Efficacy of yoga in balancing the deranged biochemical profile in healthy perimenopausal women hailing from South Kanara district of Karnataka, India.

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ABSTRACT :

Background: Alteration in biochemical profile has been observed in perimenopause due to change in the hormonal level. Regular practice of yoga has been found to be effective in improving serum lipid concentration, glycemic index and combat the oxidative stress. The purpose of this study was to analyze the effects of yoga on glycemic index, serum lipid profile, thyroid stimulating hormone (TSH), cortisol and antioxidant activity (AOA) in healthy perimenopausal women residing in the coastal region of Karnataka.

Methodology: 111 women aged 40 to 60 years with perimenopausal symptoms were recruited considering inclusion and exclusion criteria set for the study. Our participants were checked for glycemic index, serum lipid profile, TSH, cortisol and AOA levels before and after 12-weeks of yoga intervention.

Results: Yoga therapy intervention resulted in significant decrease (P=0.05) in fasting blood sugar, glycated hemoglobin (P=0.03), total cholesterol (TC) (P=0.06), low density lipoprotein (LDL) (P=0.04), TC/HDL ratio (P=0.002). Serum triglyceride concentration is decreased whereas high density lipoprotein (HDL), TSH and AOA was increased within the normal range after the intervention, though the change was not statistically significant. Cortisol showed no significant change after yoga therapy intervention.

Conclusions: Our findings indicate that yoga helps in improving the glycemic index, serum lipid profile, TSH and AOA in perimenopausal women. Thus it can be effectively used to improve the quality of life in perimenopausal women.

Keywords: Perimenopause, TSH, cortisol, AOA, yoga, Karnataka.

INTRODUCTION

Perimenopause refers to the time period before, during and after menopause. It is a physiological process in women that occurs around 40-55 years of age before the permanent cessation of menstruation. The length of this period varies from woman to woman but generally it lasts for about 7 years.[1] During this period the ovarian functions fluctuate and diminish resulting in various clinical consequences.[2]

It is characterized by gradual decline of estrogen (E) secretion and there is gradual increase in titers of progesterone & gonadotropin (FSH & LH). This gradual decline in endogenous estrogen production leads to many complications like increased cardiovascular risk [3,4,5], detrimental effects on the vasculature, bone, lipid profile, coagulation & fibrinolytic system[6]. On the other hand, changes in the levels of gonadotropins & increased FSH levels lead to alteration in the volume & frequency of bleeding (oligomenorrhea, polymenorrhea, hypo or menorrhagia).[7,8]

Studies have shown that there is abnormal atherogenic lipid profile observed in menopausal period, which is characterized by increase in total and LDL cholesterol, triglycerides (TG) and decrease in HDL-cholesterol with elevated serum glucose & insulin levels. The abnormal lipid profile results in redistribution of fat in the body and cause weight gain & development or increase in obesity.[9]

There are many factors that predispose to the development of oxidative stress during menopause[10] such as estrogen deficiency; reports have confirmed that estrogen has an antioxidant capacity independent of its binding to the receptors. Previous studies showed that the decline of estrogen during menopause transition can lead to severe oxidative stress.[11]

To improve the immediate symptoms of menopause and to manage long term consequences, hormone therapies (HT) have been used extensively. But, unfortunately these therapies have created new concerns about the increased risk of neoplasia of the endometrium and possibly the breast.[12,13] Along with this it also results in vaginal bleeding in most women.[1]

Therefore the contraindication associated with HT has motivated several researchers to investigate the role of alternative therapies in the safe management of short

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and long term effect of menopause. The commonly used alternative therapies are (i) Diet and Nutrition (ii) Psychology and spirituality (iii) Exercise (iv) Herbal and homeopathic therapies[14]. Yoga is one among the many alternative therapies. The most common yoga practices are posture (asana), controlled breathing (pranayama) and meditation (dhyana).[15] It can be very effective in providing relief from physical and psychological symptoms associated with many chronic diseases and also provide good health, physical strength and enhance overall quality of life.[16]

