Section: Physiology

Original Research Article

IMPACT OF BREATHING EXERCISE AND MEDITATION ON HEART RATE VARIABILITY AMONG PERIMENOPAUSAL WOMEN: A PROSPECTIVE COHORT STUDY

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Received *: 26/06/2024*
Received in revised form *: 18/08/2024*
Accepted *: 03/09/2024*

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DOI: 10.70034/ijmedph.2024.3.164

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2024; 14 (3); 916-920

ABSTRACT

Background: Perimenopause is a phase that is marked by physiological changes. While these are a natural part of the aging process, they can have various effects on a woman's health, including an increased risk of cardiac diseases. The autonomic nervous system plays a significant role in various physiological processes, including those that are affected during perimenopause. An association between practicing yoga and a positive effect on autonomic markers has been seen. Therefore, this study aims to determine the effect of 30 minutes of breathing exercise and meditation on heart rate variability in perimenopause women.

Materials and Methods: This prospective cohort study, included 82 perimenopausal women in the age group of 40-55 years. The participants practised yoga (30 minutes per day for 12 weeks), that included Brahmari Pranayama, Nadi sodhan kriya, Mool Bandh, and Meditation with Om Ucharan. Linear and Non-Linear parameters of heart rate variability were assessed before and after 12 weeks of yoga.

Results: In HRV, the frequency domain showed a significant decrease in LF/HF ratio and non-significant decrease in LF (ms2)(p= 0.061), a significant increase in HF% (p = <0.001), and increase in HF(ms2), Time domain showed an increase in Standard deviation of RR intervals (SDRR), RMSSD(depicting parasympathetic dominance) and a decrease in Average heart rate (depicting sympathetic activity) though non-significant.

Conclusion: Three months of daily breathing exercise and meditation improves the HRV in perimenopausal women. It can be said that practicing yoga can attenuate the cardiac autonomic dysfunction induced by hormonal imbalance set up in the perimenopause phase, giving us an opportunity for early intervention before the clinical deterioration of cardiovascular system.

Keywords: Perimenopause, Heart rate variability, Yoga, Autonomic function, Cardiovascular disease.

INTRODUCTION

Perimenopause, also known as the menopausal transition, is the time leading up to a woman's final menstrual period, which is marked by physiological changes.[1] The hormonal dynamics of the menopausal transition are complex, and there can be considerable variations in the circulating serum levels of estradiol and FSH during the early stages of this phase.[2] Hormonal changes occurring during menopause transition is associated with the development of a range of symptoms and there is risk of cardiovascular diseases (CVD) in this transitional phase.[3]

Studies shows that a significant contribution in protection from CVD in premenopausal women

comes from greater HDL levels in younger women which is an effect of estrogen. After menopause, the escalation in the frequency and severity of cardiovascular disease (CVD) in women is correlated with the protective effects of sex hormone levels against the disease. Rapid aging, heart disease, memory issues, and osteoporosis are all considered consequences of low estrogen.[4,5] Therefore, it has been suggested that problems and of lifespans are caused by the low level of estrogen that occurs in women.[6] The autonomic nervous system, which is the primary physiological regulator of the heart-brain axis, has been implicated in the risk of severe cardiovascular events in middle-aged women due to a reduction in estrogen- related signaling during the menopausal transition.7 Owing to the autonomic system's intricacy, no one test can accurately capture the operation of a particular branch of the system .

More recently, new techniques, such as evaluation of heart rate variability, have been introduced as diagnostic tools.[8] The noninvasive HRV analysis methods are attractive in assessing autonomic dysregulation in various conditions. In addition to assessing the ANS, the HRV analysis methods have also been found to be useful in determining the ANS response to various therapeutic approaches.[9,10]

Heart rate variability is the beat-to-beat variation of heart rate (cardiac cycle length). It is a physiological phenomenon that occurs mainly due to variation of cardiac activity during the respiratory cycle (respiratory sinus arrhythmia) at rest, though circadian rhythm, environmental factors, and physical activity also contribute to it.[11]

HRV analysis allows for individualized assessment and management of autonomic dysfunction in perimenopausal women. By identifying specific patterns of sympathetic and parasympathetic activity, clinicians can tailor interventions, such as lifestyle modifications, stress reduction techniques, or pharmacological treatments, to address autonomic imbalances effectively.[9]

Various national and international organizations recommends that problems arising due to the hypo-estrogenic status should be managed by planning a good health program strategy, involving lifestyle modifications. In the past few decades however, with an increase in urbanization and propagation of knowledge in terms of women health, yoga has turned out to be the most popular lifestyle modification.

