ORIGINAL RESEARCH ARTICLE

Physiological Effects of Yoga and Pranayama on Serum Adipokines, Lipoprotein (a), Thyrotropin Levels, and Blood Pressure among Obese Hypothyroid Patients with Hypertension

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ABSTRACT

Background: The trio of obesity, hypothyroidism, and hypertension can act as a strong synergistic risk factor through parameters, like elevated serum leptin and lipoprotein (a) and decreased adiponectin levels, for the development of atherosclerotic diseases. Very few studies have focused on the effects of yoga/pranayama on these parameters among obese hypothyroid patients with hypertension. Hence, the present research work was carried out to evaluate the effects of 6 months of yoga and pranayama practices on these parameters.

Materials and Methods: The present interventional study was conducted involving 20 obese hypothyroid patients with hypertension, their baseline values of serum adipokines, lipoprotein (a), thyrotropin-releasing hormone (TRH) levels, blood pressure (BP), and body mass index (BMI) were recorded and they were subjected to 6 months of yoga/pranayama and the same were recorded at the end of 6 months, and data were statistically analyzed.

Results: There was a statistically significant reduction ($P < 0.01$) between baseline versus after 6 months in parameters such as serum leptin (23.94 ± 12.96 vs. 11.88 ± 10.32 ng/mL); serum lipoprotein (a) (28.45 ± 3.12 vs. 12.98 ± 3.56 mg/dL); BMI (29.42 ± 3.01 vs. 25.36 ± 2.41 kg/m$^2$); and significant improvement ($P < 0.01$) in serum adiponectin (3.44 ± 2.32 vs. 8.86 ± 4.88 ug/mL); systolic BP (147.24 ± 7.39 vs. 126.88 ± 6.34 mmHg); diastolic BP (95.76 ± 6.32 vs. 82.04 ± 4.56 mmHg); and TSH (13.41 ± 3.34 vs. 2.83± 2.62 mIU/L).

Conclusion: Yoga and pranayama practice for 6 months resulted in beneficial effects such as reduction of serum leptin, lipoprotein (a) levels, BMI, BP, and improved adiponectin levels and thyroid functions among obese hypothyroid patients with hypertension.

ARTICLE INFO

Article history:
Received on: 27-06-2023
Accepted on: 19-08-2023
Available online: 31-08-2023

Key words:
Adipokines, Hypertension, Hypothyroidism, Obesity, Pranayama, Yoga

1. INTRODUCTION

Obesity is a growing global epidemic and it is associated with chronic inflammation, orchestrated by metabolic cells in response to excess nutrients. This inflammatory state is present in structures such as the blood vessel wall, liver, brain, pancreas, and adipose tissue and has been implicated in immunometabolic disease. Among the adipokines secreted by adipocytes, leptin and adiponectin are the two most common hormones associated with obesity. Leptin exerts pro-inflammatory effect and is considered as a potential marker of obesity and its comorbidities such as Type 2 diabetes and cardiovascular disease, due to its angiogenic, atherogenic effects through a novel leptin receptor mechanism.[1-4] Whereas, adiponectin is an anti-inflammatory, anti-diabetic, and anti-atherosclerotic adipokine, acting through the AdipoR1 and AdipoR2 receptors. Low levels of adiponectin are associated with an increased risk of developing atherosclerotic diseases and inversely related to BMI. Obesity is also associated with high levels of low-density lipoprotein-cholesterol-lipoprotein(a), which are independent and causal risk factor for atherosclerotic diseases through mechanisms such as increased atherogenesis, inflammation, and thrombosis.[3,5-8]
1.1. Obesity-hypothyroidism-hypertension Interlink
The relationship between obesity, hypothyroidism, and hypertension is very complex and pivotal. Both hypothyroidism and subclinical hypothyroidism are associated with a higher prevalence of obesity. Hypothyroidism causes decreased thermogenesis, decreased metabolic rate, and slow peristalsis causing chronic constipation, resulting in weight gain. Conversely, increased leptin levels in obese patients enhance activity of deiodinases and stimulate centrally the transcription of pro-thyrotropin-releasing hormone and consequently formation of thyrotropin-releasing hormone (TRH) and thyroid-stimulating hormone (TSH).\[13,14\]

