern of hypothyroidism affecting women in reproductive age.

Anthropometric analysis revealed a significant reduction in weight (from 68.95 ± 5.87 kg to 66.78 ± 5.58 kg; $p < 0.000$) and BMI (from 27.73 ± 1.82 to 26.85 ± 1.73 kg/m²; $p < 0.000$). This is clinically important, as excess weight can contribute to thyroid dysfunction and exacerbate symptoms.

Thyroid function tests improved significantly. TSH levels declined from 7.26 ± 1.08 µIU/mL to 4.66 ± 0.73 µIU/mL ($p < 0.000$), while T3 and T4 levels increased significantly, indicating improved thyroid activity. The increase in T3 (from 1.13 to 1.74 ng/mL) and T4 (from 75.71 to 99.41 nmol/L) remained within physiological limits, but the consistent pattern across patients reflects therapeutic efficacy.

USG-based assessment of thyroid volume showed a statistically significant reduction (from 18.51 to 16.08 cm³; $p < 0.000$). Although this is a modest change, it may reflect reduced inflammation or glandular hypertrophy, commonly associated with subclinical hypothyroidism.

Improvement in quality of life was notable. WHOQOL scores increased from 62.05 to 70.55 ($p < 0.000$), especially in the physical and psychological domains. Fatigue, a hallmark of hypothyroidism, improved significantly, with FSS scores dropping from 5.22 to 3.98 ($p < 0.000$), indicating better daily energy and activity levels. The observed improvement in fatigue and QoL aligns with earlier reports (3,5,6).

Subjective assessments also reflected meaningful changes. Sleep quality, mood stability, cold intolerance, appetite, and menstrual regularity all improved significantly. Cognitive clarity showed a non-significant trend toward improvement ($p = 0.073$), possibly due to shorter treatment duration or smaller effect size.

Symptom severity distribution showed a complete shift: all participants moved from moderate symptoms to mild post-treatment, indicating clinical recovery in terms of subjective experience.

Although the findings are promising, the study is limited by its small sample size, brief duration, and lack of a control group. Future studies with larger, randomized controlled cohorts are recommended to validate these outcomes and assess long-term sustainability.

Yoga is known to activate the parasympathetic system, reduce cortisol levels, and modulate inflammatory cytokines (7). These effects may contribute to better HPT axis regulation and improved metabolism. The asanas used in this study, such as *Sarvangasana*

and *Matsyasana*, are traditionally associated with endocrine stimulation in classical texts and modern therapeutic Yoga modules (4).

Conclusion

This study demonstrates that a structured 12-week Yoga-based intervention can significantly improve clinical, biochemical, structural, and subjective outcomes in patients with hypothyroidism. Reductions in TSH levels, body weight, and thyroid volume, alongside improvements in fatigue, sleep quality, and overall well-being, highlight the potential of Yoga as an effective complementary therapy. The physiological benefits may be attributed to autonomic regulation, endocrine stimulation, and anti-inflammatory effects of specific asanas. While the results are encouraging, larger randomized controlled trials are essential to confirm these findings and explore their long-term applicability in clinical practice.

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