Stress-induced sympathetic hyperactivity is minimized, and anxiety is reduced by practicing yoga. Decreased catecholamine secretion results from a reduction in sympathetic activity.[12] Yoga, (which incorporates physical poses, breathing exercises and meditation) and Relaxation Techniques help attenuate perimenopausal symptoms by improving the indices of Psychological and physical health without any side effects.[13]

Previous studies done showed the beneficial effect of yoga on the autonomic nervous system in women of reproductive age group and post-menopausal women, therefore our study was aimed to determine the effect of yoga on risk of cardiac diseases in perimenopausal women with specific objective to determine the effect of daily yoga (breathing exercises) and meditation on heart rate variability.

MATERIAL AND METHODS

Subjects

The present study was a prospective cohort study, done in the Department of Physiology in association with Department of Obstetrics & Gynae, Dr RMLIMS, Lucknow after obtaining the Institutional Ethical Committee approval (IEC No- 75/22).

After getting informed consent, 82 perimenopausal women in the age range of 40-55 years having a menstrual abnormality, those who were willing and able to practice yoga and meditation, and having peri-menopausal symptoms, were enrolled in the study between September 2022 to February 2024. A proforma was used to record the demographic details of the participants and the symptoms. Women who were already practicing yoga and exercise for a month or more, women who have received Hormonal Therapy in the recent few months, those who have a known history of diabetes, hypertension psychiatric illness, or any systemic disorders, smoking/tobacco, alcohol consumption, or any gynecological disorders, and those who opted for surgical menopause or have their uterus removed were excluded from the study.

Procedures

All the women were then advised to practice yoga for 12 weeks, 30 minutes daily. HRV recordings were taken two times: first(baseline) at the beginning of the study and second recording after 12 weeks of yoga practice. Subjects were asked not to consume tea/coffee or any cardiomodulator substances at least 6 hours before the test and remove any wrist or ankle jewelry before the test. HRV was recorded for 5 mins in ECG Lead II at a frequency of 100 samples per sec by three channel physiograph (AD Instruments, South Asia, Pvt Ltd., New Delhi India). HRV was analyzed by spectral analysis using software Lab Chart 8 v8.1.8. The yogic practices consisted of –

Pranayama: Nadi sodhan kriya-same and alternate nostrils,21 times and Bhramari 21 times

Mool bandh asana,5 rounds done in sitting position

Meditation for 5 mins which included Om ucharan and mindful breathing

Statistical Analysis

SPSS version 21 was used for statistical computation and analysis. All HRV parameters at two different times, 0 weeks and 12 weeks apart was recorded. Continuous Data was represented in Mean and Standard deviations, while Categorical Data was represented in Frequency & Percentage. Paired

student t-test was used to find out the change compared to baseline value.

RESULTS

Table 1 depicts the anthropometric profile of the participants. Age of the women ranged from 40 to 54 years. Mean age was 43.8±3.6 years. Majority of the women were aged through 41 to 50 years. Weight of the women ranged from 40 to 72 kgs. The mean weight was 57.3±7.4 kgs. Mean height of the women was 152.9±6.0 cms. The height ranged from 140 to 166 cms. The BMI of the women ranged from 17.5 to 30.7 kg/m2. Mean BMI was 24.46±2.82 kg/m2. At recruitment, mean systolic BP was 113.7±9.5 mmHg, while mean Diastolic BP was 75.1±8.1 mmHg. Heart rate ranged from 57.02 to 113.0 beats per minute and mean HR was 84.62±13.41 bpm. [Table 1]

