

ORIGINAL SCIENTIFIC PAPER

Therapeutic Effects of Yoga on Physiological and Psychological Parameters in Women with Early Adulthood Hypothyroidism: A Randomized Controlled Trial

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Abstract

Hypothyroidism is a common endocrine disorder impacting metabolic, cardiovascular, and psychological health in women. While conventional management emphasizes pharmacological treatments, yoga offers potential as a complementary intervention for addressing multisystemic complications. To evaluate the efficacy of a 16-week yoga intervention on thyroid function, body composition, cardiovascular parameters, and psychological well-being among women with early adulthood hypothyroidism. This prospective, randomized, controlled, single-blind parallel-group trial included 60 women aged 20–39 with hypothyroidism. Participants were randomized into yoga (n=30) and control (n=30) groups. The yoga group underwent five weekly 90-minute sessions incorporating asanas, pranayama, meditation, and mindfulness techniques for 16 weeks. Outcome measures included thyroid function markers (TSH, T3, T4), anthropometric measurements (BMI), cardiovascular parameters (systolic and diastolic blood pressure), and psychological assessments (Depression, Anxiety, and Stress Scale [DASS], self-esteem scores). The yoga group showed significant ($p < 0.05$) improvements: TSH decreased by 1.1 mIU/L, T3 increased by 0.2 nmol/L, BMI reduced by 1.7 kg/m², systolic and diastolic blood pressure dropped by 8 mmHg and 6 mmHg, respectively (both), DASS scores declined by 9.4 points, and self-esteem scores increased by 5.3 points. In conclusion, yoga demonstrated moderate-to-large effect sizes ($d = 0.54$ – 1.12) across endocrine, cardiovascular, and psychological outcomes, underscoring its value as a holistic, non-pharmacological approach for managing hypothyroidism. Additionally, the sustained benefits observed across multiple health domains highlight yoga's potential to improve long-term quality of life and reduce the risk of associated comorbidities in women with early adulthood hypothyroidism.

Keywords: hypothyroidism, yoga intervention, thyroid function, body composition, cardiovascular health, psychological well-being



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Introduction

Hypothyroidism is a common endocrine disorder characterized by reduced thyroid hormone production, predominantly affecting women of reproductive age (Taylor et al., 2018). The condition presents a complex clinical challenge, manifesting through diverse physiological and psychological symptoms that extend beyond traditional metabolic disruptions (Bode et al., 2021). Conventional management strategies have historically focused on pharmacological interventions, primarily thyroxine replacement therapy, which effectively addresses hormonal deficiencies but often overlooks the broader systemic and psychological implications (Wang et al., 2023; Wilson et al., 2021).

Recent advancements in integrative medicine have increasingly recognized the potential of mind-body interventions in managing chronic conditions (Selvameenakshi et al., 2022; Wankhar et al., 2024). Yoga, a millennia-old practice originating in India, represents a comprehensive approach that integrates physical postures (asanas; Venugopal et al., 2022), breathing techniques (pranayama; Jagadeesan et al., 2021; Maheshkumar et al., 2022), and meditative practices (Boopalan et al., 2024). Emerging scientific literature suggests that yoga may offer multidimensional therapeutic benefits, potentially modulating neuroendocrine function (Shobana et al., 2022), reducing physiological stress (Padmavathi et al., 2023), and enhancing overall well-being.

