

Effect of Heartfulness Meditation on Cortisol Levels and Vital Parameters in Healthy Female Medical Students- A Prospective Longitudinal Study

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ABSTRACT

Introduction: Medical education has been reported to be one of the most stressful academic curriculum worldwide, with a potential of negatively affecting the physical and mental health of medical students. Meditation is a self-produced relaxation technique which restores the mental peace by relieving emotional and physiological stress and is an accepted therapy to reduce stress.

Aim: To study the effect of heartfulness meditation on cortisol levels and vital parameters in healthy female medical students.

Materials and Methods: This study was a prospective longitudinal study conducted in the department of physiology at Sri Padmavathi Medical College for women, SVIMS, Andhra Pradesh, India. Sixty female medical students of age group 18 to 25 years were undergone heartfulness meditation training for a period of 6 months from September 2021 to February 2022. Baseline measurements of cortisol, heart rate, Respiratory Rate

(RR) and Blood Pressure (BP) were taken at the beginning of the session and after 6 months of intervention program i.e., from September 2021 to February 2022. Later pre and post values were compared and analysed statistically by using paired sample t-test and the p-value <0.05 or 5% was used as level of significance for comparison. For data analysis Statistical Package for Social Sciences (SPSS) version 19 was used.

Results: The vital signs and cortisol levels in female medical students were significantly changed after practicing heartfulness meditation for six months. There was a significant decrease in Pulse Rate (PR) ($p < 0.001$), RR ($p < 0.001$), Systolic Blood Pressure (SBP) ($p < 0.001$) and Diastolic Blood Pressure (DBP) ($p < 0.001$) and cortisol levels ($p < 0.001$) after 6 months practice of heartfulness meditation.

Conclusion: The study concluded that heartfulness meditation had a positive effect on sympathovagal balance and also it was effective in reducing stress levels in medical students.

Keywords: Mental peace, Physiological stress, Sympathovagal balance

INTRODUCTION

In daily life, all organisms are facing various types of day to-day stresses. Some organisms can adopt well with the stress stimulus while in others repeated daily stress results in derangement of the neuroendocrine coping mechanism, producing a wide range of deleterious effects on the physiological and psychological homeostasis [1]. Stress can be defined as a subjective perception of an adverse environmental change, which usually leads to a stress response allowing for adaptation to the new condition [2]. This adaptation is useful in shorter exposure to stress, if stress persists for longer duration it leads to tissue damage and disease [3].

It is well-known that the Hypothalamo-Pituitary-Adrenal (HPA) axis is highly sensitive to and easily activated by various stressors [4]. Once, it is activated it causes the release of Corticotrophin Releasing Hormone (CRH) from the hypothalamus and the consequently Adreno-Corticotrophic Hormone (ACTH) from the anterior pituitary gland is released. The circulating ACTH then acts on the adrenal cortex causing the release of the hormonal end-products of the HPA axis, the glucocorticoids (mainly cortisol) [5], and it is elaborately involved in the adaptation to stress. The cortisol has protective effects during times of increased demand, but chronic elevations of glucocorticoids can have damaging effects on the body over time particularly when acute responses to stress become chronic [6]. Exposing to stress for short period is called acute stress, people usually aware of acute stress and also the human stress system was generally well-equipped to manage acute stress. Exposing to stress for longer duration is called chronic stress, people may be unaware of chronic stress and in this case human body's stress system was activated very frequently to persistent stimuli which

may have detrimental effects on the brain and behaviour [7]. When compared to other education programs worldwide, medical education has been reported to be most stressful academic curriculum which is negatively affecting the physical and mental health of medical students [8]. High expectations from parent's fear of exams, peer pressure, lack of leisure time, financial problems, and aspirations for higher studies are some of the many factors known to responsible for the development of stress among undergraduate medical students [9]. In general, females are more stressed than males they are more sensitive to emotions in any given adverse circumstances [10].

Meditation, a mind-body technique that helps people in balancing mental, physical as well as emotional aspects. It can be practiced by people of any culture or religion. Meditation is an ancient spiritual practice [11]. Most of the meditation techniques are effective in management of stress, but regular practice appears to be crucial. In this modern era, people are generally busy and they require user-friendly systems. Most of the meditation techniques are not very easy to practice with all the required diligence. So, suiting the current day's busy lifestyles choosing a simple meditation technique is important to enable better adherence. Heartfulness meditation is such user friendly systems, for strict adherence to get maximum benefits [12]. Heartfulness meditation is a simple heart-based meditation practice that brings up balance, peace and overall wellbeing. People can learn to regulate the mind, by tuning into the heart, and cultivate an inner knowing that wisely directs and guides our lives [13]. This meditation consists of three core practices: relaxation, cleaning and connecting with higher self.

