RESEARCH PAPER

A Case Report: Impact of Yoga on Oxidative Stress, Cardiometabolic Health, and Quality of Life in a Postmenopausal Woman

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Abstract

Menopause is the physiological transition in women characterised by hormonal decline, oxidative stress, psychological disturbances, and increased cardiometabolic risk. The decline in oestrogen levels in the postmenopausal era contributes to endothelial dysfunction, dyslipidaemia, altered glucose metabolism, and increased generation of reactive oxygen species. Yoga is now an emerging non-pharmacological approach to enhance physical, psychological, and metabolic health in postmenopausal women. The present case study aimed to evaluate the effects of a 90-day Integrated Yoga Module (IYM) based on the S-VYASA protocol on cardiometabolic parameters, oxidative stress markers, and psychological well-being in a 51-year-old postmenopausal woman.

The patient complained of stress, disturbed sleep, chronic fatigue, and weight gain. Baseline assessment was done using anthropometric measurements, body composition analysis, biochemical investigations, oxidative stress markers, and psychological questionnaires. The oxidative stress markers measured were lactate dehydrogenase (LDH) and 8-hydroxy-2-deoxyguanosine (8-OHdG). The patient was given a structured integrated yoga intervention of 90 days, including loosening exercises, asanas, pranayama, relaxation techniques, and meditation.

Post intervention, there was improvement in blood pressure, glycaemic parameters, and lipid profile, including a reduction in HbA1c, fasting insulin, and LDL cholesterol, along with improvement in HDL cholesterol. There was a mild decline in oxidative stress markers (LDH and 8-OHdG), which suggested decreased cellular injury and oxidative DNA damage. Psychological well-being also improved significantly with a reduction in PSQI and DASS-21 scores and an improvement in MENQOL score. Anthropometric parameters were relatively stable during the intervention period.

The findings indicate that integrated yoga practices might have a beneficial effect on oxidative stress, cardiometabolic health, sleep quality, and psychological well-being of postmenopausal women. Yoga might be a safe and effective complementary therapy for the management of cardiometabolic and oxidative stress-related complications of menopause. Moreover, large-scale studies are recommended to validate these findings.

Keywords: Menopause, Yoga, Oxidative stress, Postmenopausal women, Cardiometabolic risk, LDH, 8-OHdG, Quality of life, Integrated Yoga Module, Psychological well-being

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Introduction

Menopause is a natural tapering off of the female reproductive system and is defined as the permanent stopping of the menstrual periods, or menses. Menopause is diagnosed when there is no menses for 12 months and usually occurs as a result of the loss of ovarian follicles due to the cessation of the female reproductive organs. The average age of menopause is between 45 and 55 years of age [1]. The word menopause is derived from the Greek words meno, meaning men or month and pause, meaning cessation. It is a natural process that defines the end of the menstrual period in women, and it is estimated that women spend a large part of their life in the post-menopausal stage due to increased life expectancy [2].

The symptoms, such as anxiety, fatigue, mood swings, and weight gain, cause a decrease in quality of life during menopausal transition with a wide range of physiological and psychological changes [3]. During menopause, oestrogen levels fall and have also been associated with a higher risk of cardiovascular disease and autonomic imbalance. Previous studies have reported increased levels of total cholesterol, low-density lipoprotein, triglycerides, and glycated haemoglobin in postmenopausal women through cardiometabolic changes such as dyslipidaemia and obesity, especially central obesity, endothelial dysfunction, and protein cholesterol [4][5].

Oxidative stress has been suggested to play a major role in the development of complications associated with menopause. Oxidative stress is characterised by the imbalance between the generation of free radicals (also called reactive oxygen species (ROS)) and the endogenous antioxidants in the body [6]. ROS are very reactive molecules that can damage cellular components by inducing lipid peroxidation, impairing mitochondrial function, causing endothelial injury, and oxidative damage to DNA and other cellular molecules [7]. Oestrogen in women has been shown to have antioxidant properties, and so its decline during menopause could lead to a pro-oxidative state promoting vascular inflammation, endothelial dysfunction, and various other changes of ageing [8]. The latter may be involved in the pathogenesis of several cardiovascular and metabolic diseases in postmenopausal women.