Previous research has provided preliminary insights into yoga's potential effects on hypothyroidism (Bhandari & Mahto, 2024). A recent systematic review evaluated eight interventional studies, including three RCTs, two pilot studies, two pre-post trials, and one case study, involving 421 HT patients (392 females, 29 males) with yoga interventions lasting three to six months. The findings suggest that yoga effectively improves thyroid and lipid profiles, heart rate variability, pulmonary functions, anxiety, depression, and quality of life in HT patients. Despite promising results, clinical and methodological heterogeneity limited meta-analysis, highlighting the need for well-designed RCTs to establish yoga's efficacy as a complementary intervention for managing hypothyroidism (Bhandari & Mahto, 2024). Further evidence from clinical trials has shown positive effects of yoga on hypothyroidism. To date, there has been no comprehensive review of these studies. A recent systematic review evaluated the efficacy of yoga as a therapeutic intervention for hypothyroidism by analyzing 11 clinical studies (n=516), including four RCTs, two non-RCTs, and five pretest-posttest studies. Yoga interventions varied from 1 to 6 months and commonly incorporated suryanamaskar, asanas, pranayama, and meditation. Outcome measures included TSH, T3, T4, thyroid medication usage, lipid indices, BMI, heart rate variability, pulmonary function, blood glucose, anxiety, depression, self-esteem, quality of life, and sleep. The majority of studies reported significant improvements across these parameters. However, the quality assessment revealed variability, with only one study having a low risk of bias, six with moderate risk, and four with high risk (Singh et al., 2011).

Additionally, a recent single-arm pre-post design study investigated the effect of a 3-month integrated yoga intervention (3-IY) on depression, lipid indices, and serum thyroid-stimulating hormone (sTSH) levels among 38 female patients with hypothyroidism and mild-to-moderate depression. The intervention, which included asanas, pranayama, and relaxation techniques practiced for 60 minutes daily (5 days a week), resulted in significant reductions ($p < 0.05$) in depression (58%), sTSH

(37%), BMI (6%), fatigue (64%), anxiety (57%), lipid profile indices (with a significant increase in HDL), and stress (55%) after 12 weeks compared to baseline. However, most studies have been limited by small sample sizes, methodological inconsistencies, and a lack of comprehensive, multi-domain assessment (Rani et al., 2021). The existing literature reveals fragmented evidence of yoga's impact on thyroid function, metabolic parameters, and psychological health, underscoring the necessity for rigorously designed, randomized controlled trials. This study aims to address these research gaps by conducting a systematic investigation into the therapeutic potential of a structured yoga intervention for women with early adulthood hypothyroidism.

Methods

Study Design

The Yoga for Hypothyroidism Study (YOHY) was a prospective, randomized, controlled, single-blind parallel-group trial designed to evaluate the efficacy of a 16-week yoga intervention on physiological and psychological variables among women with early adulthood hypothyroidism. The study was conducted at the Meenakshi Academy of Higher Education and Research, with primary aim of examining the potential therapeutic effects of yoga practices compared to a control group. Institutional review board approval (MAHER/IEC/PhD/34/FEB24) was obtained, and the study was overseen by an independent monitoring committee to ensure scientific integrity and participant safety.

Sample size

The sample size calculation was conducted with a conservative approach, assuming a 20% attrition rate and focusing on a single primary outcome of thyroid-stimulating hormone (TSH) levels. The calculation utilized preliminary pilot study data to estimate effect sizes, with a minimal clinically significant change in TSH defined as 1.0 mIU/L. A comprehensive power analysis determined that a sample size of 60 participants (30 per group) would provide 85% statistical power to detect significant differences, with an alpha level set at 0.05 (Nilakanthan et al., 2016). The sample size calculation accounted for potential dropouts and variability in thyroid function response. Statistical analysis was performed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA).

Participants

The target population comprised 63 women aged 20-39 years with a confirmed diagnosis of hypothyroidism. Participant recruitment utilized multiple strategies, including referrals from local endocrinology clinics, community health centers, and targeted advertising. Inclusion criteria specified young adult women with documented hypothyroidism, currently on thyroxine medication, and residing in Chennai. Strict exclusion criteria eliminated participants with comorbid conditions such as thyroid cancer, Hashimoto's thyroiditis, or significant concurrent medical interventions. Three participants were excluded due to various reasons were presented in figure 1.

