

Original Article

Efficacy of Nadi Shodhana, Bhramari Pranayama and Yoga Nidra on Symptoms of Premenstrual Syndrome Among Young Adult Females: A Prospective Randomized Controlled Trial

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ABSTRACT

Background and Objectives: Premenstrual syndrome is frequently suffered by women of reproductive age, characterized by a range of physical, emotional, and psychological symptoms, and has a detrimental impact on their mood and productivity. Female college students are especially vulnerable to this condition. Yogic practices like Nadi shodhana, and Bhramari can help in reducing stress and enhancing mental clarity, Yoga Nidra induces a state of deep relaxation, and alleviates physical discomfort and emotional turbulence. This study aimed to evaluate the impact of Nadi shodhana, Bhramari Pranayama, and Yoga Nidra in relieving the symptoms of premenstrual syndrome among young adult females. **Materials and Methods:** In this prospective randomized control trial, 60 female participants between age 18 to 25 who fulfilled the study criteria were enrolled. Subjects were randomly divided into a study group and a control group using a lottery method. PSST and VAS were assessed before and after 8 weeks of intervention. **Result:** Results suggested that the experimental group demonstrated a significant reduction in the Premenstrual Symptoms Screening Tool (PSST) ($p \leq 0.05$) and Visual Analog Scale (VAS) ($p \leq 0.05$). Interestingly in the control group, there was also a significant but lesser extent reduction in the Premenstrual Symptoms Screening Tool (PSST) ($p \leq 0.05$) and Visual Analog Scale (VAS) ($p \leq 0.05$). **Conclusion:** The present study indicates that Nadi Shodhana, Bhramari pranayama and Yoga nidra on PMS subjects has significantly reduced PMS symptoms and severity, suggesting the cost-effective and easily accessible intervention.

Key words: PMS, Yoga, Nadi shodhana, Bhramari, Yoga Nidra

Premenstrual syndrome (PMS), a psychoneuro-endocrine condition manifests cyclically in the menstruation period specifically during the luteal phase, and resolves quickly within 7-14 days of the menstruation [1, 2]. During this luteal phase of PMS, clinically significant physical and psychological symptoms cause distress and functional impairment [3]. Globally 47.8% of reproductive-age women experience PMS including 40% in Europe, 85% in Africa, 46% in Asia, and 60% in South America [4]. In India, the prevalence of PMS ranges from 14.3% to 74.4% [5]. Symptoms encompass headaches, anxiety, rage, mood swings, irritability, changes in appetite, low back pain, stomach pain, depression, tearfulness, and physical discomforts such as headaches, breast soreness, and bloating in the abdomen [6, 7]. The treatment of premenstrual symptoms involves medical and non-medical therapy. Medical therapies including SSRIs (selective serotonin reuptake inhibitors), such as sertraline and fluoxetine as recommended by The American College of Obstetricians and Gynecologists (ACOG) are effective [8]. Non-medical therapy,

which typically includes complementary and alternative medicine, rest, heat compresses, traditional Chinese medicine, lifestyle changes, meditation, cognitive and behavioral therapies, aerobic exercises, reflexology, light therapy, massage therapy, dietary and nutritional modifications, etc., is more acceptable than medical therapy [4, 9].

Yoga nurtures an experience of well-being, relaxation, enhanced concentration, self-confidence, increased efficiency, positive interpersonal relationships, increased attentiveness, with a tendency for irritation, and an optimistic outlook on life [10]. Pranayama helps in developing awareness of one's breathing followed by wilful regulation of respiration as the functional basis of one's existence in developing awareness of the mind and establishing control over it [11]. During the practice of pranayama, one concentrates on the act of breathing removing the attention from worries and de-stressing that evokes relaxed responses in which parasympathetic nerve activity overrides sympathetic activity [12]. Pranayama when

Access this article online

Received – 30th December 2024
Initial Review – 18th January 2025
Accepted – 23rd January 2025

Quick response code

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practiced regularly can reduce cardio-respiratory risk factors, and anxiety, improve concentration, mental stability, and contribute to a healthy and productive life [13].