Meditation is an accepted therapy to reduce stress. In addition to reducing stress, heartfulness meditation also makes the people

more automotive and sensitive to their surroundings. As the mind becomes calm and tuned with the heart, one develops inner confidence, becomes more grounded and learns to balance work [14]. As medical education has been reported to be one of the most stressful academic curriculum worldwide, with a potential of negatively affecting the physical and mental health of medical students, this study was conducted to see the effect of meditation on their stress levels. However, less literature was there to see the effect of heartfulness meditation on stress levels especially in female medical students. So, that the present study was taken up to see the effect of heartfulness meditation on PR, RR, BP and cortisol levels of female medical students. The hypothesis is that by practicing heartfulness meditation the students can reduce their stress level.

MATERIALS AND METHODS

This a prospective longitudinal study was conducted in physiology department, SVIMS, SPMCW, Andhra Pradesh, India. The study participants were female medical students of SVIMS, SPMCW and the study was conducted for a period of six months i.e., from September 2021 to February 2022, where heartfulness meditation was practiced for six days/week and 40-60 minutes per day (meditation in the morning for 30 to 40 minutes, relaxation for 10 minutes at any time during the day and cleaning for 10 minutes at night before going to sleep). The Institutional Ethical Clearance (IEC No.991) of the study was obtained.

Sample size calculation: The sample size was determined by using Cohen's-effect size method ($\alpha=0.05$, Power=80%) for paired comparison tests. The effect size (d) was taken as 0.3 to indicate a low effect of treatment on outcomes [15]. This gives N=52 (minimum sample size) for a two tailed comparison. Expected dropout rate (Attrition)-5%. Therefore, the sample size calculated for the present study was 60.

A total of 162 students were screened for inclusion and exclusion criteria. A 96 students were eligible for the study (n=96). These students were subjected to simple random technique to meet the final sample size (n=60).

Stress in the students was measured by Perceived Stress Scale (PSS). PSS-10 has good internal consistency reliability ($\alpha=0.78$) and adequate convergent validity ($r=0.35-0.49$). It is a ten item type self-rated questionnaire [16]. It is a 10-item self-report measure of global perceived stress. A total score ranging from 0 to 40 is computed by reverse scoring the four positively worded items and then summing all the scale items. Higher scores indicate greater levels of perceived stress. Subscale scores were computed by summing the six negatively worded items (Items 1, 2, 3, 6, 9, and 10) for factor 1 (Negative) and the four positively worded items (Items 4, 5, 7, and 8) for factor 2 (Positive), with higher scores indicating greater negative distress/stress feelings and greater positive stress feelings and coping abilities, respectively [16]. As per the norms, table for the PSS published by Cohen (1994), a score of 14.2 with a SD 6.2 was reported as the norm for 18-29 year age group [17]. For this study, therefore, a cut-off score of 14 on PSS was chosen below which students were considered to be not under stress.

Inclusion criteria:

- Willing to participate and to continue meditation practice.
- Subject should be physically fit.
- Normal personal and family health status.
- Female students of age group between 18 to 25 years are included.
- Students having PSS score above 14. This score was recorded before the study started.

Exclusion criteria:

- Previous history of meditation practice
- Any history of major illness like hypertension, history of status asthmaticus, spondylitis, joint pain, diabetes, liver diseases,

thyroid disorders, Cushing's syndrome, physical inability to practice meditation or any other disease condition which may exaggerate discomfort.

- Any addiction.
- Not willing to participate

Counseling and motivation was given to medical students for taking part in study. Before their participation, from all the subjects personal and family history was taken to assess their physical fitness, personal and family health status and written consent was taken. Their personal history includes their daily routines, dietary habit, exercise habit. A 40-60 minutes of heartfulness meditation session was conducted by a certified heartfulness trainer for first three days followed by meditation on their own at home/hostel which was followed up by keeping one diary for each participant and supervision by heartfulness trainer and other volunteers once in a week at SVIMS with six months duration (from September 2021 to February 2022). Then the follow-up readings were taken in the month of March 2022.

Study Procedure

Heartfulness is an integrated approach that consists of three core practices: Meditation-relaxation, cleaning and connecting with higher self.

- **Meditation-Relaxation:** Relaxation can be done at any time, and is especially useful before beginning heartfulness meditation.
- **Cleaning:** Do the cleaning practice at the end of your day's work, preferably not too close to bedtime. This process will rejuvenate you and purify your system of any accumulated heaviness.
- **Connecting with higher self:** The purpose of this is to reestablish our connection with the divine. This prayer is offered at bedtime, as a way of connecting to the Source before sleep [18].