Randomization and Allocation

Randomization was implemented using computer-generated permuted block randomization to ensure unbiased group allocation. A neutral third-party statistician generated the randomization sequence, which was concealed in sequentially numbered, opaque, sealed envelopes. Participants were randomly assigned to either the experimental yoga intervention

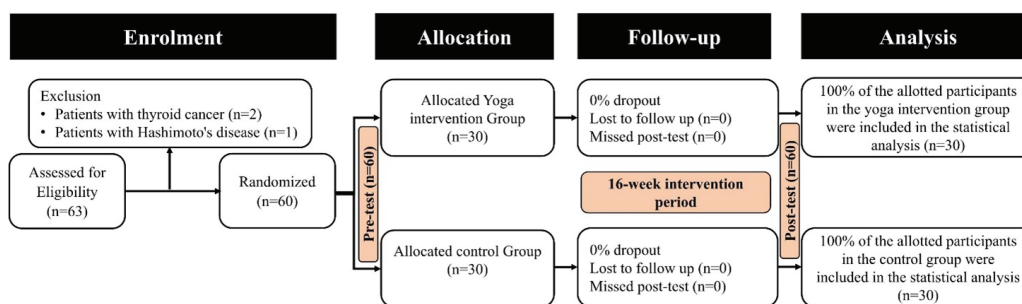


FIGURE 1. CONSORT flow diagram of the study

group (n=30) or the control group (n=30), with stratification based on key baseline characteristics including age, body mass index, and current thyroid medication dosage.

Blinding Considerations

While complete blinding was challenging due to the nature of the yoga intervention, partial blinding strategies were employed. Laboratory personnel conducting biochemical analyses remained blinded to group allocation to minimize poten-

tial bias. Independent researchers not directly involved in the intervention conducted outcome assessments. Participants and yoga instructors could not be fully blinded, but standardized assessment protocols were rigorously implemented to reduce potential performance and detection bias.

Intervention Protocol

The 16-week yoga intervention represented a comprehensive, meticulously structured therapeutic approach de-

Table 1. Details of the Yoga module

S.no	List of practices	Duration
1	AUM chant & Starting prayer	5 min
2	Loosening exercise <ul style="list-style-type: none"> » Pawanamukasana serious 1 » Padanguli naman & goolf naman » Goolf chakra » Goolf ghurnan » Januphalak akarshan » Janu naman & chakra » Ardha titali » Purna titali » Mushtika bandhana » Mani bandhana naman & chakra » Skandha chakra » Greeva sanchalana 	20 min
3	Surya namaskar	10 min
4	Asanas Standing: <ul style="list-style-type: none"> » Ardha chakrasana Sitting: <ul style="list-style-type: none"> » Janu shirasana » Navasana » Matsyasana » Marjaryasana Supine: <ul style="list-style-type: none"> » Sarvangasana » Halasana » Vipareta karani Prone: <ul style="list-style-type: none"> » Bhujangasana » Urdhva dhanurasana 	25 min
5	Pranayama <ul style="list-style-type: none"> » Nadi shodhana » Ujjayi » Brahmari 	5 min
6	Relaxation Mindfulness technique	20 min
7	AUM chant & ending prayer	5 min

signed to potentially modulate physiological and psychological parameters in women with hypothyroidism (See Table 1). Conducted over five 90-minute sessions weekly, the intervention transcended conventional exercise paradigms, integrating traditional yoga practices with a holistic mind-body wellness strategy (Singh et al., 2011). Each session commenced with Pranava mantra chanting, followed by extensive loosening exercises targeting joint mobility and flexibility, including techniques like Pawanamuktasana series and dynamic stretching. The Surya Namaskar sequence, a dynamic flowing practice synchronizing breath and movement, formed a core component, potentially stimulating metabolic processes and enhancing cardiovascular efficiency. Asana practices were systematically categorized, encompassing standing poses like Ardha chakrasana, sitting postures including Janu shirasana and Navasana, supine positions such as Sarvangasana and Halasana, and prone poses like Bhujangasana. These postures were deliberately selected to potentially stimulate thyroid function, enhance metabolic rate, and improve overall physiological homeostasis. Pranayama techniques, including Nadi shodhana, Ujjayi, and Brahmari breathing, were incorporated to potentially modulate autonomic nervous system functioning and reduce physiological stress (Maheshkumar et al., 2022). The intervention concluded with mindfulness meditation and relaxation protocols, designed to potentially mitigate psychological stress associated with chronic endocrine disorders. Critically, all sessions were conducted by certified yoga instructors trained in therapeutic applications, ensuring precise technique, safety, and intervention fidelity.

