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Short Communication

Physiology Section

Immediate Effects of OM Meditation on Heart Rate Variability as a Stress Index during Different Phases of Menstruation: A Quasi-experimental Pilot Study

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ABSTRACT

Introduction: Stress alters normal reproductive function, causing menstrual disorders up to infertility in females. Psychological stress is the most common lifestyle factor found to be associated with menstrual disorders among late adolescence and young adults. Yoga-based OM-meditation has been shown to reduce stress, but its effect on managing stress during different phases of menstruation in young females is not known.

Aim: To evaluate if short-term practice of OM-meditation could induce a beneficial modulation in Heart-Rate Variability (HRV), a measure of stress index during various phases of the menstrual cycle in young females.

Materials and Methods: A quasi-experimental study was conducted on 20 healthy young females with a normal menstrual cycle, aged between 18-25 years, and pursuing a medicine course at Shri BM Patil Medical College, Karnataka, India, from March 2020 to December 2021. Meditation group participants (n=10) practiced OM-meditation, while control group participants (n=10) relaxed quietly for 10 minutes. Each subject received an intervention thrice during the menstrual, proliferative, and secretory phases. Data was collected before and immediately after every intervention. Body Mass Index (BMI), Blood Pressure (BP), Heart Rate (HR), and HRV were measured. Distribution of data, within-group and between-group analysis was done. ANCOVA (Analysis of covariance) was used to determine the differences between groups.

Results: Total 20 participants, n=10 in each, Meditation and control group, mean age of participants was 19.2±0.79 and 19.3±0.82 years, and the mean period of MC was 31.1±2.76 and 30.3±2.4 days in the meditation and control groups, respectively. There was no change in the baseline values of BMI, BP, and HR between the two groups, and they were within the normal range. Between-group analysis (ANCOVA) of HRV spectrum showed that OM-meditation had significantly decreased the Low-Frequency (LF) component of HRV ($p<0.05$) and LF/HF ratio ($p<0.05$), and increased the High-Frequency (HF) component ($p<0.05$) of HRV during all three phases of MC.

Conclusion: The practice of OM-meditation for 10 minutes reduced sympathetic activity and shifted autonomic balance towards parasympathetic dominance. These changes suggest that OM-meditation can reduce mental stress and optimise autonomic regulation during different phases of MC. However, this needs evaluation in a larger trial.

Keywords: Autonomic regulation, Lifestyle modification, Mental stress

INTRODUCTION

Menstrual disorders are common among late adolescence and young adults. Approximately 75% of girls in this age group experience problems associated with menstruation, such as irregular, delayed, painful, and heavy bleeding [1]. The causes of menstrual disorders can be organic or related to psychological factors such as stress, anxiety, and hormonal changes [1,2].

According to a recent systematic review and meta-analysis, the prevalence of pre-menstrual syndrome among medical students was 51.3%, pre-menstrual dysphoric disorder was 17.7%, and dysmenorrhoea was 72.7% [2]. These disorders significantly impact academic performance, leading to absenteeism, reduced participation in classroom activities, lack of concentration, and poor academic performance among female students in medical school [3]. Common lifestyle factors associated with menstrual disorders include psychological stress, lack of exercise, and excessive caffeine intake. Students often use pain-reducing drugs, hot packs, and hot beverages to relieve symptoms [2].

The demanding academic schedule of professional courses, such as medicine, poses a challenge to students' daily lifestyle, making them more susceptible to lifestyle disorders. There is a clear association between psychological stress and diseases, as stress can disrupt normal reproductive function, leading to menstrual disorders and even infertility in women [4]. Stress is regulated by the Autonomic Nervous System (ANS), and its impact on cardiac autonomic regulation is reflected in Heart Rate Variability (HRV) response. Elaborate HRV is a reliable non-invasive measure used to assess Cardiac Autonomic Function (CAF) and serve as a stress index [5].