Steps to practice heartfulness meditation:

- Sit comfortably with your hands and legs in a comfortable position
- Gently focus on your heart
- Feel that the source of divine light is within your heart
- Pray that the transmission is being received and is pulling your attention inward towards the heart
- Meditate it daily for 40-60 minutes [19].

Height and weight were measured, with subjects being barefoot and lightly dressed. Body Mass Index (BMI) was calculated using the formula, weight in kg/height in m² (quetelet index). World Health Organization (WHO) classification was used to assess BMI. (Severely underweight- BMI less than 16.5kg/m² Underweight- BMI under 18.5 kg/m², Normal weight-BMI greater than or equal to 18.5 to 24.9 kg/m², Overweight-BMI greater than or equal to 25 to 29.9 kg/m² [20].

Subjects were instructed one night before till fast, till collection of blood at early morning. Blood was collected by lab technician at around 8.00 am from the subjects by the phlebotomist and sent immediately to lab for estimation of cortisol. Blood samples were collected from the students during the time when they are not undergoing any exams. PR, RR and BP were also recorded in the subjects in early morning before the intervention program. Again after the completion of six months practice of heartfulness meditation the blood was collected to assess cortisol levels and PR, RR and BP were recorded.

The stress marker serum cortisol (6.7–22.6 µg/dL) was analysed using chemiluminescence immunoassay by Beckman Coulter Access immunoassay system (Beckman Coulter, Inc.4300 N. Harbor Blvd. Fullerton, CA 92835 USA) in endocrinology lab. Then for recording PR, RR and BP subjects were asked to come in the morning before the intervention program and they were allowed to relax physically and mentally for 30 minutes in supine position in a silent room.

In the same position, the PR and the BP were recorded. The PR (60 to 100 beat/minute) in beats per minute was recorded in the right

radial artery by palpatory method for whole one minute. The RR is number of breaths per minutes (12 to 20 breaths/minute). The rate is taken by simply counting the number of breaths over one minute by watching and counting how many times the chest rises. The SBP (100 to 119 mm of Hg) and DBP (60 to 79 mm of Hg) in millimeter of mercury (Hg) were recorded with a sphygmomanometer (Diamond, Maharashtra, India), in the right upper limb by auscultatory method [21]. Similarly all the measurements were done after the intervention program i.e., after six months.

STATISTICAL ANALYSIS

Descriptive Statistics were used to describe age, anthropometric measurements and PSS score of study subjects. Paired samples t-test was used for comparing between pre and postvalues of each parameter. The p-value of 0.05 or 5% was used as a level of significance for comparison. For statistical analysis the SPSS version 19 was used.

RESULTS

The study was done in 60 healthy female volunteers of age 20.567 years \pm 1.640 (mean \pm SD). [Table/Fig-1] shows the mean and standard deviation of age, height, weight, BMI and PSS score.

Descriptive statistics				
Parameters	Minimum	Maximum	Mean	Std. Deviation
Age (years)	18	25	20.567	1.640
Height (in cm)	147	180	160.717	7.547
Weight (kg)	40	88	60.400	11.009
BMI (kg/m ²)	17.71	39.11	23.377	4.039
PSS score	16.00	34.00	21.633	3.840

[Table/Fig-1]: Mean of age, anthropometric parameters and PSS score of study subjects (n=60).
BMI: Body mass index; PSS: Perceived stress scale

The [Table/Fig-2] shows the comparison of PR, SBP, DBP, RR and cortisol levels before and after practicing heartfulness meditation for six months. A significant reduction (for all values p-value <0.001) was seen in PR, SBP, DBP, RR and cortisol levels with six months of heartfulness meditation practice.

Paired samples statistics				
Parameters	Mean	Std. Deviation	t-test	p-value
PR (beats/min)	78.5333	4.3936	8.723	0.001*
Post PR (beats/min)	75.3833	3.0370		
SBP (mm of Hg)	116.1667	3.4206	9.011	0.001*
Post SBP (mm of Hg)	112.3667	3.3647		
DBP (mm of Hg)	76.8333	3.1309	9.689	0.001*
Post DBP (mm of Hg)	72.0667	2.8276		
RR (breaths/min)	13.9333	1.5055	4.767	0.001*
Post RR (breaths/min)	12.9167	1.0133		
Cortisol (μ g/dL)	11.5200	4.5380	7.819	0.001*
Postcortisol (μ g/dL)	8.0678	2.3881		

[Table/Fig-2]: Comparison of PR, SBP, DBP, RR and cortisol levels before and after the intervention.
p<0.001 very highly significant, p<0.01 highly significant, p<0.05 significant, p>0.05 non significant. SBP, DBP, PR, RR. Wilcoxon Signed Rank test* indicates significant p-value.