Outcome Measures

Thyroid-specific biochemical markers, including Triiodothyronine (T3), Thyroxine (T4), and Thyroid Stimulating Hormone (TSH), were quantitatively assessed through standardized blood tests, providing precise insights into endocrine system functioning (Singh et al., 2011). Simultaneously, anthropometric measurements focused on body composition, with Body Mass Index (BMI) calculated using precise height

and weight measurements to assess potential metabolic adaptations. Cardiovascular parameters were evaluated through automated blood pressure monitoring (Omron HEM 7156 T Digital Blood Pressure Monitor), capturing both systolic and diastolic pressures to understand potential autonomic nervous system modulations. Psychological outcomes were comprehensively assessed using the validated Depression, Anxiety, and Stress Scale (DASS) questionnaire, enabling multi-dimensional evaluation of mental health status (Ali et al., 2021). The assessment framework incorporated standardized self-esteem metrics, providing a holistic understanding of potential psychological transformations. Measurements were strategically scheduled at two critical timepoints: baseline (pre-intervention), and completion (16 weeks), allowing for detailed tracking of progressive changes.

Statistical Analysis

Statistical analysis was conducted using R statistical software (version 4.2.1) to evaluate the intervention's impact. The Shapiro-Wilk test assessed data normality, with a significance level set at $p < 0.05$. The primary analytical approach employed paired t-tests to determine statistically significant differences between the experimental yoga and control groups. Independent samples t-tests compared baseline characteristics, while paired t-tests assessed within-group changes for thyroid function markers, blood pressure, and psychological scores. Effect sizes were calculated using Cohen's d, with values of 0.2, 0.5, and 0.8 interpreted as small, medium, and large effects, respectively (Aarts, 2014). Descriptive statistics summarized participant characteristics, and missing data were handled using multiple imputation techniques.

Results

A total of 60 women with hypothyroidism completed the 16-week study, with 30 participants in the yoga intervention group and 30 in the control group. The baseline characteristics were similar between groups, ensuring comparability at the study's onset (see Table: 2).

Table 2. Baseline Characteristics of Participants

Characteristic	Yoga Group (n=30)	Control Group (n=30)	p-value
Age (years)	28.5 ± 4.2	29.1 ± 4.5	0.62
Body Mass Index (kg/m ²)	27.6 ± 2.3	27.4 ± 2.2	0.78
Duration of Hypothyroidism (years)	3.2 ± 1.7	3.5 ± 1.9	0.55
Thyroxine Medication Dosage (mcg)	75.3 ± 12.6	74.8 ± 11.9	0.87
Baseline DASS Score	24.6 ± 5.3	25.1 ± 5.5	0.73
Systolic Blood Pressure (mmHg)	132 ± 8	131 ± 7	0.81
Diastolic Blood Pressure (mmHg)	82 ± 5	83 ± 6	0.69