There are some reports which have shown the therapeutic effects of yoga therapy in effectively managing various chronic health disorders affecting the major organ system including neuroendocrine, respiratory, excretory, cardiovascular, musculo-skeletal and gastrointestinal systems.[17] The role of yoga is also attributed to combating oxidative stress in type 2 diabetes[18], end stage renal failure[19], insulin resistance syndrome, coronary artery disease[20,21], hypertension[22] and inflammation.[23] It is also beneficial in reducing waist circumference and improving blood pressure, glycemic index, insulin sensitivity, BMI and lipid profiles.[18,20,24]

Although previous studies have shown that oxidative stress is related to the human physical status and its pathogenesis, little is known about the effects of yoga on oxidative stress and antioxidant components in perimenopausal women. In the present study, we assessed the effects of yoga therapy in combating oxidative stress and balancing the altered biochemical profile in perimenopausal women hailing from the coastal region of Karnataka.

METHODS:

Participants:

This was a cross sectional study approved by the institutional ethical committee. Informed consent was obtained from the volunteers participating in the study. The study was carried out in 111 women aged between 40 and 60 years, belonging to various self-help groups, women organizations and yoga therapy clinics in this area. The women participating in the study satisfied the following inclusion criteria (a) 40 to 60 years of age (b) be willing and be able to practice yoga (c) have perimenopausal symptoms. Those excluded from the study were (a) women who were already practicing yoga for a month or more, (b) women with surgical menopause and receiving any kind of hormone therapy (c) women who had any active psychological disorders or any other medical disorders.

Design:

In this interventional study, 111 perimenopausal women were divided into 10 sub-groups. The intervention program in all these 10 groups started with collecting blood for base line data, followed by teaching and practicing the protocols and then follow ups and collection of post interventional data. The intervention was practice of yoga in the morning for 45 minutes per day for 12 weeks. The duration of each asana is given in the table 1.

Biochemical analysis:

On the day of blood collection, the subjects were asked to abstain from yoga or any other form of exercise. Blood (5 mL) was drawn from an anticubital vein at baseline (0 week) and after 12 weeks of yoga intervention. Glucose, total cholesterol and triglycerides were measured by standard enzymatic method in a Roche/Hitachi clinical chemistry analyzer. HbA1C was measured by the turbidimetric inhibition immunoassay using commercial kits supplied by Tina-quant. HDL-cholesterol was measured by the same enzymatic assay for cholesterol in the supernatant after precipitating LDL, VLDL and lipoproteins by dextran sulfate. LDL-cholesterol was calculated using Friedwald's formula. TSH and cortisol were measured by chemiluminescent immunoassay using commercial kits supplied by COBAS in an Elesys immunoassay analyzer. The AOA was estimated by spectrophotometric method of Koracevic et al.[25]This method is based on the principle that the standardized solution of iron EDTA complex reacts with hydrogen peroxide by a Fenton type of reaction, leading to the formation of hydroxyl radicals. This reactive oxygen species degrades benzoate, resulting in the release of TBARS. Antioxidants from the added plasma cause the suppression of production of TBARS. The reaction is measured spectrophotometrically at 532nm. The inhibition of the color developed is defined as AOA.[26]

Asanas (body postures)	Approximate time
Swastikasana (auspicious pose)	2 min
Vajrasana (thunderbolt pose)	2 min
Supta vajrasana (reclined Thunderbolt Pose)	2 min
Tadasana (Mountain pose)	2 min
Trikonasana (Triangle pose)	2 min
Parsvakonasana (extended side angle pose)	2 min
Paschimottasana (seated forward bend)	2 min
Purvatanasana (seated back arch)	2 min
Janushirshana (head to the knee pose)	2 min
Pavanamuktaasana (wind relieving pose)	2 min
Bhujangasana (cobra pose)	2 min
Shalabhasana (locust pose)	2 min
Dhanurasana (bow pose)	2 min
Vakrasana (twisted pose)	2 min
Padottanasana (wide-legged forward bend)	2 min
Shavasana (corpse pose)	5 min
Pranayama (breathing exercises)	
Anuloma-viloma	5 min
Suryabhedana	5 min
Sheetali	2 min
Bhramari	2 min

