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RESEARCH ARTICLE

Effect of Nadi Shuddhi Pranayama on perceived stress and cardiovascular autonomic functions in 1st year undergraduate medical students

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ABSTRACT

Background: First year medical students have reported a high level of perceived stress. Yogic breathing technique "Pranayama" is said to balance two limbs of autonomic nervous system and therefore advocated for stress reduction and prevention of related diseases. **Aims and Objectives:** The present study was conducted to evaluate the effects of Nadi Shuddhi Pranayama on perceived stress and cardiovascular autonomic functions in 1st year medical students. **Materials and Methods:** The present study was carried out in one of the tertiary care hospitals of Mumbai. A total of 60 subjects (age 18–22 years) practised Nadi Shuddhi Pranayama daily for 12 weeks under the supervision of certified yoga trainer. Following parameters were recorded before and after 12 weeks of training; perceived stress scale (PSS) score, heart rate (HR), systolic blood pressure (SBP) and diastolic BP (DBP), DBP response to isometric handgrip (IHG) test. **Results:** There was a significant decrease in PSS scores after intervention. A significant decrease was also seen in cardiovascular autonomic functions such as HR, SBP, DBP, and DBP response to IHG test. **Conclusion:** Regular practice of Nadi Shuddhi Pranayama helps in reducing stress in 1st year medical students as evidenced by the corresponding decrease in cardiovascular autonomic parameters.

KEY WORDS: Nadi Shuddhi Pranayama; Perceived Stress Scale; Cardiovascular Autonomic Functions; Medical Students

INTRODUCTION

Stress is a process whereby an individual perceives and responds to events appraised as overwhelming or threatening to one's well-being.[1] Dr. Hans Selye described stress as the nonspecific response of the body to any demand made on it.[2] Stress response helps us in physical survival in the form of classical "fight or flight reaction.[3] Stress in medical students is common and is process oriented.[4] Stressful environment in medical colleges often exerts a negative effect on academic performance, physical health, and psychological well-being of medical students.[5] Several studies have reported that perceived stress is high among 1st year medical students.[6-8] Change of environment, demanding medical education, different teaching protocol, unrealistic expectations, lack of time for recreation, and lack of emotional support result in stress in newly admitted medical students. Real life stress in 1st year undergraduate students impairs cardiac autonomic regulation and shifts it toward sympathetic dominance.[6] Self-observation, cognitive restructuring, relaxation training, time management, and problem solving are some ways for stress management.[9] Progressive relaxation training usually consists of a series of structured exercises involving slowly tensing and relaxing certain muscle groups. Pranayama, the fourth limb of Ashtanga Yoga is one such relaxation technique.[10] It is said to

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relieve stress by stabilizing autonomic functions of the body. Slow breathing techniques such as Nadi Shuddhi and Savitri pranayama are particularly advocated for this purpose. Hence, the present study was taken to evaluate effects of the practice of Nadi Shuddhi Pranayama on perceived stress and cardiovascular autonomic functions in 1st year medical students.

MATERIALS AND METHODS

Study Design

It is a pre-post designed observational study conducted in a well-known tertiary care hospital in Mumbai. The participants of the study were 60 1st year medical students of the age group of 18–22 years. Permission to conduct the study was taken from the Institutional Ethics Committee.

Selection of Subject

Subjects were randomly selected from 1st year medical students.

Inclusion criteria

Healthy males and females between the age group of 18–22 years without preference to any sex and students living sedentary lifestyle were included in the study.

Exclusion criteria

Students who had undergone any major surgery, having any major illness such as hypertension, diabetes mellitus, and history of heart disease, and on any medication were excluded. Those who were doing other form of exercises were excluded from the study.

Consent Taking

Written informed consent was obtained from each student before the procedure.

Study Procedure

History taking, general examination, and systemic examination were performed. Volunteers were instructed not to practice any other exercise or any yogic exercises other than prescribed one.

Practice of Nadi Shuddhi Pranayama[10] was done under the guidance of certified yoga trainer. Subject was made to sit in Vajra Asana, and then, he was asked to perform Nasarga Mudra or Vishnu Mudra with his right hand. He then performed Nadi Shuddhi Pranayama in following steps:

1. Subject closed the right nostril with his right thumb and then inhaled through the left nostril. This was done to the count of 4 s.
2. Immediately he closed his left nostril with his right ring finger and little finger, and at the same time, removed his thumb from the right nostril, and then exhaled through this nostril. This was done to the count of 8 s. This completed a half round.
3. He then inhaled through the right nostril to the count of 4 s. Now, he closed the right nostril with his right thumb and exhaled through the left nostril to the count of 8 s. This completed one full round.

