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Efficacy of yogic practices on various physiological parameters during examination stress in young adult females

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Abstract

Background: There is considerable evidence that medical students are suffering from levels of distress which are higher than those of general population. Scientific evidence supports the belief that yoga benefits physical and mental health via down regulation of the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system (SNS).

Aims and Objectives: To assess the efficacy of Yogic practices on various physiological parameters and Perceived stress levels during examination stress in young adult females.

Materials and Methods: Present study was carried out on 60 first year MBBS students who were assigned into two groups. Yoga group (Group-1) n=30 and Control group (Group-2) n=30. Group-1 underwent Yoga practices for 40 minutes daily for 12 weeks. Formative examinations were conducted at 6 weeks (stressor-1) and 12 weeks (stressor-2). The subjects were assessed on the following parameters at baseline, stressor-1 and stressor-2: GSR(Basal) and GSR (At the end of 5 minutes of relaxation), Heart rate, Systolic and Diastolic Blood pressure, Mean arterial pressure(MAP), Pulse pressure(PP), Rate pressure product(RPP),Double product(Do P) and Perceived stress scale(PSS).

Results: There was a significant increase in GSR (Basal and at the end of 5 minutes of relaxation) in yoga group. Significant decrease in Heart rate, Systolic and Diastolic BP, Rate pressure product, double product and PSS scores were seen in Group-1. There was not a significant change in these parameters in the control group.

Conclusion: Our study demonstrates that intervention of yoga is useful in reducing examination stress.

Keywords: Yoga, Galvanic skin resistance, Heart rate, Blood pressure indices, Stress

Introduction

Stress is a mismatch between and individual's perceived and actual capabilities and the perceived and actual demands of the environment.[3] Each individual needs a moderate amount of stress to be alert and capable of functioning effectively in any organization. It may prove to be an asset so long as it is tolerable and helps in creating healthy competition, organization excellence and individual success are achieved through well managed stress. If stress is maintained long term behavioral, physiological, emotional, cognitive effect can occur[8,10]. Stress is known to modulate the activity of autonomic nervous system to combat stressful situation and get adapted to it. Previous studies have shown that large increases in blood pressure during psychological stress are at risk for developing essential hypertension in future[20]. Studies have shown there is immune response dysfunction due to stress since it is associated with increased latent viral reactivation, upper respiratory tract infection, and wound healing time.[13,17]

There is considerable evidence that medical students are suffering from levels of distress which are higher than those of general population[2,5]. Stress in medical students is due to competitive system, peer pressure, uncertainties of academic examination, career and financial worries[1,6,11]. Scientific evidence supports the belief that yoga benefits physical and mental health via down regulation of the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system (SNS).

Materials and Methods

This study is a non-randomized control trial. Prior permission was taken from the institutional ethics committee. Lady Hardinge Medical College, New Delhi offers MBBS course only for girl candidates, hence only female subjects in the age group of 18-20 were selected. After meeting the inclusion and exclusion criteria of the study, consecutive and consenting 60 first MBBS female student volunteers were selected and enrolled into the study. Based on their preference for yoga. Students were divided into two groups as follows:

Group-1(n=30): Subjects who underwent Yogic exercises

Group-2(n=30): Control group.

Inclusion criteria:

- Healthy female subjects in the age group of 18-20 years.

Exclusion criteria:

- Subjects with history of previous or current organic disease

- Subjects who have participated in athletic events in the past one year

Group-1 did yogic exercises for 40 minutes daily, six times per week for duration of 12 weeks.

All the subjects were assessed thrice during the study as follows:

1. Initial recordings when there was no examination stressor.
2. At 6 weeks formative assessment examination was conducted and recordings were taken one day before the examination (stressor-1)
3. At 12 weeks formative assessment examination was conducted and recordings were taken just before the examination (stressor-1)

Yogic Exercises:

They were administered by qualified yoga trainer from Morarji Desai National Institute of Yoga (MDNIY). Following yogic techniques were practiced for 40 minutes a day, six days a week for 12 weeks.

- Sukshma Vyayam (minor exercise) 3 minutes
- Sthula Vyayama (macro/major exercise) 3 minutes
- Pranayam 5 minutes
- Nadishodhan
- Bhramari
- Asanas (postures): 20 minutes
- Urdhvahastottasan
- Katichakrasan
- Konasan
- Paschimottanasan
- Vajrasan
- Mandukasan
- Gaumukhasan
- Ardhamatsyendrasan
- Padmasan
- Dhanurasan
- Bhujangasan
- Shavasan: 2 minutes
- Dhyana (meditation) 7 minutes
- Om Chanting

All the subjects (n=60) were asked to present on the day of assessment between 9AM to 11AM at least 2 hours after taking light breakfast. All the subjects were assessed on the following physiological tests:

Galvanic skin resistance: A small amount of current so small that it cannot be felt is passed across an area of skin. The resistance to the flow decreases i.e. conductance increases as the person becomes more aroused and alert. This is called Galvanic skin resistance.