Nadi shodhana pranayama is not only trained to breathe but also trained to keep the focus on the act of breathing resulting in decreased heart rate by inducing a parasympathetic response that activates in increasing the vagal activity leading to concentration, diverts the attention from all worries, and distress [14, 15]. Bhramari pranayama has a calming effect which helps in overcoming drug dependency and is effective for correcting hormonal imbalances, potentially inducing a relaxed and focused mental state, as the theta band is associated with deep relaxation [16, 17]. Nadi Shodhana and Bhramari Pranayama have para sympathomimetic effects on the autonomic nerve system [18]. Yoga Nidra systematically induces overall calmness of physical, mental, and emotional aspects, stress reduction, initiating healing processes, and personal transformation [19, 20].

Despite studies on Yoga's impact on menstrual health, research on the combined effects of Nadi shodhana, Bhramari, and Yoga Nidra for PMS is limited. Hence the study aims to evaluate the effectiveness of Nadi Shodhana, Bhramari pranayama, and Yoga Nidra in reducing the severity of premenstrual syndrome and associated pain among individuals with this condition.

METHODOLOGY

This is a prospective randomized controlled trial pre-post-study design. The subjects were recruited from Alva's education foundation, Moodbidri 574227, Dakshina Kannada district, Karnataka, India. The Institution's Ethical Committee has given the approval for the project with the ethical clearance registration certificate no **ACNYS/IECHS/2022/66**. Outcome variables are performed at baseline and after 8 weeks as depicted in [figure-1].

The study's purpose, along with the rights of participants as research subjects, was thoroughly explained to each individual. Participants were provided ample time to review the information sheet and to ask any questions, and were clarified regarding rights to withdraw from the study at any time with the participation being entirely voluntary. By signing an informed consent form, each participant expressed their willingness to take part in the study. Legally signed written consent was obtained from all female participants who were aged from 17 to 25 years, were screened and recruited through satisfied diagnostic criteria according to the American College of Obstetricians and Gynecologists (ACOG) and with regular menstrual cycles. Subjects under any medications, any psychiatric disorders, undergone surgery, and practicing yoga for the past 6 months were eliminated. 60 people were chosen for the study based on the inclusion and exclusion criteria. The subjects are randomly divided equally into a study group and a control group by lottery method.

The study group will undergo Nadi shodhana, Bhramari Pranayama, and Yoga Nidra for 45 minutes, weekly for five days for 8 weeks. The practices are regularly monitored by the researchers. Control group will be in meditating posture and Shavasana with breath awareness five days per week for 8 weeks.

Premenstrual Symptoms Screening Tool (PSST)

The PSST questionnaire was composed of 19 questions including 4 criteria namely: not at all, mild, moderate, and severe, scoring from zero to 3. PSST questionnaire consisted of 2 categories; the first category had 14 questions about EM (emotional), PHY (physical) and BE (behavioural) symptoms and the second category had 5 questions considering the effect of PMS on quality of life [21].

Visual Analog Scale (VAS)

It is a measuring instrument that tries to measure a characteristic or attitude that is believed to range across a continuum of values and cannot easily be directly measured [22, 23].