Each volunteer had practised such cycles for 15 min daily in the morning for 12 weeks.

Following parameters were recorded on all the volunteers before and after the intervention. Before testing, required pre-test instructions were given and tests were properly explained and demonstrated.

Heart rate (HR)

After complete rest for 5 min, pulse rate per minute was measured by placing three fingers on the radial artery for 3 times and the average was taken and noted.

Blood pressure (BP)

With the help of automated sphygmomanometer (Omron), systolic and diastolic pressure was measured in supine position. BP was recorded 3 times and the average was noted.

Isometric handgrip (IHG) test

This is a sympathetic test. A detail of the procedure was explained to the subject, and the baseline BP was recorded with the help of sphygmomanometer. The subject was asked to hold the dynamometer (Anand Agencies, Pune) in dominant hand at 30% of their maximum voluntary capacity. During the test procedure, the BP was recorded every 30 s with the help of sphygmomanometer on the non-exercising arm. The rise in diastolic BP at the point just before the release of hand grip is taken as the index of response to handgrip test.

Perceived stress scale (PSS) questionnaire

The PSS[11] is a 10-item self-report questionnaire that measures the persons' evaluation of the stressfulness of the situations in the past 1 month of their lives. The PSS is the only empirically established index of general stress appraisal.

Questions are based on five-point Likert scale. For each question, participant had to choose and tick appropriate option from the following alternatives: 0 - never, 1 - almost never, 2 - sometimes, 3 - fairly often, and 4 - very often. In the present study, all students had taken the questionnaire. Later, the total score was assessed as follows.

First, scores were reversed for questions 4, 5, 7, and 8. On these 4 questions, the scores can change from: 0 = 4, 1 = 3, 2 = 2, 3 = 1, and 4 = 0. Then, the scores were added up for each item to get the total score. Individual scores

on the PSS can range from 0 to 40 with higher scale score indicating a higher level of stress.

Statistical Analysis

Data were expressed as a mean ± standard deviation for parametric and as median for non-parametric parameter. All data were entered in Microsoft Office Excel 2007 and analyzed with the SPSS for Windows statistical package (Version 17.0, SPSS Institute Inc., Cary, North Carolina). Paired *t*-test was used for parametric and Wilcoxon signed-rank test for non-parametric parameter. $P < 0.05$ was considered as statistically significant.

RESULTS

Analysis with paired *t*-test shows that there was a significant decrease in HR ($P < 0.001$), systolic BP (SBP) ($P < 0.001$), and diastolic BP (DBP) ($P < 0.001$) after practice of Nadi Shuddhi Pranayama for 12 weeks [Table 1].

Analysis with paired *t*-test shows that there was a significant decrease in DBP response to IHG test ($P < 0.001$) after practice of Nadi Shuddhi Pranayama for 12 weeks [Table 2].

A Wilcoxon signed-rank test shows that there was a significant difference ($Z = -6.73$, $P < 0.001$) between PSS score for before Pranayama compared to after Pranayama [Table 3]. The median PSS score before Pranayama was 19, while after Pranayama, it was 14. Therefore, Nadi Shuddhi Pranayama can be used for reduction of stress in medical students.

DISCUSSION

We found significant reduction in HR ($P < 0.001$), SBP ($P < 0.001$), DBP ($P < 0.001$), and DBP response to IHG test ($P < 0.001$) after practice of Nadi Shuddhi Pranayama for 12 weeks. A significant decrease was also observed in PSS score after intervention ($P < 0.001$).

The finding of decrease in HR, SBP, and DBP in our study is similar to findings of other researchers who also studied the effect of Nadi Shuddhi Pranayama on cardiovascular variables in healthy young adults and suggested a shift toward parasympathetic dominance.[12,13] HR is mainly determined and decreased by parasympathetic nervous system (PNS) and decreases it. SBP is determined by HR and contractility of heart musculature. Increase in both parameters is function of sympathetic nervous system (SNS). DBP is a function of peripheral vascular resistance which is mainly determined by SNS. Hence, decrease in HR, SBP, and DBP in our study group represents an increase in parasympathetic activity and a decrease in sympathetic activity. This shift toward parasympathetic dominance is may be because of direct vagal stimulation.[14] There was a significant reduction in DBP stress response to IHG test after the practice of Nadi Shuddhi Pranayama for 12 weeks. Similar results were observed in the previous studies which found a significant decrease in DBP response to IHG test after the practice of slow breathing exercises.[15,16] Voluntary muscle activity is associated with sympathetic outflow to the cardiovascular system. The accumulation of metabolites during the isometric contraction initiates the exercise reflex, resulting in sustained sympathetic activity. In our study, reduced sympathetic reactivity in DBP can be attributed to decreased sympathetic activity because

