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A comparative study on effects of yoga and physical workout on psycho-physiological variables during examination stress in senior secondary school students

Dr. Rajinder Singh**Abstract**

Present study was conducted to assess and evaluate the differential effects of yoga and physical workout on psycho-physiological variables among students of senior secondary school appearing for board exams. For the purpose of the study total 60 number of students were selected and they were divided in two equal groups i.e. Group I (30 students) and Group II (30 students). Group 1 subjects were made to perform yoga practices and Group 2 subjects were made to perform physical workout of forty minute daily for twelve weeks. Physiological variables like heart rate, respiratory rate, and blood pressure were measured. Maudsley Personality Inventory (MPI) was used to evaluate the neuroticism and extroversion traits of the school students. Inventories developed by Defense Institute for Physiology & Applied Sciences (DIPAS) have been used to assess traits of anger and kind of persona. In the study, it was observed that there was no significant rise in pulse rate of Group 1 students, and increase in pulse rate in Group 2 at stressor 1 but become non-significant at stressor 2 in comparison to their baseline level. No change in neuroticism scores was observed in Group 1 students but there was a significant increase in Group 2. Increase in extraversion scores was found in Group 1 students both at stressor 1 and stressor 2 whereas, significant increase in extraversion scores in Group 2 students was seen only at stressor 2. Significant decrease in anger score was observed in Group 1 students as compared to Group 2 students. Significant change was noted in personality trait from Type-A towards Type-B in both groups at stressor 1 and stressor 2. Both types of intervention i.e. yoga and physical workout were found beneficial for the subjects to minimize the effect of examination stress on psycho-physiological variables however effects of yoga practice were seen quickly and were more pronounced.

Keywords: Stress, examination stress, yoga, physical workout**Introduction**

Stress may be taken into consideration as a state of mental or emotional pressure or anxiety as a result of detrimental or annoying circumstances. Lazarus and Folkman (1984) ^[11] proposed that stress occurs when people perceived that the demands from external situations were beyond their coping capacity. According to American Institute of Stress, Stress is a condition or feeling experienced when a person perceives that demands exceed the personal and social resources the individual is able to mobilize. Due to pandemic COVID-19 students are going to appear in board exams offline after a gap of two years. And, the stressful condition of students taking examination can be considered as a good model of naturalistic stress in human beings as compared with laboratory-induced stress situations. And, Studies also indicate that stress is more during examinations (Mahajan, 2010) ^[13]. Several stress managements programs, e.g., meditation, yoga, hypnosis, imagery, muscle relaxation, have been introduced in the past and such stress management programmes for students have shown to decrease depression, anxiety and help them to use positive coping skills (Shapiro, 2000) ^[20]. Physical exercises are considered as an acceptable method for improving and maintaining physical and emotional health. Yoga is an ancient science established in India, which gives the practitioner not only a healthy body but also a sound mind A developing body of prove underpins the conviction that yoga benefits physical and mental wellbeing through down-regulation of the hypothalamic–pituitary–adrenal (HPA) axis and the sympathetic nervous system (SNS) (Ross & Thomas, 2010) ^[18]. Malathi & Damodaran (1999) ^[14] have reported in their study, significant reduction in examination stress with better academic performance and sense of wellbeing in students who practiced yoga.

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The studies comparing the effects of yoga and exercise seem to indicate that, in both healthy and diseased populations; yoga may be as effective as or better than exercise at improving a variety of health-related outcome measures (Ross and Thomas, 2010) [18]. Hence the study is proposed to compare the effects of yoga and physical exercise on psycho-physiological variables in senior secondary school students.

Materials and Methods

Study Design

60 healthy students in the age group of 15-18 years who were appearing in Class XII board exams were selected randomly and enrolled into the study. Students were divided into two groups on the basis of their preference for yogic training or physical workout. Group 1 (n=30): students who underwent yoga training. Group 2 (n=30): students who practiced physical exercises in the ground.