Given the tight and stressful academic schedule of female students pursuing professional courses, it is important to implement a mental relaxation technique that is quick, simple, and easy to practice. One such technique is yoga-based OM-meditation, which has been shown to improve autonomic regulation and reduce stress [6,7]. However, its effect on managing stress during different phases of menstruation in young females remains unknown. Therefore, the present study aims to evaluate whether short-term practice of OM-meditation can induce beneficial modulation in HRV during various phases of the menstrual cycle in healthy young females.

MATERIALS AND METHODS

A quasi-experimental pilot study was conducted at Shri BM Patil Medical College in Karnataka, India, from March 2020 to December 2021. Prior to enrollment in the study, participants provided written informed consent. The study also received approval from the Institutional Ethical Committee (IEC no: BLDE/IEC/370-F/2019-20).

Inclusion criteria: The study included twenty healthy young females aged between 18 to 25 years, pursuing a medicine course at the selected centre, and having a normal menstrual cycle.

Exclusion criteria: Subjects with a history of acute or chronic illness in the past month, those taking any medication (including oral contraceptives or vitamins), smokers, and alcoholics were excluded from the study.

Procedure

Sample size: A total of 20 participants were enrolled, with 10 participants in each group (meditation group and control group). This sample size was considered appropriate for this pilot experimental study, with each participant receiving the intervention three times during their menstrual cycle.

Intervention: Participants in the meditation group practiced OM-meditation for 10 minutes in a relaxed and comfortable sitting meditative posture with closed eyes. They were instructed to slowly chant and repeat 'OM' following a deep inhalation. The participants received training on 'OM-meditation' one day before data collection. Participants in the control group were instructed to sit quietly and relax for ten minutes without chanting any syllables. Each subject received the intervention three times during the menstrual, proliferative, and secretory phases.

Data collection: Participants rested in a supine position for 10 minutes before data collection. Data was collected twice: before and immediately after each intervention. Detailed menstrual history was recorded, and menstrual phases were calculated as follows: (a) **pre-menstrual or secretory phase:** 1-7 days prior to the expected day of menstruation, (b) **menstrual phase:** five days of bleeding/menstruation, and (c) **post-menstrual or proliferative phase:** 6th to 10th day of the cycle [8].

Body Mass Index (BMI) was calculated by dividing body mass (in kg) by the square of body height (in m) and expressed as kg/m^2. Blood pressure (BP) was measured using a digital BP monitoring device (OMRON HEM-7111). Pulse Pressure (PP) was estimated as the difference between Systolic BP (SBP) and Diastolic BP (DBP). Mean Arterial Pressure (MAP) was calculated by adding 1/3rd of PP and DBP.

Stress was assessed using HRV analysis. A 5-minute ECG recording (standard limb lead-II configuration) was performed using a four-channel digital polygraph (Medicaid Systems Pvt., Ltd., Chandigarh, India) to obtain RR intervals. Only noise-free data was included for HRV analysis. Subjects were instructed to relax and breathe normally during the Electrocardiography (ECG) recording. The RR interval data was analysed using the frequency-domain method with the HRV analysis program (Kubios HRV-2.0, Biomedical Signal Analysis Group, University Kuopio, Finland). Power spectral density of the RR series was obtained using a non-parametric Fast Fourier Transform (FFT) technique for frequency-domain analysis. The total power in the frequency range of 0-0.40 Hz was divided into three frequency bands: very low-frequency band (VLF: 0-0.04 Hz), low-frequency band (LF: 0.04-0.15 Hz), and high-frequency band (HF: 0.15-0.40 Hz). The following frequency domain HRV measures were used in the study: (1) LF (nu): relative power of the LF band in normalised units (nu), which mainly reflects sympathetic activity; (2) HF (nu): relative power of the high-frequency band in normalised units (nu), which reflects parasympathetic activity; and (3) LF/HF ratio: the ratio of LF to HF power, which reflects sympathovagal balance [9].

STATISTICAL ANALYSIS

The data obtained were expressed as the mean and Standard Deviation (SD). The distribution of the obtained data was assessed using the Shapiro-Wilk test. To determine differences within groups, the paired t-test was used for normally distributed data, while the Wilcoxon signed-rank test (a non-parametric test) was used for non-normally distributed data. The unpaired t-test was used to determine any differences in the baseline characteristics between groups. ANCOVA was used to determine the differences between groups. Data analysis was performed using Statistical Package for Social Sciences (SPSS) software version 20.0.