The 16-week yoga intervention demonstrated significant ($p < 0.05$) improvements in hypothyroid women across multiple physiological and psychological domains (Table 3). Thyroid function markers showed a statistically significant reduction in TSH levels from 4.2 to 3.1 mIU/L (Cohen's $d = 0.87$), with a corresponding increase in T3 levels from 1.2 to 1.4 nmol/L (Cohen's $d = 0.67$). T4 levels also exhibited a modest increase in the yoga group from 95.6 to 102.1 nmol/L, though this change was not statistically significant (Cohen's $d = 0.54$). Anthropometric analysis revealed a meaningful Body Mass Index (BMI) reduction

from 27.6 to 25.9 kg/m² (Cohen's $d = 0.76$), indicating potential metabolic benefits. Cardiovascular parameters exhibited notable improvements, with systolic blood pressure decreasing from 132 to 124 mmHg (Cohen's $d = 0.92$) and diastolic pressure reducing from 82 to 76 mmHg (Cohen's $d = 0.85$). The most pronounced changes were observed in psychological metrics, with Depression, Anxiety, and Stress Scale (DASS) scores dramatically declining from 24.6 to 15.2 (Cohen's $d = 1.12$), accompanied by a significant self-esteem score increase from 17.3 to 22.6 (Cohen's $d = 0.93$).

Table 3. Outcome Measures - Pre and Post Intervention

Outcome Measure	Group	Pre-Intervention	Post-Intervention	Mean Change	p-value	Effect Size (Cohen's d)
TSH (mIU/L)	Yoga	4.2 ± 1.1	3.1 ± 0.9	1.1	< 0.01	0.87
	Control	4.3 ± 1.0	4.2 ± 1.1	0.1	0.62	0.09
T3 (nmol/L)	Yoga	1.2 ± 0.3	1.4 ± 0.2	0.2	< 0.05	0.67
	Control	1.3 ± 0.2	1.3 ± 0.3	0	0.95	0.03
T4 (nmol/L)	Yoga	95.6 ± 12.3	102.1 ± 11.8	0.5	0.07	0.54
	Control	96.3 ± 11.5	92.2 ± 12.0	0.9	0.62	0.08
BMI (kg/m ²)	Yoga	27.6 ± 2.3	25.9 ± 2.1	1.7	< 0.01	0.76
	Control	27.4 ± 2.2	27.3 ± 2.3	0.1	0.78	0.04
Systolic BP (mmHg)	Yoga	132 ± 8	124 ± 6	8	< 0.01	0.92
	Control	131 ± 7	130 ± 8	1	0.53	0.13
Diastolic BP (mmHg)	Yoga	82 ± 5	76 ± 4	6	< 0.01	0.85
	Control	83 ± 6	82 ± 5	1	0.67	0.17
DASS Score	Yoga	24.6 ± 5.3	15.2 ± 4.1	9.4	< 0.001	1.12
	Control	25.1 ± 5.5	24.3 ± 5.2	0.8	0.42	0.15
Self-Esteem Score	Yoga	17.3 ± 3.2	22.6 ± 2.8	5.3	< 0.01	0.93
	Control	17.5 ± 3.1	17.7 ± 3.0	0.2	0.81	0.06

Discussion

This study provides compelling evidence for the therapeutic potential of a structured yoga intervention in women with early adulthood hypothyroidism, demonstrating multifaceted improvements across physiological and psychological domains. A statistically significant reduction in TSH levels from 4.2 to 3.1 mIU/L suggests potential enhancement of the hypothalamic-pituitary-thyroid axis functioning, consistent with emerging mind-body intervention research. The concurrent increase in T3 levels further substantiates metabolic adaptations. Notable physiological improvements included substantial BMI reduction and significant decreases in blood pressures, indicating potential autonomic nervous system modulation. The most profound transformations emerged in psychological metrics, with dramatic reductions in DASS scores and significant self-esteem improvements.

These findings highlight yoga's potential as a holistic, non-pharmacological management strategy for hypothyroidism, offering simultaneous benefits to endocrine, cardiovascular, and psychological health. The results highlight the importance of comprehensive, integrative approaches in managing chronic endocrine disorders.