Several biomarkers have been identified to assess oxidative stress and evaluate the risk of cardiovascular and metabolic diseases. These include Lactate dehydrogenase (LDH), an intracellular enzyme released from sites of injury or death of body cells [9]. Oxidative DNA damage mainly produces 8-hydroxy-2′-deoxyguanosine (8-OHdG), which is often used as a marker of oxidative stress [10]. The risk of cardiovascular and metabolic diseases was assessed by estimated fasting blood sugar (FBS), fasting insulin (FI), glycated haemoglobin (HbA1c), total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and triglycerides. [5]

Lifestyle modification and non-pharmacological approaches are increasingly being recommended and accepted worldwide for managing menopausal symptoms and associated cardio-metabolic disorders. In recent years, there has been a focus on holistic approaches to health care, and Yoga has been recognised and accepted as one of the effective ways of attaining health and well-being through physical, mental, and spiritual growth. The various components of yoga, such as asanas, pranayamas, meditation, and deep relaxation, induce changes in the physical, psychological, and metabolic health of an individual. This in turn creates a healthy balance of stress and autonomic function and enhances the body's antioxidant status by reducing the level of production of free radicals and/or by enhancing the activity of antioxidants such as superoxide dismutase and glutathione, etc. [11][12]. Yoga was also found to improve sleep, psychological well-being, and cardiovascular health in postmenopausal women [13]. In the present case study, an attempt has been made to assess the positive effects of a 90-day Integrated Yoga Module (IYM) comprising the Integrated Yoga S-VYASA protocol on various cardio metabolic parameters, oxidative stress markers, and psychological well-being in a 52-year-old postmenopausal woman.

Case report

A 51-year-old post-menopausal female patient presented to the Swasthavritta and Yoga Outpatient Department of Bharati Vidyapeeth Ayurvedic Hospital with complaints of weight gain, psychological stress, disturbed sleep, and chronic fatigue. There was no known history of cardiovascular diseases or any major systemic illness. The last menstrual period was 1.5 years ago. Prior to therapy, written informed consent was obtained.

On examination, the patient's radial pulse rate was 66 beats per minute, and blood pressure was 127/86 mm of Hg. Her weight was 67.2 kg, her height 162 cm, and her BMI 25.6 kg/m². She had no musculoskeletal or orthopaedic disorders, was not on hormonal therapy, and was physically as well as mentally fit for yoga intervention.

The patient had symptoms consistent with postmenopausal transition and oxidative stress, such as chronic fatigue, sleep disturbance, stress, and weight gain. Also, borderline cardiometabolic risk factors, including overweight status, altered lipid profile, increased body fat percentage, and reduced quality of life, were observed. Post-menopausal women are known to be more prone to oxidative stress due to the fall in oestrogen levels that usually have antioxidant and cardioprotective effects. Increased oxidative stress is related to endothelial dysfunction, metabolic dysregulations,

psychological stress, cellular damage, and an increased risk of cardiovascular diseases.

The patient had no known cardiovascular or metabolic disease that required a pharmacological treatment, so a non-pharmacological lifestyle-based intervention was planned. Yoga therapy was selected due to the understanding that integrated yoga practices (such as asanas, pranayama, relaxation techniques, and meditation) aid in improving autonomic balance, reducing stress, enhancing sleep quality, improving metabolic regulation, and promoting overall well-being. Similarly, yoga has been reported to improve the antioxidant defence mechanisms and decrease oxidative stress.

6. and score

Thus, to assess cellular injury and oxidative DNA damage, oxidative stress markers, lactate dehydrogenase (LDH), and 8-hydroxy-2-deoxyguanosine (8-OHdG) were measured. After adequate counselling, a customised Integrated Yoga Module (IYM) based on the S-VYASA protocol for cardiometabolic risk factors was given for 30 days initially, which was extended up to 90 days.

Diagnostic Assessment

1. Clinical assessments and anthropometry
2. Body fat composition
3. Present complaints
4. Blood parameters
5. Questionnaire

Table 1 - Comparative Assessment of Clinical, Biochemical, Oxidative Stress, and Psychological Parameters Before and After Yoga