The relationship between obesity and hypertension has been found among all age groups and across both sexes. As per Framingham offspring study, an increase in weight by 5% was associated with a 20–30% of increase in the incidence of hypertension.\[13,14\] The mechanisms through which obesity can cause hypertension include sympathetic overactivation, stimulation of the renin-angiotensin-aldosterone system, excessive cortisol secretion, alterations in adipose-derived adipokines, and insulin resistance.\[15,16\] Similarly, hypothyroidism has also been recognized as a cause of secondary hypertension due to significant volume changes, low plasma renin activity, increased peripheral vascular resistance, and low cardiac output.\[17–19\]

Thus, the combination of obesity, hypothyroidism, and hypertension can act as a strong synergistic risk factor, for the development of atherosclerotic diseases, through altered levels of serum adipokines and lipoprotein (a). Even though medications are used in the management of these patients, the overall effectiveness in ameliorating symptoms and prevention of complications is insufficient.

Practice of yoga and pranayama has numerous beneficial physiological effects in human body. Yoga is derived from Sanskrit word “yuj” is a psycho-somatic-spiritual discipline for achieving union and harmony between our mind, body, and soul and the ultimate union with the universal consciousness. Pranayama means regulation of breath and is derived from Sanskrit words, namely, “prana,” which means life energy or vital force, “ayama” means to prolong. Hence, the present research work aims to evaluate the effect of 6 months of yoga and pranayama practices on these parameters.

2. MATERIALS AND METHODS
The present interventional study was conducted from November 2022 to June 2023 at Preksha wellness and Yoga Centre, and Sakaria Hospital, Bangalore, India. Baseline parameters were recorded and the patients were instructed to continue thyroid and BP medications. All patients were taught yoga and pranayama by single/same expert yoga instructor and the parameters were again recorded after 6 months of yoga and pranayama practice.

2.4. Protocol of Yoga/Pranayama in the Present Study
Total execution time for yoga and pranayama practices was 60 min per session per day, 6 days in a week, in the morning between 6.30 am and 7.30 am and 7.30 am to 8.30 am in two batches (online/offline) as per the time/batch chosen by the patients for 6 months. The specific protocol of yoga and pranayama was finalized by yoga expert based on the review of literature and consultation with many other yoga experts. Printed handouts with instructions, pictures of yoga, and recorded YouTube videos of yoga practices were also handed over to all patients, for better understanding and compliance. All patients were monitored telephonically during the study period to ensure there were no serious adverse effects, reported by any of the patients.[20]

- Execution time – 10 min – Warmup exercises – neck movements, shoulder rotation, wrist movements, twisting back, leg movements, and ankle joint movements.
- Execution time – 10 min – Suryanamaskara – 6–10 rounds/repetitions.
- Execution time – 20 min – Asanas.
  a. Standing – Trikonasana, Padahastasana, and Virabhadrhasana 1 and 2.
  b. Sitting – Paschimottanasana, Ustrasana, and Marjariasana.
  c. Lying supine – Viparitakarni, Sarvangasana, Setubandhasana, and Matsyasana.
  d. Lying prone – Bhujangasana, Shalabhasana, and Dhanurasana.
- Execution time – 5–7 min Relaxation – Shavasana.
- Execution time – 15 min – Pranayama – Nadishuddhi Pranayama (1:4:2), Ujjayi Pranayama (1:4:2), and Bhramari pranayama.

2.5. Protocol of Measurement of Basic Components Like BP, BMI, and Serum TSH in the Present Study
BP was measured using Omron automatic BP monitor, model HEM 7124, Vietnam, with prior clinical validation. Patients were asked to avoid from strenuous physical activity for 24 h and avoid smoking, consumption of alcohol and caffeinated beverages for 12 h before the laboratory tests. The patients were asked to void urine before testing and made to sit in the laboratory comfortably to get accustomed to the new place. Measurements were obtained after the patient had been sitting quietly for 15 min. The mean of three consecutive measurements with a maximum variation of 4 mmHg of both systolic and diastolic BPs was recorded.

