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Effect of yoga on cardiac autonomic tone and lipid profile in perimenopausal women

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ABSTRACT

Introduction: Cardiovascular diseases and cholesterol levels are increased postmenopausal/perimenopausal women. Cardiac autonomic tone as assessed with heart rate variability (HRV) is also altered in postmenopausal women. Yoga practice improves vasomotor symptoms in postmenopausal women. Whether yoga can improve HRV and cholesterol levels in perimenopausal women is not clear.

Materials and methods: Sixty perimenopausal women, not on any medication, were randomized into two groups; yoga (n=30, age 44±2.64 years) and control (n=30, age 46±5.09 years). The yoga group practiced meditation, pranayama, and few simple asanas for 40 min/day, 6 days/week for four weeks along with their daily routine activities. The control group practiced no additional exercises except their daily routine activities. Short-term HRV, lipid profile, and other biochemical parameters were assessed at the beginning and after four weeks and compared.

Results: Both groups were comparable in terms of their age body mass index (BMI), blood pressure (BP), heart rate (HR), and respiratory rate at 0 week. The yoga group showed a decrease in BMI, HR, systolic BP, total cholesterol [167.81±32.69 vs 144.46±26.98 mg/dl, p=0.013], LDL-cholesterol [118.19±28.25 vs 94.33±23.55 mg/dl, 0.002]; and an increase in HDL-cholesterol (49.62±6.34 vs 56.37±8.19 mg/dl, p=0.004), markers of cardiac parasympathetic tone [SDNN {33.3(24.35-40.1) vs 43.2(34.4-50.1) ms, p=0.041}, rMSSD {25.2(21.95-33.05) vs 30.6(25.1-38.0) ms, p=0.034}, and high frequency power] after four weeks of yoga practice.

Conclusions: Parasympathetic tone and HDL-cholesterol increased, whereas total and LDL-cholesterol, BMI, HR, and systolic BP decreased in perimenopausal women after four weeks of yoga practice. It is suggested that yoga can be a cardio-protective alternative therapeutic measure in perimenopausal women.

Keywords: Perimenopause, heart rate variability, LDL-cholesterol, HDL-cholesterol, yoga

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INTRODUCTION

Perimenopause, or menopause transition, is the stage of a woman's reproductive life when the ovaries gradually begin to produce less estrogen. It usually starts around the age of 43 years.1 The average length of perimenopause is four years, but in some women, it may continue for 10 years, or in some, it may last only for a few months. Perimenopause ends with the 1st year of menopause (amenorrhea).2

Cardiovascular diseases are well documented in peri- and postmenopausal women.3-5 Increased risk of hypertension, dyslipidemia, obesity, and other components of metabolic syndrome were found in perimenopausal women.6 Around 2.5 times higher mortality was found in perimenopausal women than men after mitral valve operation.7 Perimenopausal/post-menopausal women had generally higher lipid levels.3,8

In perimenopausal/postmenopausal women total cholesterol and triglycerides were higher,4,8 LDL-cholesterol was also higher, whereas HDL-cholesterol was lower compared to premenopausal women.8 The increased levels of triglycerides and total and LDL-cholesterol are known risk factors for cardiovascular diseases.3-7

The modulation of cardiac autonomic tone is found altered in cardiovascular diseases as assessed with HRV.9It is a highly informative cardiac rhythm analysis tool. Patients with myocardial ischemia10 as well as myocardial infarction11 and some other cardiac problems showed reduced HRV.12,13 The reduced HRV was found to be an independent predictor of sudden cardiac death.13,14 Perimenopausal/postmenopausal women also showed altered HRV.15,16 It is also one of the risk factors for cardiovascular diseases in perimenopausal women.