Table 4 shows the change in the heart rate variability parameters after 12 weeks of yoga when compared with the baseline values. A statistically significant decrease was found in LF/HF ratio($p<0.001$), SD2(ms) ($p<0.001$), while a significant increase was found in HF% and SD1 during the same observation. [Table 4]

Table 1: Age and Anthropometric profile of the study population (N=82)

Parameter	No.		%
Age Group (years)			
40 yrs	18		22.0
41-50 yrs	58		70.7
≥51 yrs	6		7.3
	Min	Max	Mean ± SD
Age (years)	40	54	43.8±3.6
Weight (kgs.)	40	72	57.3±7.4
Height (cms.)	140	166	152.9±6.0
BMI (kg/m^2)	17.5	30.7	24.46±2.82
Systolic BP (mmHg)	74.0	130.0	113.7±9.
Diastolic BP (mmHg)	60.0	116.0	75.1±8.1

Table 2: Heart Rate Variability parameters of the study population before yoga(N=82)

Parameter	Min	Max	Mean	± SD
Time Domain				
Avg.Heart Rate (bpm)	57.02	113.0	84.62±13.41	
SDRR (ms)	10.76	80.77	30.80±13.05	
RMSSD (ms)	4.82	92.10	21.80±14.14	
Prr50	0.00	950.80	13.85±104.97	
Frequency Domain				
Total Power (ms^2)	57.74	4545.00	757.51±711.14	
LF (%)	7.80	64.37	31.71±14.18	
HF (%)	3.28	61.98	26.80±14.21	
LF (ms^2)	1.56	1301.00	237.59±254.71	
HF (ms^2)	6.36	2436.00	256.84±345.40	
LF (nu)	0.12	77.57	25.50±24.99	
HF (nu)	15.44	91.75	52.41±17.85	
LF/HF	0.20	72.70	20.12±24.23	
Non-linear				
SD1 (ms)	3.59	65.21	19.39±11.50	
SD2 (ms)	5.18	104.80	36.54±17.03	

Table 3: Heart Rate Variability parameters of the study population at 12th week, after yoga (N=82)

Parameter	Min	Max	Mean ±	SD
Time Domain				
Average Heart Rate (bpm)	38.45	112.19	81.95±13.53	
SDRR (ms)	1.08	84.81	34.33±15.89	
RMSSD (ms)	0.53	60.42	22.45±13.31	
Prr50	0.00	574.20	8.23±63.43	
Frequency Domain				
Total Power (ms^2)	25.62	4791.63	731.03±648.54	
LF (%)	3.42	78.60	29.46±17.49	
HF (%)	8.42	161.00	41.17±21.40	
LF (ms^2)	5.27	1252.32	84.68±186.97	
HF (ms^2)	0.67	1337.40	308.75±266.47	
LF (nu)	0.17	90.08	46.25±21.30	
HF (nu)	9.57	87.37	46.55±18.52	
LF/HF	0.03	31.11	1.49±3.68	
Non-Linear				
SD1 (ms)	5.14	68.59	26.84±13.01	
SD2 (ms)	1.12	64.74	23.61±15.04	

Table 4: Change in Heart-rate Variability parameters after yoga of 12 weeks

Parameter	Mean ± SD	% Change	't'	'p'
Time Domain				
Avg Heart Rate (bpm)	-2.66±16.62	-3.14	-1.451	0.151
SDRR (ms)	3.53±17.57	11.46	1.820	0.072
RMSSD (ms)	0.65±17.03	2.99	0.347	0.729
Prr50	-5.62±123.39	-40.56	-0.412	0.681
Frequency domain				
Total Power (ms^2)	-26.48 ± 654.82	-3.50	-0.366	0.715
LF (%)	-2.24 ± 22.73	-7.07	-0.894	0.374
HF (%)	14.27 ± 23.93	53.25	5.367	<0.001*
LF (ms^2)	-52.91 ± 252.09	-22.27	-1.901	0.061
HF (ms^2)	51.91 ± 339.28	20.21	1.385	0.170
LF (nu)	20.88 ± 31.68	81.89	5.932	<0.001
HF (nu)	-5.86 ± 26.26	-11.18	-2.020	0.047
LF/HF	-18.63 ± 24.11	-92.62	-6.999	<0.001*
Non Linear				
SD1 (ms)	7.46 ± 15.56	38.50	4.316	<0.001*
SD2 (ms)	-12.93 ± 19.59	-35.39	-5.979	<0.001*

*** significant (p<0.05)**

DISCUSSION

The descriptive analysis of age and anthropometric profile of participants depicts age of the women ranged from 40 to 55 years; In the present study, at recruitment, most of the women had normal blood pressure. Nayak et al,[14] Joshi et al,[15] also provided a similar descriptive analysis of the demographic profile.