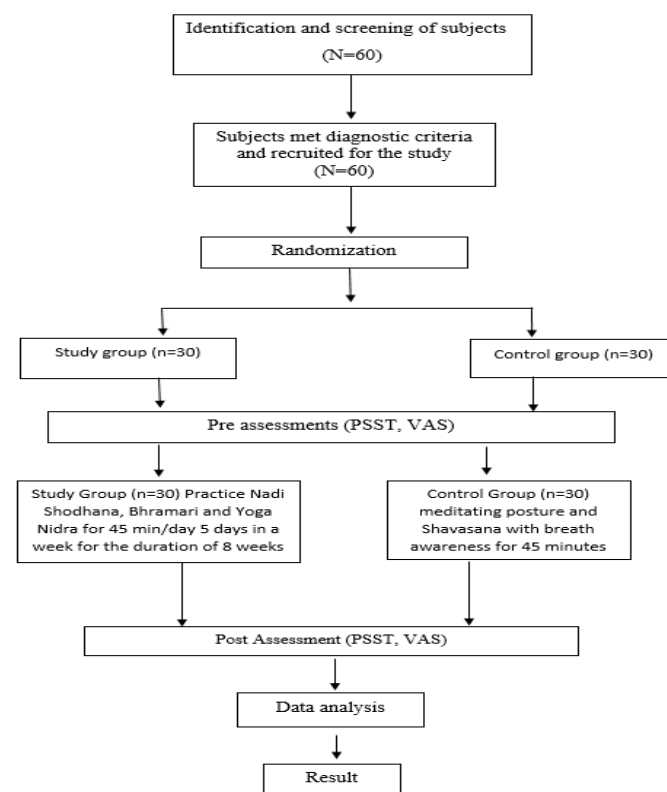


Figure -1: Illustration of study plan

Intervention

Nadi Shodhana

Sit comfortably in a meditative posture, ensuring that your head and spine are upright. Relax your entire body and gently close your eyes. Use your right hand to adopt nasikagra mudra and rest your left hand on your knee in chin mudra. Close your right nostril with your thumb and inhale deeply through your left nostril, taking care not to strain. Then, close your left nostril with your ring finger while releasing the thumb's pressure from your right

nostril. Ensure that the duration of inhalation and exhalation is equal. Next, inhale through your right nostril, maintaining the same count. At the end of this inhalation, close your right nostril and open your left nostril to exhale. This is one round. Practice for 5 minutes.

Bhramari Pranayama

Sit comfortably in a meditative posture with your hands resting on your knees in chin mudra. Close your eyes and allow your entire body to relax. Keep your lips gently closed and your teeth slightly apart throughout the practice. Raise your arms to the sides and bend your elbows, bringing your hands close to your ears. Use your index or middle fingers to block the ears, or press the ear flaps without inserting your fingers. Breathe in through your nose. As you exhale slowly and steadily, produce a deep, continuous humming sound, resembling the buzz of a black bee. Ensure that both inhalation and exhalation are smooth and controlled. This is one round. Practice is done for 5 minutes [24].

Yoga Nidra

Preparation: Prepare for Yoga Nidra by lying on your back in Shavasana. Position your body straight from head to toe, with your legs slightly apart and your arms a little away from your torso. The palms must be turned upwards and eyes must be until instructed otherwise. Avoid any physical movement during the practice. Take deep breaths, and as you exhale, let go of the cares and worries of the day. This practice will help you cultivate a sense of deep relaxation. Throughout Yoga Nidra, remain alert to the instructor's voice, functioning on the levels of hearing and awareness.

Relaxation: Begin by bringing a sense of inner relaxation to your entire body. Focus on your body and acknowledge the importance of complete stillness. Develop an awareness of your body from the top of your head to the tips of your toes. Mentally repeat the mantra **O--o--o--m--m--m**, allowing yourself to experience absolute stillness and heightened awareness of your body. Repeat the mantra again.

Resolve: Now, make a resolution. This should be a simple, positive statement, expressed in straightforward language. Repeat your resolve three times with full awareness, emotion, and intention. The resolve you make during Yoga Nidra holds the power to manifest in your life.

Rotation of Consciousness: Shift your awareness through different parts of your body in a systematic rotation of consciousness. Quickly move your attention from one part to

the next, mentally naming each and simultaneously becoming aware of it. Focus on the right side, the left side, the back, the front, and the major areas of the body.

Breathing: Turn your attention to your breath. Notice the flow of air moving in and out of your lungs. Count your breaths backward, starting from 27, while maintaining awareness of the navel, chest, throat, and nostrils.