Table 1: Duration of yoga therapy – 45minutes/day

Statistical analysis:

Statistical analysis was performed using Statistical Package for Social Sciences, version 15.0 (SPSS Inc. Chicago, USA) for a level of statistical significance of 5%. The base line values for all the variables in both groups were compared using paired t-test and P values less than 0.05 were accepted as significant differences between pre and post-intervention data. Mann-Whitney test was performed for skewed data and the results were expressed in median & IQR. Pearson's correlation was applied to correlate between the parameters. The results were expressed as mean ± SD in a tabular form.

RESULTS:

Table 2 shows that yoga therapy intervention resulted in significant (P=0.05) decrease in fasting blood sugar by 3.33%, glycated hemoglobin (P=0.03) by 1.89%, total

cholesterol (*P*=0.06) by 2.05%, low density lipoprotein cholesterol (LDL-C) (*P*=0.04) by 3.42%, TC/HDL-C (*P*=0.002) by 4.91% and LDL-C/HDL-C ratio (*P*=0.006) by 6.27%. Serum triglycerides concentration (Table 3) was moderately decreased (4.20%) whereas high density lipoprotein cholesterol (HDL-C) was slightly increased (1.73%). Thyroid stimulating hormone (TSH) and cortisol was increased by 6.42% and 2.11% respectively. Marginal increase (3.93%) was also observed for total antioxidant activity (AOA) after the yoga intervention. But the change was statistically not significant.

On Pearson's correlation, glycated hemoglobin correlated positively with serum cortisol before (r=0.274, *P*=0.004) and after (r=0.352, *P*= 0.001) yoga therapy. Also, serum low density lipoprotein cholesterol correlated positively with thyroid stimulating hormone before (r=0.337, P=0.001) and after (r=0.227, *P*=0.017) yoga intervention.

Parameters	Pre yoga (n=111)	Post yoga (n=111)
Fasting blood sugar(mg/dL)	110.26±31.95	106.59±26.88*
Glycated hemoglobin (%)	6.34±0.84	6.22±0.83†
Total cholesterol (mg/dL)	208.27±35.85	204.00±35.02‡
HDL-cholesterol (mg/dL)	48.92±12.64	49.77±10.86
LDL-cholesterol (mg/dL)	132.20±31.76	127.68±29.32•
TC/HDL-cholesterol ratio	4.48±1.20	4.26±1.08||
LDL-C/HDL-C	2.87±0.97	2.69±0.88**
Cortisol (µg/dL)	14.16±5.62	14.46±5.73
Antioxidant activity (mmol/ litre)	0.890±0.16	0.925±0.23
p-value: *=0.05, †=0.03, ‡=0.06, • =0.04, ||=0.002, **=0.006		

Table 2. Comparison of biochemical parameters in perimenopausal women before and after yoga therapy. (Mean ± SD)

Parameters	Pre yoga	Post yoga	p value
Triglycerides (mg/dL)	119.0 (85.0, 161.0)	114.0 (83.0, 157.0)	0.870
Thyroid stimulating hormone (UIU/ml)	2.80 (2.0, 4.6)	2.98 (2.3, 4.0)	0.580

Table 3. For skewed data, the results were expressed in median & IQR

DISCUSSION:

Menopause is an important event in a woman's life. It is be associated with severe physical and psychological changes. Effective health care management of menopause involves two important issues, first control of symptoms associated with menopause and the second, prevention and management of conditions that become more prevalent after menopause like osteoporosis, metabolic syndrome, cardiovascular disease, neuro-degenerative diseases and cancer. All the above mentioned conditions can also results due to excessive oxidative stress which is observed due to change in the hormonal level during menopause. Thus these issues need to be addressed and strategies need to be developed that will help women to maintain a healthy and productive life. In our study we explored the role of yoga therapy in the management of biochemical alterations during menopause.