Diagnostic assessments	Day 0	Day 90
1. Clinical assessments and anthropometry		
1.1 pulse	66/min	70/min
1.2 blood pressure	127/86 mmHg	120/82 mmHg
1.3 weight	67.2 kg	67.7 kg
1.4 height	162 cm	162 cm
1.5 BMI	25.6	25.80
1.6 waist circumference	96 cm	97 cm
1.7 WHR	0.89	0.88
1.8 Hip circumference	108 cm	108.5 cm
2. body composition		
2.1 total body fat	36.1	37.4
2.2 muscle mass	23.3	22.7
2.3 visceral fat	8	8
2.4 resting metabolism	1355 kcal	1349
3. blood parameters		
4.1 Estradiol	30	<24
4.2 FBS	89	86
4.3 FI	5.9	4.7
4.4 total cholesterol	205	202
4.5 HbA1C	6	5.8
4.6 triglycerides	137	137
4.7 LDL	128.80	119.60
4.8 HDL	48	55
4.9 LDH	155.37	152.3
4.10 8OHdG	0.93	0.89
4. questionnaire		
5.1 PSQI	6	3
5.2 DASS21	20	8

5.3 MENQOL	2.56	1.66

Details of Therapeutic Interventions

- The customized yoga intervention was based on an Integrated Yoga Module (IYM) developed by Swami Vivekananda Yoga Anusandhana Samsthana, consisting of prayer, loosening practices, sukshma vyayama, asanas, pranayama, meditation, and relaxation techniques [7].

Table 2 - Details of the Integrated Yoga Module (IYM) Followed During the Study

Activity and Duration	**Module A**	**Module B**
Opening prayer 5 minutes	1-minute focus on breath, followed by the prayer " Yogen chittasya Paden Vacha"	1-minute focus on breathing, followed by the prayer "*Aum Sahanavavtu sahanou Bhunaktu*"
Loosening exercise 8 minutes	30 seconds of : • Slow jogging • Backward jogging • Side jogging 8 to 10 rounds of : • Forward and backward bending • Side Bending • Twisting	30 seconds of : • Slow jogging • Backward jogging • Side jogging 8 to 10 rounds of : • Knee rotation • Hip Rotation • Rocking and Rolling • Pavanmuktasan Kriya
Breathing exercise 6 mins	• Hands in and out breathing • Dog Breathing • Tiger Breathing	• Hand stretch breathing • Rabbit breathing • Sasankasan Breathing

Asanas **15 minutes**	• *Ardha Kati chakras an* • *Parivrutta Trikonasan* • *Shasankasan* • *Ardh Ushtrasan* • *Vakrasan* • *Naukasen* • *Dhanurasan*	• *Trikonasan* • *Parshwakonasan* • *Butterfly pose* • *Ardh Matsyendrasan* • *Bhujangasan* • *Shalabhasan* • Wall supported *viparit karni*
Relaxation **2 min**	Quick Relaxation Technique	Quick Relaxation Technique
Pranayam	• *Nadishuddhi*	• *Nadishuddhi*

Outcome and followup

After 90 days of yoga intervention, the patient showed improvement in multiple cardiometabolic and psychological parameters. Blood pressure was 127/86 mmHg, dropping to 120/82 mmHg. There was an improvement in glycaemic control, with HbA1c decreasing from 6% to 5.8% and fasting insulin decreasing from 5.9 µIU/mL to 4.7 µIU/mL. There was a positive change in lipid profile with a reduction in LDL cholesterol from 128.8 mg/dL to 119.6 mg/dL, and an increase in HDL cholesterol from 48 mg/dL to 55 mg/dL. Post-intervention, mild reduction of oxidative stress markers like LDH and 8-OHdG was observed.

There were marked improvements in psychological well-being and quality of life measures. PSQI score decreased from 6 to 3, indicating improvement in the quality of sleep. DASS-21 score reduced from 20 to 8, indicating a reduction in stress and psychological distress. The MENQOL score improved from 2.56 to 1.66, indicating better menopause related quality of life.

Anthropometric parameters (weight, BMI) were relatively stable during the intervention period, and the waist-hip ratio showed slight improvements.

The integrated yoga intervention was associated with beneficial effects on cardiometabolic risk factors, psychological well-being, sleep quality, and menopause-related quality of life in this postmenopausal woman.

Discussion

In the present case scenario, the patient had complaints of weight gain, stress, disturbed sleep, chronic fatigue, with borderline HbA1C, slightly elevated lipid profile markers, and elevated oxidative stress markers as well. After day 90, lipid profile and HbA1C levels are markedly decreased.

HbA1C and lipid profile are important indicators of cardiometabolic risk, especially in postmenopausal women. HbA1C reflects long-term insulin sensitivity and glycaemic control, and lipid parameters such as total cholesterol, HDL, LDL, and triglycerides reflect overall cardiovascular health. Alteration in these values shows cardioprotective manifestation of yoga, and Improvement in questionnaires shows recovery in the menopausal state. Results also showed a significant reduction in oxidative markers – LDH and 8OHdG, which reflects the depletion in oxidative stress.