Intervention for both the groups (i.e. yogic exercises for Group 1 students and physical workout/exercises for Group 2 students) was given for 40 minutes daily, six times per week for the duration of 12 weeks. All students were assessed thrice during the study as follows:

1. Baseline recordings when no examination stress was given (No stress)
2. 6 weeks later assessment was conducted and data was recorded before exams (Stressor 1)
3. 12 weeks later, another assessment was conducted and data was recorded just before exams (Stressor 2)

Yoga training: To ensure regularity and uniformity, yoga training was given by qualified yoga trainer. Group 1 students were familiarized with different theoretical aspects of yogic practices and technique of meditation by the yoga trainer. Common Yoga Protocol designed by AYUSH, was daily practiced by Group 1 students

Physical workout: Group 2 students were administered physical workout as follows:

Session was started with stretching exercises for 5 minutes, followed by warm-up including freehand exercises for 10 minutes and after that students were asked to do running and maintain target heart rate between 55-75 % of maximum heart rate (HR_{max}) calculated by formula $HR_{max} = 220 - \text{age (years)}$ for 20 minutes. Afterwards, students again did 5 minutes of stretching exercises to cool down.

All the students (n=60) were asked to be present on the day of assessment between 8 am to 10 am at least 2 hours after taking light breakfast. Consent was taken from them. All the students were then assessed on following tests:

Physiological Variables

1. Basal pulse rate and blood pressure
2. Respiratory rate (BPM)

Psychological tests

a. **Maudsley Personality Inventory (MPI)** developed by Eysenck (1950) [6] is a commonly used questionnaire to assess the personality traits of a person. It consists of 48 questions and it assesses personality on two biologically-based independent dimensions of temperament measured on a continuum as follows:

- **Neuroticism / Stability:** Neuroticism or emotionality is characterized by high levels of negative affect as compared to normal healthy students. According to

Eysenck's theory, neuroticism is based on activation thresholds in the sympathetic nervous system or visceral brain. This is the part of the brain that is responsible for the fight-or-flight response in the face of danger. Neurotic people have lower activation thresholds, therefore find it difficult to control their emotional reactions, experience negative affect (fight or flight) and become nervous or get upset in the event of even minor stressors. If individual is emotionally stable, he can handle pressure better and remains calm even under stressful conditions.

- **Extraversion** is characterized by being outgoing, talkative, high on positive affect (feeling good), and in need of external stimulation as opposed to introversion with opposite characteristics. According to Eysenck's arousal theory, optimum performance of individual is based on adequate cortical arousal. Introverts have higher arousal and therefore are seeking peace and aloofness as compared to extroverts who are under-aroused and need external stimulation for enhancing performance. Within limits (scores from 30 to 70), increase in extraversion scores can be depicted as positive, emotionally stable and cheerful state. Above or below these scores indicates considerable deviation from the average healthy mental condition.

b. **Inventories developed by Defense Institute for Physiology & Applied Sciences (DIPAS)** were used to measure traits of anger and type of personality. These inventories are chosen because they are valid for Indian population, reliable and specific to measure the tested psychological domains. Every item amongst all the questionnaires measures the tested domain on the weighted scores of responses from 0 to 3 ranging from 'never' to 'almost always' response respectively. Questionnaires were scored by adding the weighted (0 to 3) scores of each item. Following Psychological inventories were used:

- **Personality Type A / B:** It consists of 17 questions and aims to assess the attitudes and interests of individual. Optimal score is less than 20. Higher score represents individual having more type-A personality characteristics as compared to type-B personality characteristics. This scale was chosen because students have to appear in Board exams and in offline line mode first time after COVID-19 pandemic and students with type A personality characteristics are exposed more to stress and have higher chance of suffering from a physical or mental disorder on account of the pressure of stressful events. Type A personality is characterized by more aggressiveness, impatience and intolerance towards others, high ambitiousness, strong need to always have situations totally under control, strong drive to acquire things, objects and assets and to be a consumer, addictive behavior with very limited physical activity, few interests apart from work and irregular and excessive eating habits. On the other hand, type-B category reveals a greater capacity to cope with potentially stressful situations, consequently reducing their risk of becoming ill. The difference between the two types does not depend on the fact they present two different and well-defined personality structures but rather on the way in which they organize their responses to stressful situations.