DISCUSSION

When compared to other education programs worldwide, medical education has been reported to be most stressful academic curriculum which is negatively affecting the physical and mental health of medical students [8]. With this the students undergo chronic stress and may suffer with stress related disorders. Hence, the present study was chosen to study the effect of stress relieving technique i.e., heartfulness meditation. Four vital signs have been described, Heart Rate (HR), BP, body temperature and RR. These basic and essential

measurements indicating the status of the body's life sustaining functions, helps the clinician to determine health or disease and life or death. Any vital signs abnormality is an early indicator of a progressive disease. The result of most lifestyle enhancement programs is to achieve a balanced and well-regulated human body in which the vital parameters assume normal values [22].

For the stress and inflammation, Serum cortisol level is a reliable marker. Yoga and meditation was known to reduce stress level in regular practitioners [23]. In this study there was a significant decrease in cortisol levels after six months practice of heartfulness meditation. Similar results were observed in the following studies on relaxation techniques. Michaels RR et al., compared the effect of transcendental meditation on cortisol levels and found that there was a significant fall in cortisol levels in meditators compared to non meditators [24]. Similar findings were observed in other studies by Walton KG et al., and Mc Lean CRK et al., on cortisol levels by the effect of transcendental meditation in normal subjects and also in postmenopausal women exposed to laboratory stressors [25-27]. Studies by Sudsuang R et al., showed that after the practice of Buddhist Dhammakaya, the serum cortisol levels were found to be significantly reduced in meditators in comparison with non meditators [28]. Study by Bullen V et al., in young adults who practiced kinesthetic meditation for a period of 5 weeks showed a significant decrease in cortisol levels [29]. Similar findings were shown by Jin P in a study that the salivary cortisol levels were found to be decreased in long-term practitioners of Tai Chi when compared to beginners [30]. Day of the week, time of measurement, time since awakening, infections, recent eating, smoking, and exercise are some of the confounding factors that affect cortisol levels [31]. These confounding factors are taken into account by asking subjects about their habits (such as when they wake up, whether they have any current infections, whether they smoke, whether they exercise, etc.), and by instructing them to arrive fasting.

In this study, mean heart rate, BP and RR at baseline were higher in subjects and were statistically reduced after six months of meditation practice of heartfulness meditation. This observation is similar to the results observed in previous studies. Study by Paholpak S et al., found that teens who meditate twice a day for 15 minutes each time for four months can lower their BP up to several digits [32]. Study by RajaAmarnath G et al., also shown the similar results that were, fall in heart rate, SBP and RR in experienced and new meditators after a 30-minute heartfulness meditation session [33]. In a study by Chakrabarthi et al., which was conducted on Rajayogis, both males and females, by the Rajayoga Education and Research Foundation, an overall decrease in the mean values of the heart rate, systolic and DBP was observed [34]. In several studies, there was a significant reduction in the systolic and DBP, serum cholesterol and the incidence of ischaemic heart disease in the meditators [35,36]. In normotensive individuals also the regular practice of meditation results in decrease of BP levels as like in hypertensive individuals, hence it could give significant protection from cardiovascular diseases [37]. The decrease in the diastolic and SBP and the heart rate may be because of the activation of the parasympathetic state [38]. Meditation reduces the stress induced sympathetic over-activity, by modifying the state of anxiety, resulting in lowering of the DBP and the heart rate. It makes the person relaxed and thus decreases the arterial tone and the peripheral resistance [39].

Practice of meditation for long time lowers the effects of stress hormones to influence the brain and the body. Sleep and relaxation response bring a decrease in oxygen consumption; this change occurs more rapidly with the relaxation response. With continued practice of meditation results in feelings of greater control over life. Physical benefits as well as psychological benefits occur during regular practice especially in stress induced conditions [32]. Meditation by its action on the hypothalamus decreases the stress which leads to decrease in the secretion of corticotropin-releasing factor, Adrenocorticotrophic Hormone (ACTH) and consequently the stress hormone cortisol. This decreased cortisol causes decrease fat

mobilisation and decreased gluconeogenesis [40]. Meditation also exerts a regulatory effect on the autonomic nervous system [10].

Limitation(s)

This study did not estimate all the biomarkers of stress depending on feasibility and time constraint hence cortisol levels were also recorded only once. Subjects practiced meditation on their own at home which may be makes the readings subjective.

CONCLUSION(S)

In this study, there was a significant decrease in vital parameters and cortisol levels Heartfulness meditation produces relaxation response on nervous system, cardio vascular system, respiratory system, endocrine system and brings moderation in overall body's physiology and psychology. Furthermore, the practice of heartfulness meditation should be adopted and continued for a long duration to get more benefits.

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