Visualization: Stop counting your breaths and shift to visualization. Various images will be named; allow yourself to visualize each as vividly as possible. Engage your feelings, awareness, emotions, and imagination in the process.

Resolve: Return to your resolve. Repeat the same resolve you made at the beginning of the practice. State it three times with complete awareness, emotion, and intention.

Finish: Release all effort and draw your attention outward. Become aware of your natural breath, your whole body, and your state of relaxation. Feel your body resting peacefully on the floor, breathing quietly and slowly. Develop awareness of your body from head to toe and mentally repeat the mantra **O--o--o--m--m--m**. Take your time and move slowly as you begin to reawaken your body. When you feel fully alert, sit up gently and open your eyes. The practice of Yoga Nidra is now complete. It is practice for 35 minutes [20].

Table 1: Method of Nadi Shodhana, Bhramari and Yoga Nidra

Nadi Shodhana	5 minutes
Rest	1 minute
Bhramari	5 minutes
Rest	1 minute
Yoga Nidra	30-35 minutes

Statistical Analyses

The data was manually inspected for errors. Paired samples t-test was used to assess within group differences. Univariate analysis of variance was performed to assess between group changes adjusting for age and respective baseline values. Bonferroni's correction for multiple testing was made. Levene's test for equality of variances were performed.

RESULTS

Table 2 mentioning the results of within-group comparisons through paired t-test and univariate analysis of covariance was performed to assess within-group changes. The level of significance fixed at $p \leq 0.05$.

Table 2: Table representing group averages in Mean \pm SD before and following the intervention.

Variable	Experimental Group			p-value	Control Group		
	Pre	Post			Pre	Post	p-value
PSST	36.87 \pm 6.30	23.30 \pm 7.68*		$p \leq 0.05$	33.77 \pm 7.43	30.30 \pm 6.7	$p \leq 0.05$
VAS	6.77 \pm 1.48	4.17 \pm 1.72*		$p \leq 0.05$	6.93 \pm 1.31	5.27 \pm 1.41	$p \leq 0.05$

* $p \leq 0.05$: Univariate analysis of covariance was made adjusting for age and baseline value

PSST

Homogeneity of variance using Levene’s test for equality was met ($p > 0.05$). Bonferroni’s test for multiple corrections was made. The PSST score was significantly different between the two groups following the intervention $F(3,56) = 52.71$, $p \leq 0.001$, $\eta^2 = 0.49$. Age did not significantly influence the PSST scores $F(3,56) = 1.15$, $p = 0.29$, $\eta^2 = 0.02$. Within group comparison showed significant difference $F(3,56) = 74.02$, $p \leq 0.001$, $\eta^2 = 0.569$. Paired sample t-test showed significant reduction in both the experimental ($p \leq 0.05$) and the study group ($p \leq 0.05$) following the intervention.

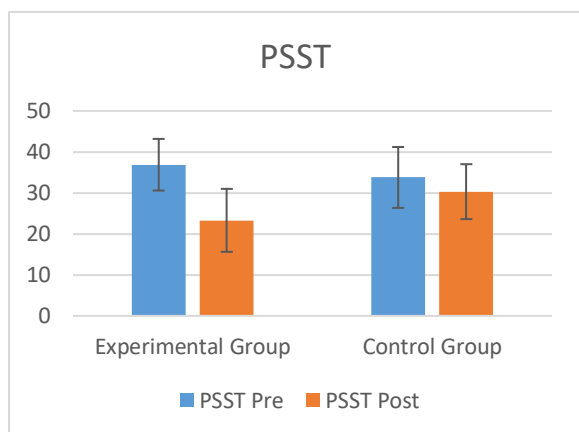


Figure 2- Graph showing in between group changes pre and post intervention and control of PSST