- **Anger self-report scale:** Anger, hostility and aggression are central concepts of many theories of personality. Perceived stress levels have been reported to be higher in students appearing in board exams. This scale consists of 16 items and was included because it was hypothesized that chronic high levels of stress may lead to increased levels of anger related behavior. Maladaptive

effects of anger and hostility can make individual prone to hypertension, depression, anxiety and other psychiatric disorders. This scale rates individual on the level of angry feelings and expression of anger reactions (general, physical and verbal), guilt and hostility self-directed (intro punitiveness) or towards other people or objects (extra punitiveness). Optimal score is < 6

Results

Table 1: shows the means and standard deviation of comparison baseline levels of tested physiological and psychological variables between students of both the groups

Variables	Mean	Standard Deviation
Neuroticism	53.83	5.48
Extraversion	33.36	6.74
Personality	25.73	3.51
Anger	22.06	4.55
Anxiety	48.48	5.64
Pulse Rate	77.00	3.72
Respiratory Rate	17.30	3.14
Systolic Blood pressure	104.73	5.26
Diastolic Blood Pressure	68.57	4.61
Mean Arterial Pressure	80.62	3.65
Rate Pressure Product	80.69	6.25

Graphical shows of means and standard deviation of comparison baseline levels of tested physiological and psychological variables between students of both the groups

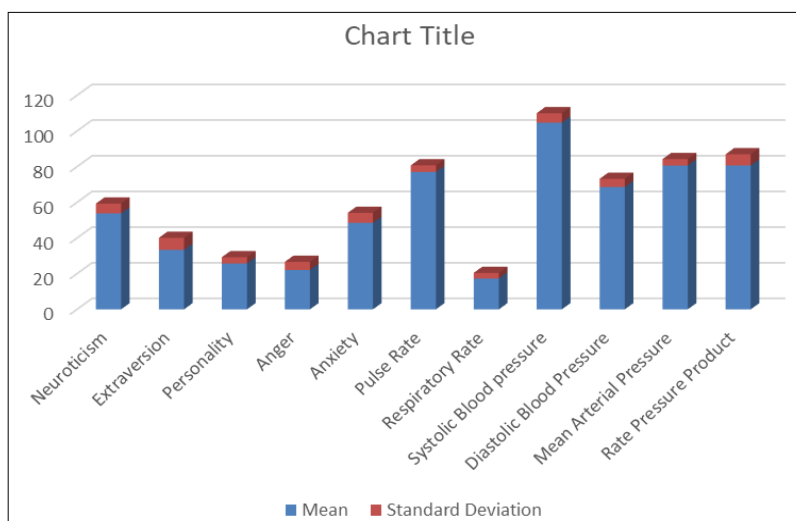


Fig 1: Shows the means and standard deviation of comparison baseline levels of tested physiological and psychological variables between students of both the groups

Table 2 shows the comparison of baseline levels of tested physiological and psychological variables between students of both the groups. There is no significant difference between

the groups except for extraversion score ($p < 0.05$). Hence, groups were considered comparable for the study.