GSR Biofeedback equipment (GBF-2000) was used. Two metal electrodes were tied over the pulp of index finger tips after cleaning with surgical spirit. The basal skin resistance was recorded. Then, the subjects were asked to close the eyes and relax. The GSR at the end of 5 minutes was recorded again.

Cardiovascular parameters: After giving 10 minutes of supine rest to the subjects. Brachial systolic (SBP) and DBP and Heart rate were recorded on a semi-automatic non-invasive BP monitor (CitizenCH432B, Japan). Pulse pressure, Mean Arterial pressure, Rate pressure product and Double product were calculated for each recording.

- Pulse Pressure (PP=SBP-DBP)
- Mean Arterial Pressure(MAP)=(DBP+PP/3)
- Rate pressure product(RPP={HR×SBP}/100)
- Double product (DoP=HR×MAP)

Three BP and Heart rate recordings at 1 min intervals were taken and the lowest of these values was included for the present study.

Perceived Stress Scale (PSS): All the subjects were administered PSS. PSS is the most widely used psychological instrument for measuring the perception of stress. The questions in the PSS are of general nature, relatively free of content specific to any sub-population group and enquire about feelings and thoughts to measure the "degree to which situations in one's life is appraised as 'stressful" especially, over last 1 month. The items are easy to understand and response alternatives are simple to grasp. Items are designed to tap how unpredictable, uncontrollable and overloaded respondents find their lives. It comprised of 10 items, four of which are reverse-scored, measured on a 5-point scale from 0 to 4. PSS scores are obtained by reversing responses (e.g. 0=4, 1=3, 2=2, 3=1and 4=0) to the four positively stated items (items4, 5, 7 and 8) and then summing across all scale items. Total score ranges from 0 to 40.

Statistical Analysis: For each group means and standard deviation of the scores were calculated. For intragroup comparisons of parameters-paired t- test were used. P value less than 5%(0.05) was considered statistically significant. Coefficient of variation was also calculated to look for the consistency of various parameters.

Results

Table 1: shows that Baseline values of GSR (Basal) were comparable in yoga and control groups. But GSR recordings at the end of 5 minutes of relaxation were higher at the baseline in yoga group. Our study demonstrates that in Group-1 there was statistically significant increase($p<0.001$)in GSR readings in both the basal as well as at the end of 5 minutes of relaxation at 6 weeks(stressor-1) and 12 week(stressor-2). On the other hand in the control(Group-2) group there was no significant change.

Baseline values of Cardiovascular parameters were comparable in yoga and control groups. It was observed that there was a statistically significant ($p<0.001$) difference in cardiovascular parameters in yoga group at 6wk and 12 weeks.

Heart rate and BP (both systolic and diastolic) showed a continuous and significant decline at 6 weeks and 12 weeks.

Mean arterial blood pressure (MAP), Rate pressure product and Double product (Do P) showed a statistically significant decline at 6 and 12 week stressors as compared to the baseline. On the other hand in the control group the recordings of cardiovascular parameters were not significantly different at 6 and 12 weeks.

Initial values of PSS score were comparable in both the groups. It also shows that PSS score in yoga group decreased significantly ($p<0.05$) while there was no change in control group.

Coefficient of variation (%) calculated at initial, 6 and 12 wks (Table-1) showed that parameters of Basal GSR, Heart rate, RPP, DoP and PSS scores became more consistent at 12 wks as compared to Baseline.

Table 1: Comparison of different Parameters without and with examination stressors at 6 weeks and 12 weeks in Yoga and control group (Mean±SD), p Values(*, #) and Coefficient of Variation-cv(%)

Physiological Parameters	Group	No Stressor (Initial)	Cv (%) (Initial)	Examination Stressor-1 (6 wks)	Cv (%) (6 wks)	Examination Stressor-2 (12 wks)	cv(%) (12 wk)
Basal GSR	Yoga	295.85±209.40	70.8	303.00±209.01**	68.9	308.33±208.18##	67.5
	Control	283.67±189.89	66.7	280.07±187.27	66.7	281.30±188.58	66.9
GSR (end of 5 minutes of relaxation)	Yoga	463.11±252.93	54.4	480.04±275.12*	57.2	486.37±275.63##	56.5
	Control	361.56±202.24	55.9	363.60±201.68	55.3	360.00±203.49	56.3
HR (bpm)	Yoga	80.9±12.07	14.9	78.51±12.65*	16.1	76.22±10.51#	13.7
	Control	79.85±13.09	16.4	80.37±10.54	12.5	79.96±11.77	13.9
SBP (mmHg)	Yoga	118.11±4.34	3.3	113.78±5.24**	4.4	110.30±6.60##	5.4
	Control	116.96±3.67	2.5	118.19±3.91	2.5	117.22±3.32	2.5
DBP (mmHg)	Yoga	78.89±3.30	3.8	74.59±4.86**	5.4	71.33±4.99##	5.6
	Control	77.92±4.16	5.1	78.66±3.30	3.8	78.37±3.30	3.8
PP (mmHg)	Yoga	39.22±4.92	12.5	39.19±7.07	18	38.96±7.20	18.4
	Control	38.07±5.85	15.3	39.51±4.73	11.9	38.85±4.12##	10.6
MAP (mmHg)	Yoga	91.96±2.85	3.0	87.65±3.72**	4.2	84.32±4.43	5.2
	Control	91.58±2.90	3.1	91.84±2.72	2.9	91.32±2.68	2.9
RPP (bpm-mmHg)	Yoga	95.31±13.82	14.5	89.42±13.72**	15.3	83.96±11.16##	13.2
	Control	93.40±14.63	15.6	95.01±12.40	13	93.65±12.68	13.5
DoP (bpm-mmHg)	Yoga	7428.50±1140	15.3	6886.37±1211.50**	17.5	6426.10±887.25##	13.8
	Control	7316±1181.70	16.1	7383±1050.74	14.2	7302±1130.68	15.4
PSS score	Yoga	19.10±4.21	22.0	18.50±4.56*	24.6	15.43±3.24#	20
	Control	19.50±4.52	23.1	19.80±4.32	21.8	20.60±5.24	25.4