Body mass index (BMI) was calculated using Quetelet’s index (BMI = weight (kg)/[height (m)]²). Height was measured to the nearest 0.5 cm without shoes/footwear, using a stadiometer (V.M. Electronics...
Another study conducted among 16 healthy postmenopausal Korean women aged 54.50 ± 2.75 years with more than 36% of body fat, randomly assigned to either a yoga exercise group (n = 8) or to a “no exercise” control group (n = 8), after 16 weeks indicated that yoga exercise improved adiponectin levels, decreased serum lipids, and metabolic syndrome risk factors in obese postmenopausal women and consequently, concluded that yoga exercise would be effective in preventing cardiovascular disease caused by obesity in obese postmenopausal Korean women.[22]

A comparative study involving 50 healthy women (mean age=41.32 years, range=30–65 years), 25 novices and 25 yoga experts, provided fasting blood samples for analysis of serum leptin and adiponectin, during three separate visits. Leptin was 36% of higher among novices compared to yoga experts. Longer years of yoga practice were significantly associated with lower leptin, raised adiponectin levels among yoga experts.[23]

There was a significant (P < 0.01) reduction in BMI and lipoprotein (a) levels and improvement in TSH levels after 6 months of yoga and pranayama practices in the present study, which are in accordance with a pilot study conducted to depict the effects of 6 months of intense yoga practice on lipid profile, thyroxine medication, and serum TSH level among 22 household females suffering from hypothyroidism, demonstrated that physical postures, Surya namaskar, and dynamic yogic breathing practices such as Bhastrika and Kapalabhati pranayama helped in the improvement of physical well-being and metabolic rate, and slow breathing practices such as Nadi Shuddhi pranayama, Ujjayi pranayama, and Bhramari pranayama helped in the improvement of physical and mental relaxation and there was a significant reduction in total cholesterol, low-density lipoproteins (LDLs), triglycerides, and significant improvement in protective high-density lipoproteins (HDLs) levels.[24]

### 4.1. Possible Physiological Mechanisms of Yoga and Pranayama Resulting in Beneficial Effects on Obesity, Lipids, and Adipokines

The sequential slow and non-strenuous movements of yoga positively affect the hypothalamic-pituitary axis response, to stress and this could be the main basis for the reduction in weight among obese individuals.[25] The improvement in the lipid profile among obese patients could be due to increased hepatic lipase and lipoprotein lipase at cellular level, which alters the metabolism of lipoprotein and thus increases the uptake of triglycerides by adipose tissues and further, meditation also brings about a balanced metabolic state and decreases the stress-induced sympathetic activity which leads to overcome stress that ultimately results in lowered cortisol levels and inflammatory lipoproteins, it can also be a possible mechanism for beneficial effects on lipid profile among patients practicing yoga/meditation and pranayama. Yoga practice can induce secretion of anti-adipogenic adipokines and suppress adipogenic/inflammatory adipokines by regulating transcription of microRNA(miRNAs).[26]

In a recently conducted and randomized study in Tamil Nadu, India, involving 120 hypothyroidism patients wherein 60 patients were allocated to yoga group and another 60 to control group, with yoga group subjected to 90 days of ujjayi pranayama, revealed that practice of Ujjayi pranayama decreased the BMI and improved thyroid function in the yoga group in comparison to that of the control group.[27]

Another study conducted at a nature cure hospital, Shantivan, Dharmasthala, involving 60 obese hypothyroid subjects, 29 males (age 44.2 ± 7.0 years) and 31 females (age 40.6 ± 7.4 years) with BMI ≥30 were randomly assigned to case group (n = 30) and waitlist control group (n = 30). The subjects of case group underwent naturopathy and yoga intervention for 10 days. The result showed a significant

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**Table 1**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Case Group</th>
<th>Control Group</th>
<th>P value</th>
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</thead>
<tbody>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Leptin (ng/mL)</td>
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<td>Lipid profile</td>
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<td>Systolic blood pressure</td>
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<td>DBP (mmHg)</td>
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<td>TSH (mIU/L)</td>
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<tr>
<td>BMI</td>
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**2.6. Protocol of Measurement of Parameters Like Serum Adipokines-leptin and Adiponectin and Lipoprotein (a) Levels in the Present Study**

Serum leptin was measured by Human Leptin Quantikine ELISA Kit DLP00, Bio-Techne India Private Limited, India, and serum adiponectin levels by Human HMW Adiponectin/Acrp30 ELISA Kit, Bio-Techne India Private Limited, India, and serum lipoprotein (a), by Lipoprotein A kit (latex-enhanced immunoturbidimetry method), Genuine Biosystem Private Limited, Chennai, India. All the tests were carried out as per manufacturer’s manual of instructions.