Yoga is a set of exercises developed in the ancient age. Yogic exercises (meditation, pranayama, and asanas) were found to be effective in improving conditions in several stress-related diseases.17,18 Yoga practice decreased total- and LDL-cholesterol18,19 and suggested that yoga could lower the risk of cardiovascular diseases. Khattab and colleagues20 suggested that yogic exercises increased HRV. Thus, overall it reflected that yoga could be a cardio-protective measure. Yoga practice was found effective in improving menopausal symptoms.21,22 Whether yoga practice had cardio-protective effects in peri-menopausal women, was not much clear. Therefore, we conducted this study to explore the effect of yoga on HRV, lipid profile, and some other biochemical parameters in perimenopausal women.

MATERIALS AND METHODS

The study included 60 peri-menopausal women aged 45-52 y recruited from the Department of Obstetrics and Gynecology, BP Koirala Institute of Health Sciences (BPKIHS), Dharan, Nepal. The study was approved by the Institutional Review Board, BPKIHS. Informed written consent was taken from all subjects.

Clinical signs and symptoms, patients' history, medication (if any), and demographic data of all women were noted using a standardized proforma. Patients with frequent ventricular ectopics & arrhythmia, diseases like diabetes mellitus, renal failure, severe physical and mental disorders, severe hypertension (SBP >160 & DBP >100, according to JNC-7, 2003 guidelines23), patients on estrogen or progesterone therapy or any other drugs, previously engaged in any kinds of exercises, smokers and alcoholics were excluded from the study.

All subjects were randomized into two groups; control (n=30, age 46±5.09 years) and yoga (n=30, age 44±2.64 years) groups using a computer-based random table method. In both groups, the first recording (visit-1) was taken at 0-weeks and the second recording (visit-2) after four weeks. The control group led their usual life for four weeks. They did not practice any kinds of exercise. The yoga group practiced yoga (meditation, pranayama, and easy yogic postures) for 40 minutes/day, 6 days/week for four weeks. They practiced yoga at Yoga & lifestyle Clinic, BPKIHS, Dharan for two weeks. After they learned yoga practices properly, they continued at home. Protocol of yoga practice was given to all subjects of the yoga group and all were followed up regularly for their practices.

Yoga Practices consisted of[24]

- Warming-up exercises (for 5 min): Consisting of Manibadha vikash, Shakti vikash, Ardhabhuja Shakti Vikash, Purnabhuja Shakti Vikash, Anjuli Shakti Viksh, Kamar Chakrasana, Vakshasthal shakti vikash and Uder shakti vikash. Each exercise for 2-3 times.

- Yogic asanas (for 6-7 min): Consisting of Tarasana, Trikonasana, Gomudhasana, Shashankasana, Padmasana, Bhujangsana, Hardhayastambhasana, Naukasana, & Makarsana. Each for 2 to 3 times.
- Shavasana, for 5 min.
- Meditation in a comfortable posture for 5 min.
- Pranayama: Anuloma-biloma and Nadisuddin pranayama, each for 2 min.

Recording and analysis of short-term HRV

Electrocardiogram (ECG) was recorded for 5 min for short-term HRV preferably from limb lead-II in the supine position after 15 min of supine rest using software, Coulbourn Instrument, DI-400 Series, USA at sampling frequency 1000 Hz. The recording was performed between 8 and 11 AM, in a quiet room, temperature maintained at 26±1 oC. The HRV analysis was done using software HRV analysis Kubios/2.0, Finland. The acquired ECG signals were checked for errors and corrected, and analyzed for HRV measures using time-domain and frequency-domain methods. The time-domain measures of HRV were: SDNN (Standard deviation of the R-R intervals), rMSSD (The square root of the mean squared differences of successive R-R intervals), pNN50 (Percentage of the number of interval differences of successive R-R intervals greater than 50 ms divided by the total number of R-R intervals); frequency-domain measures were: spectral powers of low frequency (LF) and high frequency (HF) components of HRV, LF/HF ratio, and in normalized units; LFnu and HFnu.