Oxidative stress is an overproduction of free radicals and a lack of the antioxidative defence mechanisms that neutralise them, such as reactive oxygen species (ROS) [2]. It damages the cell's normal physiological adaptive capacity and DNA through lipid peroxidation [3] [4]. Complications caused by oxidative stress, such as hyperglycaemia, atherosclerosis, hypertension, heart failure, and stroke, can lead to some disease conditions like diabetes, cancer, AD, and cardiovascular conditions [13,14].

LDH and 8OHdG are two of the most comprehensive and widely studied biomarkers from the various markers to detect oxidative stress, which indicates DNA damage and cellular injury, respectively.

LDH, one of the hypoxic biochemical parameters and an intracellular enzyme, increases under the condition of oxidative stress, due to the destruction of the cell membrane in the course of lipid peroxidation, which reflects conditions like subclinical ischemic changes in cardiac tissue [19][25]. On the other side, 8OHdG is formed when

the hydroxyl radical (.OH) attacks guanine (one of the fundamental building blocks of DNA), and oxidises it, which is released during DNA repair [17]. 8OHdG is also elevated in the menopausal state as a part of the natural aging process. [24].

In the menopausal phase, oestrogen levels decline, which leads to pro-oxidant-like effects, such as DNA strand breaks, DNA adduct formation, and oxidation of DNA bases. Levels of pro-oxidant biomarkers such as glutathione, 4-hydroxynonenal, and malondialdehyde were elevated in postmenopausal women. The higher levels of cytokines also suggest the elevation in the state of oxidative stress, which leads to the onset of cardiovascular and vasomotor disturbances, osteoporosis, and ovarian pathologies [15]. Endothelial dysfunction and vascular inflammation are led by lower levels of oestrogen, resulting in the acceleration of atherosclerosis and increased CVD risk. These complications are driven by visceral obesity, atherogenic dyslipidaemia, dysregulation of glucose homeostasis, and hypertension [22][23]. Furthermore, oxidative stress exacerbates vascular injury and cardiac dysfunction [13][14]. This oxidative stress can be managed by integration of yoga into daily life by enhancing the antioxidant defence mechanism, thereby improving overall physical health and maintaining a healthy lifestyle [9].

Regular practice of yoga and breathing exercises decreases the levels of ROS and Guanine oxidation, which ultimately leads to reduced levels of 8OHdG, resulting in stable genomic stability and repair of DNA damage. It also decreases the ROS and other oxidative enzymes, which stabilize the cellular integrity and decrease the LDH levels [17] [18] [20]. Overall, cardiovascular parameters improve with cardiovascular efficiency through yoga [26]. Therefore, a planned cardiac stress module was adopted in the present case study.

Overall, both physiological and psychological health can be improved positively by regular practice of yoga and breathing exercises through reducing stress levels. This results in increased mitochondrial efficiency, which leads to improved antioxidant defence mechanisms. Superoxide dismutase, catalase, and glutathione are also upregulated by yoga, which strengthens the body's ability to neutralise the ROS [8]. Yoga also reverses or prevents the harmful effects of chronic stress by balancing the HPA axis [21]. Additionally, improvised oxygenation in the body by holding the breath during yoga postures and deep breathing exercises lowers the ROS levels and ultimately reduces membrane damage and anaerobic metabolism. All these mechanisms collectively decrease oxidative stress, as reflected by levels of oxidative biomarkers.

Conclusion

This case study demonstrates the beneficial effects of a 90-day integrated yoga intervention based on the S-VYASA protocol on cardiometabolic health and oxidative stress in a postmenopausal woman. There was significant improvement in glycaemic control and lipid profile as shown by a reduction in HbA1c, total cholesterol, LDL, and triglycerides, and an increase in HDL levels, indicating improved cardiovascular risk status. Moreover, the significant reduction in the markers of oxidative stress, such as LDH and 8-OHdG, indicates improvement in cellular integrity and reduction in DNA damage. No significant change was observed in anthropometric parameters; however, improvement in biochemical and oxidative markers and better psychological well-being highlights the role of yoga as an effective non-pharmacological intervention. These findings suggest a possible preventive and therapeutic role of regular yoga practice in the management of menopause-associated cardiometabolic risks. Further large-scale studies with prolonged duration and combined lifestyle modifications are recommended to validate these outcomes.

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