Table 2: Comparison of basal variables

Variables	Group 1	Group 2	P value
Neuroticism	53.83±5.48	52.53±5.31	0.3546
Extraversion	33.36±6.74	39.76±8.22*	0.0017
Personality	25.73±3.51	26.66±2.96	0.2718
Anger	22.06±4.55	21.00±6.46	0.4654
Anxiety	48.48±5.64	51.20±7.45	0.1163
Pulse Rate	77.00±3.72	76.60±3.79	0.6815
Respiratory Rate	17.30±3.14	17.20±2.72	0.8956
Systolic Blood pressure	104.73±5.26	103.93±5.25	0.5577
Diastolic Blood Pressure	68.57±4.61	67.53±3.88	0.3484
Mean Arterial Pressure	80.62±3.65	79.67±2.89	0.2683
Rate Pressure Product	80.69±6.25	79.69±6.68	0.5517

$p < 0.05$: significant

Table 3: Shows the mean and Standard deviations of changes occurring in all the tested physiological and psychological variables in both the groups from baseline level to stressor 1 and stressor 2

Variables	Mean	Standard Deviations
Neuroticism	53.83	5.48
	52.53	5.31
Extraversion	33.36	6.74
	39.76	8.22
Personality	25.73	3.51
	26.66	2.96
Anger	22.06	4.5
	21.00	6.46
Pulse Rate	76.53	4.83
	76.33	3.5
Respiratory Rate	17.30	3.14
	17.20	2.72
Systolic Blood pressure	114.73	5.26
	113.93	5.25
Diastolic Blood Pressure	68.57	4.61
	67.53	3.88
Mean Arterial Pressure	83.96	3.65
	83.00	2.89
Rate Pressure product	87.89	7.70
	87.07	7.52

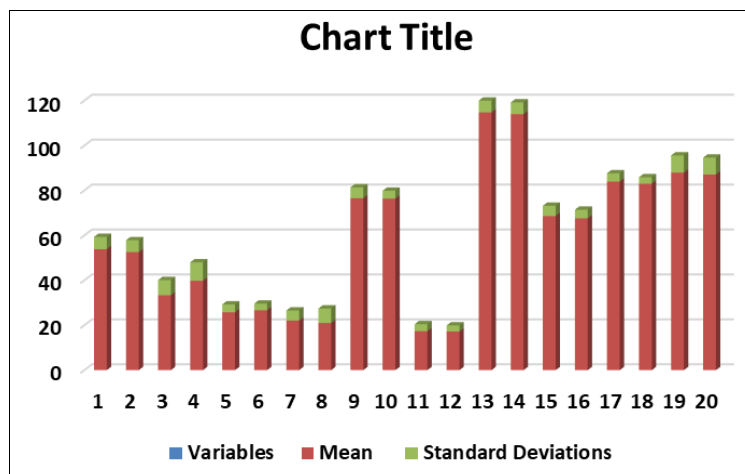


Fig 2: Graphical shows of means and standard deviation of changes occurring in all the tested physiological and psychological variables in both the groups from baseline level to stressor 1 and stressor 2

Table 4, Shows the changes occurring in all the tested physiological and psychological variables in both the groups from baseline level to stressor 1 and stressor 2 and also

compares the differences obtained between group 1 students (i.e., yoga group) and group 2 students (i.e. physical workout group) at stressor 1 and stressor 2.

Table 4: Comparison of basal variables with examination stress in yoga and physical workout group

Variables	group	Baseline	Examination stressor 1	Examination stressor 2
Neuroticism	Group 1	53.83±5.48	54.73±5.97	54.40±6.13
	Group 2	52.53±5.31	54.60±3.78*	55.13±3.83**
Extraversion	Group 1	33.36±6.74	37.60±5.81***	40.03±5.75***##
	Group 2	39.76±8.22	42.50±7.45	43.16±6.02*
Personality	Group 1	25.73±3.51	24.40±4.16*	23.66±4.16***
	Group 2	26.66±2.96	25.06±3.45*	24.23±3.34***
Anger	Group 1	22.06±4.5	18.10±6.46***	16.41±9.37***
	Group 2	21.00±6.46	17.00±6.68***	17.43±6.90**
Pulse Rate	Group 1	76.53±4.83	76.57±4.03	73.67±4.25
	Group 2	76.33±3.5	78.50±3.9*	76.80±3.04
Respiratory Rate	Group 1	17.30±3.14	16.93±2.79	16.07±3.68
	Group 2	17.20±2.72	17.07±3.04	16.83±2.53
Systolic Blood pressure	Group 1	114.73±5.26	113.73±5.26	112.23±4.79
	Group 2	113.93±5.25	113.07±5.09	112.10±5.30
Diastolic Blood Pressure	Group 1	68.57±4.61	68.03±4.85	66.73±3.87
	Group 2	67.53±3.88	66.87±3.81	66.90±3.59
Mean Arterial Pressure	Group 1	83.96±3.65	83.27±3.77	81.90±3.29
	Group 2	83.00±2.89	82.27±3.13	81.97±2.78