VAS

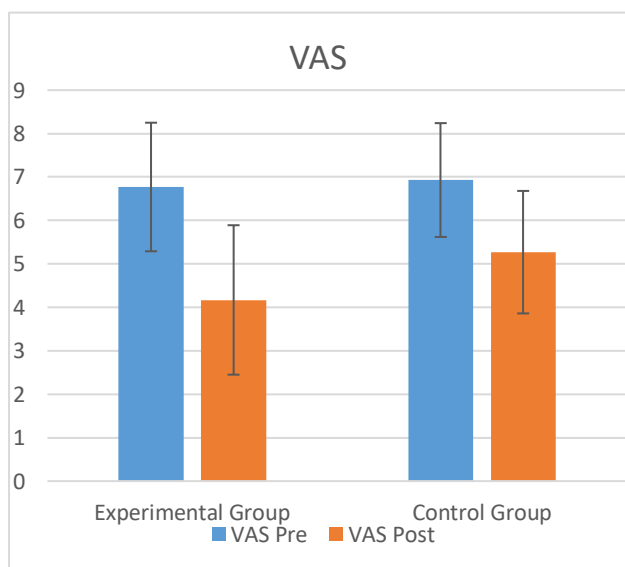


Figure 3 - Graph showing in between group changes pre and post intervention and control of VAS

Homogeneity of variance using Levene’s test for equality was met ($p > 0.05$). Bonferroni test for multiple corrections was made. The VAS score was significantly different between the two groups following the intervention $F(3,56) = 9.05$, $p = 0.004$, $\eta^2 = 0.14$. Age did not significantly influence the visual analog scores $F(3,56) = 0.551$, $p = 0.46$, $\eta^2 = 0.01$. Within group

comparison showed significant difference $F(3,56) = 44.57$, $p \leq 0.001$, $\eta^2 = 0.443$. Paired sample t-test showed significant reduction in both the experimental ($p \leq 0.05$) and the study group ($p \leq 0.05$) following the intervention.

DISCUSSION

The present study investigated the efficacy of Nadi Shodhana, Bhramari Pranayama, and Yoga Nidra following an 8 weeks-intervention in managing symptoms of Premenstrual Syndrome among young adult females. The findings suggested that the intervention effectively alleviated the symptoms of PMS.

During the luteal phase, women with PMS showed reduced parasympathetic activity and increased sympathetic activity [25]. A Study by Sharma et al. investigated the effect of anuloma viloma on PMS showing a significant reduction in sympathetic activity and an increased relaxation response which led to a notable reduction in symptom score [26]. Alternate nostril breathing raised the vagal tone, baroreflex sensitivity, and galvanic skin resistance, which indicates parasympathetic activity [27]. The mechanism behind the effects of Nadi Shodhana Pranayama may be attributed to its breathing techniques, which stimulate the olfactory nerves located at the roof of the nasal cavity. These signals are then transmitted to the olfactory bulbs, found in the region of the cribriform plate. This olfactory bundle connects to the front of the brain, which in turn is linked to the hypothalamus [28]. Consistent yoga practice has the potential to modify chemical levels in the blood and central nervous system. Yoga and exercise raise serotonin levels in the body, and this neurotransmitter can penetrate the blood-brain barrier, resulting in mood elevation [29].

It has been demonstrated that pranayama lessens PMS symptoms. During breathing exercises, attention to breathing removes attention from worldly worries, de-stress a person, and decreases adrenaline release [30]. Vasanthan et al study suggests that pranayama, a breathing practice, may impact cortical activity, resulting in a dampening effect and a steadying of the mind due to the Hering-Breuer reflex, which stimulates stretch receptors in the lung during inspiration resulting in impulses ascend via the vagus nerve to the pontine apneustic center, inhibiting inspiration and promoting expiration. Excessive stimuli may modify the ascending reticular activating system, leading to a steady state of mind [31].