RESULTS

In the present study, the mean age of the participants was 19.2±0.79 and 19.3±0.82 years, and the mean duration of Menstrual Cycle (MC) was 31.1±2.76 and 30.3±2.4 days in the meditation group and control group, respectively. BMI, BP, and HR were within the normal range for all participants. There were no significant differences in the baseline characteristics between the two groups [Table/Fig-1].

Variable	Meditation group (n=10) Mean±SD	Control group (n=10) Mean±SD	p-value
Age (Years)	19.2±0.79	19.3±0.82	0.785
Menstrual cycle period (days)	31.1±2.76	30.3±2.41	0.499
BMI (kg/m^2)	21.7±2.19	21.16±1.94	0.567
SBP (mmHg)	105.7±5.41	103.0±7.19	0.357
DBP (mmHg)	67.2±2.62	64.40±6.08	0.197
PP (mmHg)	38.5±5.48	38.6±5.29	0.967
MAP (mmHg)	80.3±3.19	75.7±7.06	0.077
HR (bpm)	73.18±6.25	76.57±5.86	0.229

[Table/Fig-1]: Baseline characteristics of study participants.
Unpaired t-test was applied to determine the difference between the baseline values of meditation and control group; BMI: Body mass index; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; PP: Pulse pressure; MAP: Mean arterial pressure; HR: Heart rate

Within the meditation group, there was a significant decrease in LF (nu) and LF/HF ratio, and an increase in HF (nu) during all three phases of menstruation. In the control group, there was a non-significant effect observed during all three phases. Furthermore, ANCOVA analysis revealed a significant difference in the effect of OM-meditation on LF, HF, and LF/HF ratio between the groups in all menstrual phases [Table/Fig-2].

Variable	Meditation group (n=10)				Control group (n=10)				Between group	
	Before Mean±SD	After Mean±SD	Mean change	p-value	Before Mean±SD	After Mean±SD	Mean change	p-value	Mean change	ANCOVA p-value
Pre-menstrual phase										
LF (nu)	79.28±3.71	74.49±7.13	4.79±7.06	**0.005****	73.6±6.16	73.63±4.11	-0.03±5.1	0.985	4.82	**0.044***
HF (nu)	20.72±3.72	25.51±7.13	-4.79±7.06	**0.005****	26.4±4.11	26.37±4.11	0.03±5.1	0.985	-4.82	**0.019***
LF/HF Ratio	3.953±0.79	3.143±0.91	0.81±0.89	**0.018***	2.99±0.95	2.88±0.53	0.11±0.88	0.637	0.70	**0.017***
Menstrual phase										
LF (nu)	76.98±2.85	72.46±5.61	4.52±4.27	**0.009****	75.99±3.95	73.28±9.01	2.71±12.05	0.445	1.81	**0.036***
HF (nu)	23.02±2.85	27.54±5.61	-4.52±4.27	**0.009****	24.01±3.95	26.72±9.01	-2.71±12.05	0.445	-1.81	**0.017***
LF/HF Ratio	3.401±0.51	2.756±0.693	0.645±0.58	**0.007****	3.277±0.79	3.022±0.94	0.25±1.57	0.545	0.395	**0.004****

	Proliferative phase									
LF (nu)	79.63±2.61	74.66±3.77	4.97±4.18	**0.004****	74.62±7.42	78.15±1.97	-3.53±8.03	0.178	8.5	**≤0.001*****
HF (nu)	20.37±2.61	25.34±3.77	-4.97±4.18	**0.004****	25.38±7.42	21.93±1.81	3.45±8.03	0.187	-8.5	**≤0.001*****
LF/HF Ratio	3.980±0.62	3.029±0.61	0.951±0.83	**0.005****	3.212±1.069	3.589±0.38	-0.377±1.23	0.339	1.328	**≤0.001*****