The findings from our 16-week yoga intervention align with and expand upon existing evidence regarding yoga's positive impact on thyroid function, psychological well-being, and cardiovascular health in hypothyroid patients. Our study demonstrated significant reductions in TSH levels (from 4.2 to 3.1 mIU/L, $p < 0.01$, Cohen's $d = 0.87$) and notable increases in T3 levels, while T4 levels showed a modest, non-significant rise. These results are consistent with those of Ranjna et al. (2020), who observed significant increases in free T4 and reductions in TSH and anti-TPO levels, achieving clinical euthyroid status in the yoga group. Similarly, Sharma and Mahabala (2016) reported significant improvements in T3, T4, and TSH, reinforcing the endocrine benefits of yoga interventions.

Our observed reduction in TSH parallels the findings of Rani et al. (2021), who also reported decreased sTSH levels alongside a reduction in thyroxine medication dosage. This

suggests that consistent yoga practice may potentially enhance thyroid function to the extent that it reduces reliance on pharmacological treatment, although our study maintained constant medication dosages for control. Contrastingly, Swami et al. (2010) and Nilakantham et al. (2016) reported non-significant changes in TSH levels, which may be attributed to differences in intervention duration, yoga protocols, or sample characteristics. Interestingly, Tripathi et al. (2018) found significant improvements using specific hand mudra interventions, highlighting that even targeted yoga techniques can influence thyroid-related outcomes.

Beyond thyroid hormone modulation, our study demonstrated substantial improvements in psychological metrics, with DASS scores decreasing significantly ($p < 0.001$, Cohen's $d = 1.12$) and self-esteem scores rising notably ($p < 0.01$, Cohen's $d = 0.93$). These findings resonate with the work of Javed Akhtar (2019) and Singh et al. (2011), who reported enhanced quality of life and mental health outcomes following yoga interventions. While Akhtar observed improvements primarily in physical and psychological domains, Singh reported broader benefits across all domains, including social well-being—a contrast to our findings, where psychological domains showed the most pronounced improvements. This discrepancy may reflect differences in the intensity of social components within yoga practices or the baseline psychosocial context of participants.

Moreover, Kamatchi and Elangovan (2022) documented increased self-confidence and self-esteem in yoga participants, consistent with our findings. However, our study's larger effect size in self-esteem improvements suggests that integrating mindfulness and meditation techniques alongside physical postures may amplify psychological benefits.

In summary, our results substantiate and build upon prior research, demonstrating that a structured, multi-component yoga intervention can yield significant physiological and psychological benefits for hypothyroid women. The consistency of our findings with recent studies strengthens the evidence base for yoga as an effective complementary therapy in hypo-

thyroidism management. Importantly, our study contributes novel insights into the magnitude of these effects, particularly regarding psychological well-being, and underscores the need for further high-quality, long-term randomized controlled trials to explore the sustained impacts of yoga on thyroid health and overall quality of life.

Strengths

Our study's rigorous design, including randomized controlled methodology, comprehensive outcome measures, and stratified allocation, enhances the credibility of the findings. The use of certified yoga instructors and standardized intervention protocols minimized potential confounding variables.

Limitations

While promising, several limitations must be acknowledged. The relatively small sample size and single-center design necessitate cautious generalization. The study's duration

Acknowledgement

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Conflicts of interest

The authors declare that there are no conflict of interest.

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of 16 weeks provides preliminary evidence, but long-term follow-up studies are warranted to establish sustained benefits.

Clinical Implications

The results suggest yoga as a potential complementary therapeutic strategy for women with hypothyroidism. The multidimensional improvements observed indicate that yoga may offer more than traditional exercise interventions, addressing both physiological dysregulation and psychological distress.

Conclusion

This study provides robust evidence supporting yoga as a holistic intervention for women with hypothyroidism. The significant improvements in thyroid function, metabolic parameters, cardiovascular health, and psychological well-being underscore the potential of mind-body practices in managing chronic endocrine disorders.

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