In the present study, compared to pre yoga, post yoga group showed significant reduction in both FBS and GHB levels. Previous studies have documented reduction in FBS and GHB levels in diabetic patients following the practice of yoga either alone or in combination with other therapies[20]. Our study also showed that yoga is effective in improving the indices of insulin resistance in non-diabetic perimenopausal women. This observation is important as insulin resistance increases dramatically with menopause[27,28] and is considered to be a key factor underlying the abrupt increase in CVD risk among women after menopause.[29,30]

Several factors and mechanisms seem to be responsible for the improved glucose metabolism associated with yoga intervention. Manjunath et al[31] have reported that yoga practice also leads to increased sensitivity of β-cells of pancreas to glucose signals which seems to be a sustained change resulting from a progressive long term effect of asana. Another study by Gorden et al[32] reports that yoga helps in increasing the percentage of insulin binding receptors as well as internalization of the insulin- receptor complex. Reduced parasympathetic tone and increased sympathetic activity with enhanced cardiovascular reactivity are strongly involved in the pathogenesis of atherosclerosis, cardiovascular diseases and insulin resistance syndrome (IRS).[33] These risks can be reduced by the effective use of yoga, as yoga decreases the activation of hypothalamic-pituitary-adrenal axis and the sympatho-adrenal system. Along with this yoga also enhances the parasympathetic tone via vagus which further reduces the risk and gives the feeling of well-being.[34] Possibly, a similar mechanism helped in reducing the FBS and GHB in our study.

Significant reduction in serum total cholesterol (TC), low density lipoprotein cholesterol (LDL-C) and TC/HDL-cholesterol ratio is one of the most important observations in the study. Several studies from different parts of the world have reported the derangement of lipid profile during and after menopause.[35-38] This derangement is mainly due to hormonal changes, especially of estrogen, that takes place during menopause. Thus, this metabolic change increases the risk of atherosclerosis in general and CVD in particular.[39,40] Our study is comparable with the review article of Innes and Vincent.[34] They reviewed 12 previous studies which suggest the lipid lowering effect of yoga. Though earlier studies have shown this lipid lowering effect of yoga in patients with hypertension, diabetes or CVD[41-44], this study demonstrate significant positive changes in blood lipids following yoga intervention in otherwise healthy perimenopausal women.

The serum triacylglycerol (TG) levels, which have been reported to be increased in menopausal women[45], were not significantly altered after yoga intervention in our study. Findings on serum HDL-C levels in menopause have been inconsistent with studies reporting both increased[46,47] and decreased values. [45, 48] Again, in this study no significant change in HDL-C levels was observed after yoga intervention, though the TC/HDL-C and LDL-C/HDL-C ratios were significantly reduced. This finding is also important as previous evidence shows positive association between TC/HDL-C ratio and atherosclerotic mortality in women like in men, although women's absolute risk seems to be lower.[49] One study has indicated hepatic lipase as a

possible mediator of lowered HDL-C as well as increased LDL-C in long term menopausal woman.[50] Similar to regulation of glucose metabolism through insulin receptors, yoga also may stimulate the peripheral utilization of LDL particles by modulating cellular LDL receptors and thereby reducing serum LDL-C levels. Further exploration of the suggested relationship of yoga and various cell receptors is definitely worthwhile.

Although there is paucity of research articles, press releases have reported that yoga can improve thyroid function and regular practice of yoga can increase the release of thyroid hormone.[51,52] Hypothyroidism is not new in perimenopause, as 26 percent of women in or near perimenopause experience hypothyroidism.[53] A previous study reported that subclinical hypothyroidism is increasing in peri and post-menopausal women[54] and this subclinical hypothyroidism is an independent risk factor for atherosclerosis and myocardial infarction in these women[55]. In the present study we observed a slight increase in thyrotropin (TSH) levels in the post intervention samples but the increase was within the normal range and was not statistically significant. There was positive correlation with the TSH level and LDL-C level in both pre and post interventional sample which was comparable to the finding of a study done by Geng et al in Chinese women.[56] This slight increase could be due to yoga asana and the practice of pranayamas (breathing exercise) which increased the blood flow to the neck area, stimulating the thyroid gland.[57] However no scientific studies have confirmed this theory yet. Nevertheless, we postulate that regular practice of yoga can be beneficial in perimenopausal women experiencing hypothyroidism.