**2.7. Statistical Analysis**

The collected data were entered into master Excel chart. The data were analyzed using Smith’s Statistical Software version 2.80, developer-Gary Smith, and parametric variables were expressed as means ± standard deviations, and non-parametric variables were expressed as medians and interquartile ranges, within the group pre- and post-assessment were done using Student’s paired t test for paired data and P value below 0.01 was considered as statistically significant.

**2.8. Drop Outs**

During the study, out of the total 20 patients involved, four (two males and two females) of them dropped out due to personal reasons.

**3. RESULTS**

Table 1 shows a statistically significant reduction (P < 0.01) between baseline versus after 6 months in parameters such as serum leptin (23.94 ± 12.96 vs. 11.88 ± 10.32 ng/mL); serum lipoprotein (a) (28.45 ± 3.12 vs. 12.98 ± 3.56 mg/dL); BMI (29.42 ± 3.01 vs. 25.36 ± 2.41 kg/m²); and significant improvement (P < 0.01) in serum adiponectin (3.44 ± 2.32 vs. 8.86 ± 4.88 ug/mL); diastolic blood pressure (147.24 ± 7.39 vs. 126.88 ± 6.34 mmHg); and TSH (13.41 ± 3.34 vs. 2.83 ± 2.62 mIU/L).

**4. DISCUSSION**

Our present study depicted a statistically significant reduction (P<0.01) in serum leptin levels and beneficially raised serum adiponectin levels after 6 months of yoga and pranayama practice. Similar results were demonstrated in a study involving a total of 97 Hong Kong Chinese individuals aged (57.6 ± 9.1) years with metabolic syndrome and high-normal BP randomly assigned to control (n = 45) and yoga groups (n = 52) with patients of yoga group subjected to a yoga training program with three 1-h yoga sessions weekly for 1 year, showed that 1-year yoga training decreased pro-inflammatory adipokines and increased anti-inflammatory adipokine among patients suffering from metabolic syndrome with high-normal BP.[21]

Another study conducted among 16 healthy postmenopausal Korean women aged 54.50 ± 2.75 years with more than 36% of body fat,
A beneficial impact by reduction of serum leptin, and lipoprotein (a) by yoga and pranayama practiced for a period of 6 months have shown.

Our present study also demonstrated a significant reduction of both systolic as well as DBPs after 6 months of yoga practice. Concordantly, in a study conducted at Bengaluru, India, involving 45 hypertensive patients depicted a statistically significant decrease in both systolic as well as DBP with \( P < 0.05 \), and reduction in inflammatory markers like high-sensitive CRP following 6 months of yoga practice.

Another study conducted by Thiyagarajan et al. also demonstrated SBP reduction by 4 and 6 mmHg with lifestyle changes alone and lifestyle changes plus yoga therapy respectively. Further, yoga also resulted in reduction of heart rate, waist circumference, and lipid levels, which in turn could reduce cardiovascular disease prevalence and mortality.

4.2. Possible Physiological Mechanisms of Yoga and Pranayama Resulting in Beneficial Effects on Thyroid Functions and BP

Yogasanas such as shoulder stand (Sarvangasana), plow pose (Halasana), fish pose (Matsyasana), camel pose (Ustrasana), cobra pose (Bhujangasana), bridge formation pose (Sethubandhasana), and bow pose (Dhanurasana) help balance and regulate the functions of the thyroid gland by improving its blood circulation, squeezing out stagnant colloid secretions and strengthening neck muscles. Pranayama like Ujjayi results in constriction of glottis and throat region thereby causing stimulation and relaxation of the thyroid gland and other pranayama like Bhramari causes voluntary prolongation of breath, leading to stretching of the thyroid gland and also by rebalancing metabolism and improving reflex pathways within the throat could cure thyroid imbalance. The mechanism by which yoga and pranayama/meditation reduces BP could be by reduction in sympathetic activity, facilitating autonomic balance, enhancing baroreflex sensitivity, and alteration of chemoreceptor responses.