Rate Pressure product	Group 1	87.89±7.70	87.13±6.71	82.74±6.66
	Group 2	87.07±7.52	87.27±6.29	86.14±6.10

Compared with basal value <0.05 , ** <0.01 , *** <0.001 , #Compared with 6 weeks value# <0.05 ,## <0.01 ,### <0.001

Discussion

Table 1 represents that baseline of two groups were well matched for all the tested physiological and psychological variables except for the higher baseline extraversion scores in Group 1 students as compared to Group 2 students ($p < 0.01$). Therefore, both groups were considered comparable for the study. In the present study, no significant rise in pulse rate was observed in Group 1 students, both at stressor 1 (examination stress at 6 weeks) and at stressor 2 (examination stress at 12 weeks) as compared to baseline (no stressor) whereas, significant increase in pulse rate ($p < 0.05$) was observed in Group 2 students at stressor 1 ($p < 0.05$) which again became non-significant at stressor 2 compared to their baseline level. Stress induces imbalance of the autonomic nervous system (ANS) with decreased parasympathetic nervous system (PNS) and increased sympathetic nervous system (SNS) activity (Streeter *et al.*, 2012) [22]. This demonstrates that both interventions i.e. yoga training and physical exercises for 12 weeks can lead to reduction of stress levels and thereby, preventing the autonomic dysregulation by stressor but the effect of yoga practice on autonomic tone stabilization starts much before physical exercises. Also, there was no significant change was observed in both the groups on other tested physiological variables at both stressors as compared to their baseline. Results of Group 1 students are similar to findings observed by previous study by Gopal *et al.*, (2011) [8] who studied the effect of examination stress on young female students after 12 weeks of yoga practice and compared it with control students. No significant rise in the heart rate was observed in students practicing yoga for 12 weeks as compared to group 2 students who showed significant rise in heart rate during examination stress. Result of Group 2 students are in line with previous studies which documented that long term moderate intensity aerobic exercise training causes increased parasympathetic activity and therefore improves the autonomic tone of the students (Raczak. *et al.*, 2006) [17]. Therefore, present study demonstrates that yoga training was more effective than physical workout in stabilizing autonomic tone of the students exposed to examination stress.

In the present study, no change was found in neuroticism scores in Group 1 students both at stressor 1 (at 6 weeks) and stressor 2 (12 weeks), whereas, significant increase was observed in neuroticism scores in Group 2 students at stressor 1 ($p < 0.05$) and 2 ($p < 0.01$) as compared to their baseline values. Further, highly significant increase in extraversion scores was recorded in Group 1 students both at stressor 1 ($p < 0.001$) and stressor 2 ($p < 0.001$) with continued improvement in scores from 6 to 12 weeks of intervention ($p < 0.001$) whereas, significant increase in extraversion scores in Group 2 students was observed only at stressor 2 ($p < 0.05$). So, it can be predicted that effect of yoga training starts earlier and has more impact as compared to physical exercise. Our results are similar to findings obtained by Udupa & Singh (1972) [23] found 12 weeks of hatha-yoga training results in decreased neuroticism and decreased mental fatigability. Other studies also found yoga suitable in the treatment of neurosis and neurotic behavior arising out of stressful life events (Nespor, 1994) [15].