Previous studies showed both increase[58] and decrease[59,60] in serum cortisol levels after following a yoga regime in different disorders but there is no study which clearly indicate the role of yoga on cortisol level in perimenopausal women. In our study we observed that the serum cortisol level remain unchanged after yoga intervention which is comparable to the study by Schell et al.[61] who reported the similar trend in healthy women. The results add to the previous contradictions of effect of yoga on cortisol. By this study we can draw a conclusion that 12 weeks of yoga practice may be too short to stimulate a significant change in the hormonal profiles of perimenopausal women. Having said that if they continue to practice yoga for a longer duration there will be reduction in stress due to meditation and pranayama (breathing exercise) which will eventually balance the cortisol level as well. Our results demonstrate that perimenopausal women with high cortisol level have high glycated hemoglobin and they correlate positively in both pre and post intervention samples. This shows that psychological stress in perimenopausal women leads to increase in cortisol level which in turn increases the blood glucose level and glycated hemoglobin which eventually leads to insulin resistance and metabolic syndrome.

In this study we have observed a slight increase in antioxidant activity after yoga intervention. This has been proven in the previous studies that there is marked oxidative stress observed in postmenopausal women [62- 64,] which is mainly due to hypoestrogenism[65]. Estrogen acts as an antioxidant [66-68] during the reproductive life of a woman and its gradual decline can lead to severe oxidative stress. Therefore various methods have been used to combat the oxidative stress such as dietary therapy with antioxidant supplement, [69] Menopause hormonal therapy (MHT) [70] and Selective estrogen receptor modulators (SREMS).[71] Along with these, yoga is also an effective therapy to combat oxidative stress. It has been reported in previous studies that yoga can decrease the oxidative stress[72] caused during menopause and increase the antioxidant profile in different conditions.[73,74] This is the first study which shows that yoga intervention can improve the total antioxidant activity in perimenopausal women.

In a nutshell, our study reflects the benefits of practicing yoga which can be put forth as follows. Trikonasana, paschimottanasana, purvatanasana, pavanamuktasan, bhujangasan and dhanurasan and parsvakonasana relives pain in muscles and joints and help in reducing the fat around abdomen and prevent weight gain. This keeps a check on obesity which is a risk factor for insulin resistance and metabolic syndrome. Padottanasana strengthens the respiratory system, facilitates the venous return and increases the strength and stamina of the body. This helps in balancing stability of mind and body. Vakrasana tones up the spinal nerves, stimulates the pancreas which helps in utilizing the glucose load. It is useful for diabetic patients. Pranayamas such as anuloma-viloma, suryabhedana, sheetali and bhramari creates a soothing effect on the nervous system and gives the sense of mind body harmony. They also help in lowering the stress, nervousness, depression and anxiety. Thus improves the quality of life in perimenopausal women.

CONCLUSION

Our study shows that 12 weeks of yoga therapy produces a significant improvement in blood glucose, glycated hemoglobin and lipid profile in perimenopausal women. The improvement in the TSH, cortisol and AOA was observed but it was not statistically significant. This shows that there is decrease in the oxidative stress and improvement in antioxidant system after yoga intervention. Probably the duration of yoga therapy was not enough to bring a significant change. Yoga therapy program for longer duration might be efficient in bringing more positive results. Thus yoga therapy program alone or as an adjunct to the conventional treatment can be effective in decreasing the oxidative stress , risk of CVD and metabolic syndrome and improving the quality of life in perimenopausal women.

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