Thus, the various health benefits of yoga and pranayama among obese hypothyroid patients with hypertension could be related to changes in the level of various hormones, enzymes, neurotransmitters, autonomic balance, and reduction of inflammatory markers by complex physiological mechanisms.

4.3. Limitations of Present Study

1. Diet patterns of patients were not monitored.
2. Sample size was relatively small.
3. There was no control group; instead within yoga group (pre/post) comparison was assessed.
4. Other adipokines such as resistin, visfatin, interleukin-6, and tissue necrosis factor were not estimated and T3 and T4 were not compared.

5. CONCLUSION

Yoga and pranayama practiced for a period of 6 months have shown a beneficial impact by reduction of serum leptin, and lipoprotein (a) levels, BMI, BP, and improved serum adiponectin levels, and thyroid functions among obese hypothyroid patients with hypertension, by complex physiological mechanisms and thus, can be considered as an important adjuvant therapy in these patients, which could be explored with research projects in future to elucidate its molecular mechanisms.

6. ACKNOWLEDGMENT

We thank our all the participants, staff, and friends for their cooperation and support during study.

7. AUTHORS’ CONTRIBUTIONS

All the authors contributed equally in design and execution of the research article.

8. FUNDING

None.

9. ETHICAL APPROVALS

This study got Ethical clearance number: EC/PR/2022-156, was received from institutional ethics committee, Dr. B R Ambedkar Medical College and hospital, Bangalore. India.

10. CONFLICTS OF INTEREST

None.

11. DATA AVAILABILITY

This is an original manuscript and all data are available for only research purposes from principal investigators.

12. PUBLISHERS NOTE

This journal remains neutral with regard to jurisdictional claims in published institutional affiliation.

REFERENCES


Asvold BO, Bjoro T, Nilsen TI, Vatten LJ. Association between blood pressure and serum thyroid-stimulating hormone concentration within the reference range: A population-based study. J Clin Endocrinol Metab 2007;92:841-5.


Top 8 Yoga Poses and Pranayama for Thyroid Problems. Available from: https://www.curejoy.com/content/yogaand-pranayama-for-thyroid-problems/#sarvangasana [Last accessed on 2023 Jul 19].


How to cite this article:
Varne SR, Balaji PA. Physiological Effects of Yoga and Pranayama on Serum Adipokines, Lipoprotein (a), Thyrotropin Levels, and Blood Pressure among Obese Hypothyroid Patients with Hypertension. IRJAY. [online] 2023;8(8):9-14.
Available from: https://irjay.com
DOI link- https://doi.org/10.47223/IRJAY.2023.6802
Table 1: Comparison of parameters baseline versus after 6 months of yoga/pranayama

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Yoga group (baseline) n=16</th>
<th>Yoga group (after 6 months) n=16</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum leptin (ng/mL)</td>
<td>23.94±12.96</td>
<td>11.88±10.32</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Serum adiponectin (µg/mL)</td>
<td>3.44±2.32</td>
<td>8.86±4.88</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Serum lipoprotein (a) (mg/mL)</td>
<td>28.45±3.12</td>
<td>12.98±3.56</td>
<td>&lt;0.01</td>
</tr>
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<td>BMI (KG/M2)</td>
<td>29.42±3.01</td>
<td>25.36±2.41</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>TSH (m IU/L)</td>
<td>13.41±3.34</td>
<td>2.83±2.62</td>
<td>&lt;0.01</td>
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<td>SBP (mmHg)</td>
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<td>DBP (mmHg)</td>
<td>95.76±6.32</td>
<td>82.04±4.56</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, TSH: Thyroid stimulating hormone, BMI: Body mass index

Figure 1: Chart shows gender distribution – females and males