Significant decrease was found in anger score in both Group 1 ($p < 0.001$) and Group 2 students ($p < 0.001$) at stressor 1.

However, there was more significant decrease in anger score in Group 1 students ($p < 0.001$) as compared to Group 2 students ($p < 0.01$). Results of the present study are consistent with other studies which found that there is significant and comparable improvement in mood including reduction in anger scores, tension and fatigue level of students doing either yoga training or physical exercises (Hassmen, P., Koivula, N., & Uutela, A., 2000) [9], (Dua, J. K., & Swinden, M. L., 1992) [5]. Results of the present study shows that students practicing either regular yoga training or physical exercises for 12 weeks is better able to control his negative emotions like anger and hostility towards stressor as compared to sedentary individual. Significant change was observed in personality trait from Type A towards Type B in both group students ($p < 0.05$) at stressor 1 and stressor 2 ($p < 0.001$). This observation is in concordance with previous studies stating that yoga tends to make individuals more relaxed and calm and has preventive role in 'burnout syndrome', a trait characteristic of type A personality individual (Nespor, 1994) [15]. Similar changes of conversion of type A personality to type B by yoga practice have been also been previously observed in school children (Sharma, *et al.*, 1992) [21].

Integrated yoga practice includes aspects of exercise (asanas), breath manipulation (pranayama) and relaxation (meditation), effects of yoga are multi-dimensional and have immediate down-regulating effect on both SNS / HPA axis response to stress (Ross and Thomas, 2010) [18]. Yogasanas are low intensity usually non-strenuous exercises which affect HPA axis positively bringing down sympathetic stimulation and significantly decreasing the release of catecholamines. Also, yoga-based practices have been found to correct under activity of the parasympathetic nervous system (PNS) and GABA systems in part through stimulation of the vagus nerves, the main peripheral pathway of the PNS Streeter (2012) [22]. Regular practice of meditation has also been documented to reduce sympathetic activity, balance neuro-endocrine axis and decrease stress and anxiety levels (Lee,*et al.*, 2007) [12], (Vempati & Telles, 2002) [24].

Therefore, present study concludes that both yoga training and physical workouts are beneficial for the students, however, the effects of yoga training started earlier and have comparatively more impact on measured psycho-physiological variables as compared to physical exercise. In a previous study, Ross, *et al.*, (2010) [18] also concluded yoga may be as effective as or better than exercise at improving a variety of health-related outcome measures. Differences that have been found between yoga and exercise training may be a result of how the two interventions differ in their effects upon the autonomic tone and HPA axis. Different levels of intensity of exercise have been shown to affect the HPA axis response to acute stress differently (Ross & Thomas, 2010) [18]. Low-intensity exercise repeatedly has been shown to decrease HPA axis lower cortisol levels (Few, 1974) [7], (Davies & Few, 1973) [4] and while higher intensity exercise leads to proportional increases in cortisol (Howlett, 1987) [10]. Exercise stimulates SNS, raising plasma catecholamines (Peronnet, *et al.* 1981) [16], (Bloom, *et al.*, 1976) [2] whereas, yoga has been shown to lower SNS and therefore, reduces catecholamine level (Selvamurthy, *et al.*, 1978) [19]. When a sedentary subject starts practicing moderate intensity physical exercise, it causes stimulation of sympathetic nervous system (SNS),

raising plasma epinephrine and norepinephrine. If physical exercise is continued for longer time, it leads to better autonomic tone and HPA axis regulation.

Conclusion

Present study concludes that both forms of intervention i.e. yoga training and physical exercises are beneficial for the students in reducing the effect of examination stress on tested psycho-physiological variables but effect of yoga practice starts immediately and is more evident on most of the tested variables. Yoga is a form of low intensity exercise affecting HPA axis positively and reducing the autonomic dysregulation caused by examination stress whereas, moderate intensity physical exercises initially stimulates HPA axis and SNS but ultimately also improves autonomic tone with longer duration of practice.

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