The recording of HRV, collection of blood samples for estimation of biochemical parameters recording of demographic data, and clinical history, all were performed on the same day. The blood sample was collected from the antecubital vein in the 12 h fasting state between 8:30 and 9:30 AM. All blood samples were allowed to clot and serum was separated after centrifugation at 3000 RPM and stored at -20 degrees for the analysis. It was analyzed in the Department of Biochemistry, BPKIHS using an Auto-analyzer (Roche Cobas C311, Roche Diagnostics) and standard protocol. All the recorded data were compared between the groups using statistical tools.

Statistical Analysis: Data were analyzed statistically using software SPSS 11.5. Anthropometric, cardio-respiratory, and biochemical parameters were normally distributed, these data were compared within the group using paired t-test and between the groups using unpaired t-test, and the data are presented in terms of mean±SD. The HRV measures were non-normally distributed, HRV data were compared within the group using Wilcoxon-sign rank test and between the groups using the Mann-Whitney U test; and the data are presented in terms of the median (inter-quartile range). The $p<0.05$ was considered statistically significant.

RESULTS

Comparisons of anthropometric and cardio-respiratory variables within and between yoga and control groups (Table 1)

In visit 1 (at 0 weeks i.e. at the start of the study) comparisons between yoga and control groups showed no significant differences in their age (44±2.64 vs 46±5.09 years, p=0.628), BMI, systolic blood pressure (SBP), diastolic blood pressure (DBP), HR, and respiratory rate (RR).

In visit 2 (after four weeks of the study), the yoga group showed a significant decrease in BMI (p=0.039), DBP (p=0.041), and HR (p=0.047) compared to the control group.

In within-group comparisons, the control group showed no significant differences between visit 1 and visit 2 in any of the anthropometric and cardio-respiratory variables. However, the yoga group showed a significant decrease in BMI, SBP, and HR in visit 2 as compared to visit 1.

Comparisons of biochemical parameters within and between yoga and control groups (Table 2)

In visit 1, comparisons between yoga and control groups showed no significant differences in serum glucose, urea, creatinine, total cholesterol, HDL- and, LDL-cholesterol, and triglycerides levels.

In visit 2, the yoga group showed significant decrease in total cholesterol (p=0.049) and LDL-cholesterol (p=0.039) as compared to the control group. Other biochemical parameters were comparable between the groups.

In within-group comparisons, the control group showed no significant differences between visit 1

Table 1: Comparisons of anthropometric and cardio-respiratory parameters within and between the groups

Parameters	Yoga group (n=30) mean±SD			Control group (n=30) mean±SD		
Visits	Visit-1 (At 0-week)	Visit-2 (After 4 weeks)	p value	Visit-1(At 0-week)	Visit-2 (After 4 weeks)	p-value
Body mass index, Kg/m^2	24.49±4.9	22.18±2.4*	0.021	25.20±6.21	24.98±4.21	0.393
Systolic BP, mmHg	121.0±15.0	114.0±12.0	0.019	121.0±11.0	121.3±10.0	0.893
Diastolic BP, mmHg	74.8±7.7	73.9±7.2*	0.073	72.9±7.9	76.8±10.0	0.079
Heart rate, bpm	78.8±7.7	71.4±5.7*	0.032	78.2±8.0	77.4±9.0	0.745
Respiratory rate, breaths/min	17.6±2.4	16.4±2.4	0.063	16.6±2.3	16.9±2.1	0.543

The p<0.05, considered a statistical significance, NS, no significant differences; (*), a significant difference between the yoga and control groups

Table 2: Comparison of biochemical parameters within and between yoga and control groups