Table 1: Comparison of pre- and post-HR, SBP, and DBP (*n*=60)

Parameter	Pre (mean±SD)	Post (mean±SD)	*t* value	*P* value
HR	76.88±7.753	72.67±5.619	15.86	0.000**
SBP	114.2±5.984	109.93±5.405	14.11	0.000**
DBP	75.60±6.797	71.43±5.729	9.70	0.000**

HR: Heart rate, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, SD: Standard deviation

Table 2: Comparison of pre- and post-DBP response to IHG test (*n*=60)

Parameter	(mean±SD)		*t* value	*P* value
	Pre-DBP - pre-DBP after IHG	Post-DBP - Post-DBP after IHG		
DBP response to IHG test (difference in mm Hg)	19.73±1.965	16.67±1.410	9.52	0.000**

DBP: Diastolic blood pressure, IHG: Isometric hand grip, SD: Standard deviation

Table 3: Comparison of pre- and post-PSS score (*n*=60)

Parameter	Median (before pranayama)	Median (after pranayama)	Z value	W value	*P* value
PSS score	19	14	−6.73	0	0.000**

PSS: Perceived stress scale

Analysis was performed by Wilcoxon signed-rank test; W value represents sum of all signed ranks; Z value represents standardized test statistics; ***P<0.001* - statistically highly significant

although vagal parasympathetic pathways are predominant for HR, sympathetic pathways play a major part in BP.[17] Slow pranayamic breathing increases baroreflex sensitivity leading to decreased chemoreflex activation and thus reduces sympathetic reactivity.[18] We observed a significant reduction in PSS scores after practice of Nadi Shuddhi Pranayama for 12 weeks. Reduction in stress may have resulted because of increased parasympathetic activity and decreased sympathetic activity. Bhimani *et al*.[19] studied the effect of pranayama on stress and cardiovascular autonomic functions and found that stress level has reduced after 2 months of practicing various pranayama. Sharma *et al*.[20] compared the effect of fast and slow pranayama on perceived stress and cardiovascular parameters and concluded that slow breathing exercises are more beneficial for rebalancing of autonomic nervous system and therefore for reduction of stress. Chronic exposure to non-specific stressors results into chronic hyperactivation of both hypothalamic-pituitary-adrenal (HPA) axis and the SNS leading to constant state of hypervigilance and dysregulation of generalized stress response system.[21] Integrated yoga practices most probably act through the cerebro-cortico-limbic pathways on the hypothalamus and anterior pituitary systems. It thus influences the HPA in such a way that the activation of this system is optimized and a balance is created between the sympathetic and parasympathetic limbs of the autonomic nervous system when the subject is faced with a stressful situation.[22] Jerath *et al*.[23] has hypothesized that voluntary slow deep breathing functionally resets the autonomic nervous system through stretch-induced inhibitory signals and hyperpolarization currents propagated through both neural and non-neural tissue which synchronizes neural elements in the heart, lungs, limbic system, and cortex. During inspiration, stretching of lung tissue produces inhibitory signals by the action of slowly adapting stretch receptors and hyperpolarization current by action of fibroblasts. Both inhibitory impulses and hyperpolarization current are known to synchronize neural elements leading to the modulation of the nervous system and decreased metabolic activity indicative of the parasympathetic state.

Our study has some limitations. It was a pre- and post-designed study without a control group. Only a single composite questionnaire-based measure of stress was done without assessing medical students' general sense of well-being and coping mechanisms. Biochemical parameters of stress such as serum cortisol or urine vanillylmandelic acid were not studied. In spite of these limitations, our study definitely instates Nadi Shuddhi Pranayama as stress reduction tool. Advantage of Nadi Shuddhi Pranayama is that it is simple, inexpensive, and rewarding exercise which can be done virtually anywhere, anyplace. A medical student can easily learn and practice it without any supervision. However, this is a preliminary study. A future study with larger sample size using biochemical markers of stress and assessing other factors such as emotional and social needs to be done before extrapolating findings of our study.

CONCLUSION

To summarize, we conclude that regular practice of Nadi Shuddhi Pranayama helps in reducing stress in medical students as evidenced by corresponding decrease in cardiovascular autonomic parameters. It does so by downregulation of HPA axis and the SNS. Ultimately, sympathetic dominance, vagal withdrawal, and baroreceptor impairments which result due to distress are corrected and homeostatic balance is reestablished. Therefore, slow breathing exercises such as Nadi Shuddhi Pranayama can be used as a stress coping tool in 1st year medical students along with other stress management techniques.

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