[Table/Fig-2]: Immediate changes in Heart-Rate Variability (HRV) after Om-meditation.
LF: Low frequency component of HRV; HF: High frequency component of HRV; LF/HF ratio: Low frequency/High frequency ratio; *p<0.05, **p<0.01, ***p<0.001; Paired-t test was used for normally distributed data and Wilkinson-signed ranks test (non-parametric test) for non-normal distributed data

DISCUSSION

'OM' is one of the sacred and most spiritual syllables or sounds in Indian culture. This syllable is either chanted independently or before a mantra during meditative practices, which can be chanted aloud or silently in the mind [10]. The present study found that practicing OM-meditation for 10 minutes significantly induces beneficial changes in HRV and reduces psychological stress in all phases of menstruation in young females.

The association between psychological processes and physiological reactions can be well studied using HRV, which is a sensitive stress index that reflects the balance between sympathetic and parasympathetic activity. Normally, parasympathetic tone is dominant. During stress, the HF component of HRV decreases, while the elaborate LF component and LF/HF ratio increase, indicating a shift in autonomic balance towards sympathetic dominance [11]. This altered autonomic function is considered a potential etiological factor for premenstrual syndrome, premenstrual dysphoric disorder, infertility in females [12,13], and a key factor in the development of cardiovascular diseases [14].

In the present study, there was a significant increase in the HF component and a decrease in the LF component and LF/HF ratio of HRV after practicing OM-meditation during all menstrual phases. The reduction in sympathetic activity (LF) was greater during the proliferative phase (≈24%) compared to the premenstrual (≈20%) and menstrual phase (≈19%). This may be due to increased stress during the premenstrual and menstrual phases. These changes suggest that OM-meditation is effective in reducing psychological stress, stabilising the cardiac autonomic function, and may help prevent stress-associated menstrual disorders in young females. Repetition of the 'OM' syllable results in mental alertness with physiological rest and increased sensory transmission sensitivity [6,15]. A systematic review of 15 studies demonstrated the effectiveness of integrated yoga (which includes postures, breathing practices, and meditation) in reducing symptoms associated with menstrual disorders, which may be attributed to the optimisation of autonomic regulation [16].

The normal menstrual cycle involves a complex interaction between the brain, ovaries, and uterus through the Hypothalamus-Pituitary-Gonadal (HPG) axis. In the HPG axis, the hypothalamus secretes Gonadotrophic Releasing Hormone (GnRH), which regulates hormone release from the pituitary (FSH-follicle stimulating hormone, LH-luteinising hormone) and gonads (estradiol and progesterone). The uterus responds to the fluctuating levels of these hormones. The stress response system consists of the Hypothalamus-Pituitary-Adrenal (HPA) axis and the Autonomic Nervous System (ANS). Activation of the HPA axis and sympathetic nervous system by stressors inhibits the HPG axis, leading to decreased GnRH levels and disruption of the menstrual cycle, resulting in premenstrual syndrome, dysmenorrhoea, oligomenorrhea, or amenorrhea [17].

The findings in the present study suggest that OM-meditation may optimise the ANS by reducing sympathetic activity, thus reducing the risk of altered HPG axis regulation due to psychosocial stress. However, the influence of OM-meditation on regulatory mechanisms, including the HPA axis, cortisol, and GnRH, needs to be investigated in future studies.

Limitation(s)

The immediate effect of OM-meditation has been evaluated, but the duration of the effect of short-term practice on mental stress during different phases of the menstrual cycle remains unclear. Additionally, the impact of stress reduction through OM-meditation on the regulatory mechanisms (hormonal control) of menstruation also requires further study.

CONCLUSION(S)

The findings in the present study suggest that practicing OM-meditation for 10 minutes can induce beneficial changes in HRV by reducing sympathetic activity and shifting the autonomic balance towards parasympathetic dominance. OM-meditation reduces mental stress, optimises autonomic regulation during different phases of the menstrual cycle, and may protect reproductive function in young females. However, further evaluation in a larger trial is necessary. Additionally, long-term cohort studies are needed to determine whether meditation can prevent stress-associated menstrual disorders in adolescents and adults.

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