*6wks compared with basal value *<0.05, **<0.001, ***<0.0001, #12 wks compared with baseline value #<0.05, ##<0.001, ###<0.0001

Discussion

In our study at the Baseline, GSR (basal) readings were comparable in both the groups but the readings of GSR relaxation response at the end of 5 minutes were higher in subjects who opted for yoga, than in control group. This means that the subjects who preferred doing yoga were already more relaxed in the beginning of study as compared to control group and probably had an inclination towards yoga. We also noted significantly higher GSR (at the end of 5 minutes) as compared to Basal readings in both the groups. This finding tells that relaxation with closed eyes even for 5 minutes caused an increase in GSR. In our study there

was a significant increase in the GSR (Basal) and GSR (at the end of 5 minutes) in the yoga group as compared to the control group. There was a statistically significant increase in GSR (basal) and GSR (at the end of 5 minutes) in yoga group at 6 weeks and at 12 weeks ($p<0.001$)as compared to the baseline. This increase in GSR is because regular yogic practices lead to better autonomic tone and HPA axis regulation. Yogasanas are low intensity exercises which affect HPA axis positively bringing down sympathetic stimulation and significantly decreasing the release of Catecholamines[35]. Also, yoga corrects under activity of the PNS and GABA systems in part through stimulation of the Vagus nerves, the main peripheral pathway of the PNS. Yogic exercises are known to improve the autonomic tone as shown in studies done by[28,29]. Our findings are in consensus with their study.

Heart rate, Systolic and Diastolic Blood pressure, Pulse pressure, Mean arterial pressure, RPP ,Do P were also comparable initially in both the groups.

Our study showed a Statistically significant ($p<0.001$) decrease in Heart rate, Systolic and Diastolic Blood pressure, Rate pressure product and Double product in yoga group. While there were not a statistically significant decrease in these parameters in control group. Rate pressure product and Double product are a measure of sympathetic activity and are indirect measures of oxygen consumption of heart or work load of heart.[21,22,24] Therefore, there is a decrease in resting sympathetic activity in yoga group. Diastolic blood pressure is a measure of total peripheral resistance (TPR). Increase in parasympathetic activity decreases resting HR and decrease in sympathetic tone vessels decreases PVR resulting in decrease in DBP, MAP, reduced work load on heart.

We noted a significant decrease in PSS score in Physical exercise group while there was no change in PSS scores of Control group. Improvement of physiological parameters due to better autonomic tone and HPA axis due to yogic exercises is most likely reason of this improvement.[29]

Several workers have proposed that the decrease in heart rate and blood pressure with Yoga is most likely due to inhibition of posterior or sympathetic area of hypothalamus leaving the parasympathetic area alone, thus decreasing the sympathetic activity without affecting parasympathetic activity.[30,31,32]

Calculation of Coefficient of variation showed an increase in consistency of Basal GSR, Heart rate, RPP, DoP and PSS scores. While other parameters showed variability. This could mean that period of 12 was not sufficient to bring about a consistency in these parameters although they showed statistically significant change with the intervention of yoga for a period of 12 weeks. There could be an increase in consistency of parameters if yoga is practiced for a longer duration than 12 weeks.

Regular yoga exercise had favorable effect on psychological well being and decreased the perceived stress of subjects. This is in consensus with the studies done by Malathi et al.[19]

Conclusion

Our study demonstrates that there was an increase in autonomic tone and cardiovascular functioning of yoga group. This is probably due to the regular physical activity. We also noted a decrease in PSS in Group -1. Therefore our study shows that Regular yoga practices improved the psychological well-being of subjects. During stress, yoga most probably acts through the Cortico-limbic pathways on the hypothalamus and the anterior pituitary systems and a balance is created between sympathetic and parasympathetic divisions of ANS.

Limitation of study

It is a non-randomized trial and results should be interpreted with potential rater bias. Other forms of Yoga could not be included.

Conflict of interest: Nil

Source of funding: Nil

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