Parameters	Yoga group (n=30) mean±SD			Control group (n=30) mean±SD		
Visits	Visit-1 (At 0-week)	Visit-2 (After 4 weeks)	p value	Visit-1(At 0-week)	Visit-2 (After 4 weeks)	p value
Glucose, mg/dl	99.06±25.77	92.18±23.88	0.889	97.6±23.0	78.0±19.6	0.092
Urea, mg/dl	30.5±5.92	30.75±4.33	0.888	30.2±6.8	29.56±6.98	0.735
Creatinine, mg/dl	0.73±0.16	0.78±0.15	0.161	0.70±0.21	0.73±0.15	0.347
Total Cholesterol, mg/dl	167.81±32.69	144.46±26.98*	0.013	178.76±42.35	177.16±36.61	0.678
HDL, mg/dl	49.62±6.34	56.37±8.19	0.004	49.78±3.96	52.11±7.47	0.313
LDL, mg/dl	118.19±28.25	94.33±23.55*	0.002	129.18±39.79	131.43±40.7	0.678
Triglycerides, mg/dl	174±32.33	137.26±27.69	0.006	169.44±24.2	159.01±40.73	0.441

HDL, High density lipoprotein; LDL, Low density lipoprotein; The p<0.05, considered a statistical significance, NS, no significant differences; (*), a significant difference between the yoga and control groups

and visit 2 in any of the biochemical parameters. Whereas, the yoga group showed a significant decrease in serum total cholesterol, LDL-cholesterol, and triglycerides, and significant increase in HDL-cholesterol in visit 2 compared to visit 1. Other biochemical parameters were comparable between the visits in the yoga group.

Comparisons of measures of HRV within and between yoga and control groups (Table 3)

In visit 1, comparisons between yoga and control groups showed no significant differences in any of the time-domain or frequency-domain measures of HRV.

Table 3: Comparisons of measures of heart rate variability within and between yoga and control groups

Parameters	Yoga group (n=30) Median (interquartile range)			Control group (n=30) Median (interquartile range)		
Visits	Visit-1 (At 0-week)	Visit-2 (After 4 weeks)	p-value	Visit-1(At 0-week)	Visit-2 (After 4 weeks)	p-value
SDNN (ms)	33.3 (24.3-40.1)	43.2 (34.4-50.1)*	0.041	25.05 (22.7-27.5)	23.9 (18.5-35.4)	0.678
RMSSD (ms)	25.2 (21.9-33.0)	30.6 (29.1-38.0)*	0.034	17.4 (14.9-26.7)	17.3 (12.4-21.8)	0.594
pNN50 (%)	2.5 (0.8-6.9)	9.2 (3.5-17.6)*	0.026	0.9 (0.5-5.0)	0 (0-2.25)	0.678
LF power (ms^2)	139.4 (126.6-244.8)	279.0 (152-686.5)*	0.027	107.5 (60.5-138.0)	68.0 (49.0-348.0)	0.515
HF power (ms^2)	275.0 (170.5-381.0)	343.0 (228.0-643.2)*	0.048	102.0 (72.5-151.7)	132.5 (85.2-200.8)	0.859
Total power (ms^2)	957.0 (659.5-1119.5)	1539.0(766.5-1983.0)*	0.045	442.0(300.5-1477.7)	339.0 (306.5-1386.7)	0.859
LF nu	34.8 (31.4-45.8)	45.6 (32.6-65.9)	0.161	48.2 (36.2-53.0)	40.5 (36.5-59.5)	0.953
HF nu	45.6 (54.1-68.6)	54.4 (34.0-67.3)	0.161	40.5 (36.5-59.5)	59.5 (48.5-63.5)	0.953
LF/HF ratio	0.53 (0.46-0.84)	0.84 (0.48-2.15)	0.123	0.93 (0.58-1.13)	0.68 (0.58-1.57)	0.767

Time-domain measures of HRV: SDNN, standard deviation of the R-R intervals; rMSSD, the square root of the mean squared differences of successive R-R intervals; pNN50, percentage of the number of interval differences of successive R-R intervals greater than 50 ms divided by the total number of R-R intervals; Frequency-domain measures of HRV: LF, low frequency; HF, high frequency; nu, normalized unit; the $p<0.05$, considered a statistical significance; NS, no significant differences.