On studying the mean scores of all the HRV parameters at baseline, after 12 weeks of yoga and the change in the values post-yoga we found an increase in the frequency domain spectrum of HRV (heart rate variability) [HF%, HF(ms2)], SDRR, RMSSD of the time domain spectrum, and SD1 of nonlinear parameters. However, out of these only HF%, and SD1 were statistically significant. We also found a statistically significant decrease in LF/HF ratio after 12 weeks of yoga. Average Heart rate (bpm) showed a decrease from the baseline value, but it failed to achieve statistical significance. This finding is in accordance with Praveena et al,[16] who observed after 4 weeks of yoga therapy, there was a significant increase in SDNN, RMSSD, HF power also a significant decrease in LF/HF ratio.

However, the findings of M.W Jones et al,[17] differ from our study where he reported that the time and frequency domain measures did not change statistically post yoga therapy of 12 weeks.

Khadka et al,[18] and Lepir et al,[19] stated that practicing yoga – breathing exercise and meditation 40min/day for a month showed an increase in markers of cardiac parasympathetic tone and that middle aged women (over 40 years) with climacteric symptoms performing yoga has non-significant increase in heart rate variability post yoga. Pal et al,[20] found yoga practice especially relaxation techniques and slow pranayama has been known to ensure sympathovagal balance, improve HRV and reduce cardiovascular risk.

Khattab et al,[21] has a similar finding to that of our study, i.e increase in HRV parameters was significantly higher during yoga exercise than during placebo and control especially for the parameters associated with vagal tone, i.e. mean standard deviation of NN (Normal Beat to Normal Beat of the ECG) intervals for all 5-min intervals and root mean square successive difference for both concluding, relaxation by yoga training is associated with a significant increase of cardiac vagal modulation.

Previous studies have shown that yoga can improve heart rate variability, but most have focused on younger populations. Few studies have examined different durations or included a control group. Our study included a cohort of 82 perimenopausal women, in whom we assessed HRV before and after completion of yoga therapy has not been done to the best of our knowledge, makes it novel.

The significant increase in the parasympathetic domain of HRV coupled with a significant decrease in the LF/HF ratio suggests shift of autonomic activity towards beneficial vagal dominance. Yoga practice reduces the LF spectrum possibly by inhibiting the sympathetic area of hypothalamus which in turn helps restore the autonomic regulatory mechanism. LF/HF ratio represents sympathovagal activity, a lower LF/HF ratio post 12 weeks of yoga signifies vagal modulation activity. Our study has few limitations such as the follow up duration in our study was of 3 months. Longer follow up would probably give more consistent results regarding the changes in the autonomic function as depicted by heart rate variability post yoga in these women. There was no control group in the study. Future study with a control group will help to better analyze the role of yoga as an intervention.

CONCLUSION

Yoga practices including pranayama (breathing), asanas(postures), meditation, and relaxation appear to improve autonomic regulation enhancing vagal dominance as reflected by a significant increase in

the HF, and a significant decrease in LF/HF ratio, an increase in SDRR, RMSSD of HRV. So this present study on perimenopausal women demonstrates a significant improvement in the cardiac autonomic function with parasympathetic dominance as depicted by HRV with a regular yoga practice for 12 weeks and thus it can be said that yoga can be advised as adjuvant therapy in ameliorating symptoms caused due to hormonal changes during and improving the quality of life, knowing that Yoga has no known adverse effect on health. It can also be said that practicing yoga can attenuate the cardiac autonomic dysfunction induced by hormonal imbalance set up in the perimenopause phase, giving us an opportunity for early intervention before the clinical deterioration of cardiovascular system.

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