The vibrations of Bhramari tone the hypothalamus which regulates hormones in the pituitary, thyroid, and adrenal glands, promoting hormonal balance [32]. Humming also helps to stimulate nitric oxide production from the sinuses and nasal mucosa, which serves as a vasodilator known to control nor-epinephrine, serotonin, dopamine, and glutamate neurotransmitters involved in the neurological process [33]. A study by Vungarala S et al. shows that a humming sound in Bhramari causes vibration of nasal/laryngeal mucous membrane during exhalation, causing reflex apnoea by

switching off the inspiratory center through chemoreceptor Sino-aortic mechanism enhancing baroreceptor sensitivity a sense of well-being, and calmness [34]. In the current study, the symptoms of PMS decreased in the study group including anger or irritability, stress, rise in sensitivity to negative issues, depressed mood, loss of interest in work activities, lack of focus, and lack of energy. According to Dvivedi *et al.*, 80% of participants who practiced yoga indicated that their irritation symptoms had improved and showed higher relaxation and lower sympathetic activity by the use of relaxation therapy, and showed that yoga reduces many symptoms of PMS, which enhances its benefits for the nervous system regulation and relaxation [35].

Yoga Nidra, a practice that stimulates the pituitary gland, has been uncovered to release endogenous morphine-like brain hormones, such as endorphins and enkephalin, which are produced by the pituitary gland during stress and prolonged pain are secreted into the cerebrospinal fluid, reducing the need for external painkillers [36]. It primarily impacts the brain by lowering parasympathetic hyperactivity and relaxing the neural system [37]. Metabolic effects of Yoga Nidra include decreased adrenocortical activity, long-term decreased cortisol secretion, and lesser thyroid stimulating hormone (TSH) abnormalities [38]. It holds significant similarities with sleep. During this meditation practice, the person disconnects from external stimuli, enhances parasympathetic drive (*i.e.* relaxation), and experiences dream-like visuals [39].

Given the high prevalence of PMS seeking affordable methods and therapies to alleviate PMS symptoms is crucial because untreated PMS can lead to issues and negatively impact women's quality of life. Yoga is now accepted as a non-invasive method for PMS by researchers and clinicians and is recommended by many researchers to improve women's well-being and quality of life. The practice involving meditation, breathing, and physical poses engages the mind and the body and embarks attention from the medical community, hence, yoga is studied widely for its benefits on the overall mental and physical aspects of life. According to the result of the current study, there was a significant reduction in PSST and VAS scores. Concerning earlier studies, the current study shows that Nadi shodhana, Bhramari pranayama, and Yoga Nidra decrease the symptoms of PMS by improving autonomic functions and neuro-hormonal mechanisms. The prevalence shows that PMS has been the most common mental health issue faced by young adult females. Hence Nadi shodhana, Bhramari Pranayama, and Yoga Nidra have therapeutic benefits on Premenstrual syndrome in young adult females.

CONCLUSIONS

The present study concluded that the practice of Nadi shodhana, Bhramari, and Yoga nidra for 8 weeks had been shown to bring positive impact and significant improvement in alleviating PMS symptoms and can promote women's health and well-being. Given the non-invasive, low-risk nature of the

pranayama and yoga nidra, they should be considered viable complementary therapies for PMS management.

Limitations and Future directions of study

The limitation of the study is the short duration of the study plan and biochemical analysis. Further research could be conducted with a longer duration to assess the effect of Nadi shodhana, Bhramari pranayama, and Yoga nidra. Such studies require a larger sample size, advanced techniques, boarder age range and a longer intervention period than previous studies.

Acknowledgements: I am very grateful to Dr Swathi KV, Dr Sharada Shetty P S and Dr Vanitha Shetty for guiding me throughout the study. There is no funding from any organisations.

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How to cite this article: Lanjiklu Gonmei, Sharada Shetty P S, Vanitha S Shetty, Swathi KV. Efficacy of Nadi Shodhana, Bhramari Pranayama and Yoga Nidra on Symptoms of Premenstrual Syndrome Among Young Adult Females: A Prospective Randomized Controlled Trial. *Indian J Integr Med*. 2025; Online First.

Funding: None;

Conflicts of Interest: None Stated