In visit 2, the yoga group showed significant increase in SDNN (p=0.022), RMSSD (p=0.001), pNN50 (p=0.008), HF power (p=0.022), and total power (p=0.048) as compared to control group. Other measures of HRV were comparable between the two groups.

In within-group comparisons, the control group showed no significant differences in any of the measures of HRV. The yoga group showed increased SDNN, RMSSD, pNN50, LF, HF, and total powers in visit 2 as compared to visit 1.

DISCUSSION

The present study assessed the effect of yoga on lipid profile, other biochemical parameters, and HRV in perimenopausal women. In the study, the time-domain measures of HRV; SDNN, RMSSD, pNN50, and the frequency-domain measures of HRV; LF power, HF power, and total power were increased in perimenopausal women after 4 weeks of yoga practice. However, there were no significant changes found in LFnu, HFnu, and LF/HF ratio compared to the control group. The RMSSD, pNN50, and HF power are considered as the markers of parasympathetic tone; and LFnu and LF/HF ratio are considered as the markers of sympathetic tone,9 whereas the SDNN, LF power, and total power are markers of overall variability.9 These results suggest that modulation of overall HRV and cardiac parasympathetic tone increased in perimenopausal women after a month of yoga practice.

A previous study found an increase in parasympathetic tone and a decrease in sympathetic tone after 3-month of a similar set of yoga practice in women within 5 years of menopause.25 But, in the present study, women practiced yoga for four weeks. It suggests that even a short period of yoga practice is effective in increasing parasympathetic tone in perimenopausal women. A study found improvement in menopausal symptoms with 12 weeks of yoga practice but no changes in HRV.26 In that study women practiced breathing techniques, yogic postures, and Yoga Nidra. No changes in HRV might be due to the different sets of yoga practices. Yoga consists of several postures, breathing techniques, and meditation techniques. All have different effects on the body.

In several studies increased parasympathetic tone was found to be a cardio-protective measure. 27,28,29 High vagal tone correlated with a good prognosis in patients with mild-to-moderate congestive heart failure (NYHA II-III).27 Selective activation of intracardiac cholinergic neurons lessened cardiac dysfunction and mortality seen in heart failure in a pressure overload-induced heart failure animal model.28 Vagal activation resulted in cardioprotection associated with heart rate, anti-adrenergic effect, anti-inflammatory activity, regulation of cellular redox states, and regulation of mitochondrial targets. Thus, it was suggested that vagal nerve activation could be a promising new therapeutic approach for the treatment of cardiovascular diseases.29 In the present study yoga practice increased parasympathetic tone in perimenopausal women. Thus, it is suggested that selected yoga practice can be a cardio-protective measure in perimenopausal women.

Yogic asana and pranayama practice for 1-year showed a decrease in BMI, total cholesterol, and triglycerides in middle-aged and older-aged patients with metabolic syndrome.30 We found a decrease in BMI in essential hypertensive patients after a 6-weeks of easy yoga practice.24 In the present study, 4 weeks of easy yoga practice resulted in a decrease in BMI, total cholesterol, LDL-cholesterol, and triglycerides levels, and an increase in HDL-cholesterol levels in perimenopausal women. It reveals that even short-term practice of easy yoga asanas and pranayam is effective in reducing BMI and LDL-cholesterol, and increasing HDL-cholesterol in perimenopausal women. It is again an indication that yoga practice can reduce cardiovascular risk factors in perimenopausal women and can be a cardio-protective measure in perimenopausal conditions.

CONCLUSION

Four weeks of combined yoga practice (meditation, pranayama, and simple asanas) decreased BMI, SBP, HR, levels of total cholesterol, LDL-cholesterol, triglycerides; and increased levels of HDL-cholesterol and cardiac parasympathetic tone in perimenopausal women. The results suggest that yoga practice can be effective in reducing cardiovascular risk factors in perimenopausal women. Thus, it can be a cardio-protective measure in perimenopausal women.

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CONFLICT OF INTEREST

None.

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