Original Article

Physiology

Eustress in Education: Analysis of the Perceived Stress Score (PSS) and Blood Pressure (BP) during Examinations in Medical Students

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ABSTRACT

Background: Stress is widely perceived as a detrimental phenomenon which causes bad effects on individuals. Students are subjected to periodical examinations which often lead to stress responses. Overwhelming evidence in the literature suggests that examination stress is bad. However, Hans Selye had suggested that there were two types of stress responses, namely, distress and eustress.

Setting and Study Design: In this study, we analyzed the results of the Perceived Stress Score (PSS) and the blood pressure variations among first year medical students.

Materials and Methods: One hundred (50 males and 50 females) first year medical students, one month before and immediately after the examinations, were given the PSS sheets. Their blood pressure was also recorded on both the occasions.

Results: We are reporting here, the increased PSS score in all the students during the post-examination period ($p<0.01$). The number of students in the low stress group was the highest (77) before the examination and in the moderately stressed group, it was 20. But in the post examination period, the low stress group had only 24 students, while the moderately stressed group showed an increase in the number of students to 65. There was an increase in the BP also.

Conclusions: From the results, it is evident that there was some stress during the examinations, which was in agreement with the previous reports. But we, from the results of this study, suggest that the examinations which causes mild to moderate stress that will condition the students and the efficacy of the General Adaptation Syndrome will be improved in such subjects. Therefore, we suggest that the examination stress (within limits) may be considered as eustress.

Key Words: Examination Stress, Adaptation

KEY MESSAGE

- The examinations in medical education need not be considered as detrimental stress.
- Moderate stress in young adults could be beneficial for long term success.
- Therefore, the examination stress may be categorized as 'eustress'.

INTRODUCTION

Stress appears to be essential for life. From the time of explanation of stress and the General Adaptation Syndrome (GAS) by Hans Hugo Bruno Selye, numerous research articles have been flowing in on this subject [1, 2]. Selye presented the concept of two types of stress viz. distress and eustress, the former being caused due to negative inputs and the latter, due to positive inputs. Is the exposure to stress always harmful?

There are a number of articles which suggest that the stress in education could cause bad effects on individuals [3,4] and that it could lead to mental breakdown and even push the students towards a suicidal tendency in extreme cases. Some researchers claimed that yoga practice, including 'SudarshanaKriya', could prove to be beneficial in relieving stress. [5,6] But the posttraumatic growth is a positive outcome of stress, which leads to beneficial effects.

There is enough evidence to suggest that stress appears to be responsible for the closely related and the wide range of physiological and psychological dysfunctions such as cardiovascular disease [7], infertility [8], anxiety related disorders [9], anorexia [10] and neurodegenerative disease. Though it is believed that stress is essential for life and growth, continued stress could cause deleterious effects. Stress which is produced as a result of parental expectations, peer pressure and examinations is viewed as intimidating. Nevertheless, the students learn to cope with it. Their academic behaviour points to the individuals' disposition to academic activities, including lecture attendance, participation in tutorials, submission of assignments, use of the library, study habits, note taking and preparation for the examinations [11]. Incidences of suicide attempts among young students from the high school and college levels have been reported and this has been on the rise over the years [12]. Reports suggest that tests or examinations are one of the main causes of academic stress and that most of the

university students seem to be vulnerable to examination [13, 14]. It is a well-documented fact that stress like fear, worry or anxiety will increase the blood pressure to a certain extent, depending on the severity of the triggering factors [15,16].

We undertook this study to assess the effects of academic stress by using the Perceived Stress Score (PSS scale) [17] and also its effect on the blood pressure before and immediately after examinations in medical students. The results have been discussed with a view, particularly in young adults, that the exposure to stress could make them physically and psychologically strong to prepare them to face the arduous responsibilities (of life) ahead.

MATERIALS AND METHODS

Subjects: Healthy volunteers from among the first year medical students participated in the study. A total of 100 students (50 males and 50 females) were chosen for the study. The time of the study was between 10 am and 12 Noon. The students who were selected for this study were from a well-known private university in south India which had an annual admission of 250 students. Out of them, 50 boys and 50 girls (randomly) were requested to participate in this study. The students of this university were provided with state of the art technology for teaching-learning and a good academic atmosphere. These students were provided with a teacher guardian and a psychology counselor's assistance as and when required. The students were asked to come in a relaxed and quiet mood. The data was taken both in the pre-examination (one month before the examination) and later in the post-examination period (same day after the examination). Informed consent was taken from the subjects. A clearance was obtained from the institutional ethics committee before the start of this study.

Inclusion Criteria

1. Healthy students
2. Age group between 17 and 19 years
3. First year MBBS

Exclusion Criteria

1. History of illness in the recent past
2. Any recent family distress

Grouping: The students were divided into 3 groups on the basis of their stress levels, viz. the low stress, moderate stress and the high stress groups as per the grades after tabulating their responses.

PARAMETERS WHICH WERE STUDIED

Perceived stress scale questionnaire: The Perceived Stress Scale is a 10-item self-report questionnaire that measures the persons' evaluation of the stressfulness of the situations in the past one month of their lives. The Perceived Stress Scale is the only empirically established index of general stress appraisal.

In the present study, the students were explained about the PSS scale questionnaire in detail and were told to tick the appropriate numbers. Later, the total score was assessed.

For each question, they had to choose from the following alternatives:

0 - never , 1 - almost never , 2 - sometimes , 3 - fairly often and 4 - very often

Assessing the PSS score: The PSS score was determined by the following method:

First, by reversing the scores for questions 4, 5, 7 and 8. On these 4 questions, the scores could change from: 0 = 4, 1 = 3, 2 = 2, 3 = 1, 4 = 0.

Then, the scores were added up for each item to get the total. The total score was represented as the stress score:

The individual scores on the PSS could range from 0 to 40, which were grouped into 3 groups.

- Low stress: Scores ranging from 0-13.
- Moderate stress: Scores ranging from 14-26.
- High perceived stress: Scores ranging from 27-40.

MEASUREMENT OF BLOOD PRESSURE

The subjects were made to relax for 10 minutes before the measurement. The blood pressure was measured by using a standard sphygmomanometer. Both the systolic and diastolic BP were measured with the students in the supine position and they were recorded one month before and immediately after the examinations. The blood pressure was compared before and after the examinations in all the 3 groups.

Statistics: The statistical analysis was done by using the Student's unpaired 't' test.

RESULTS

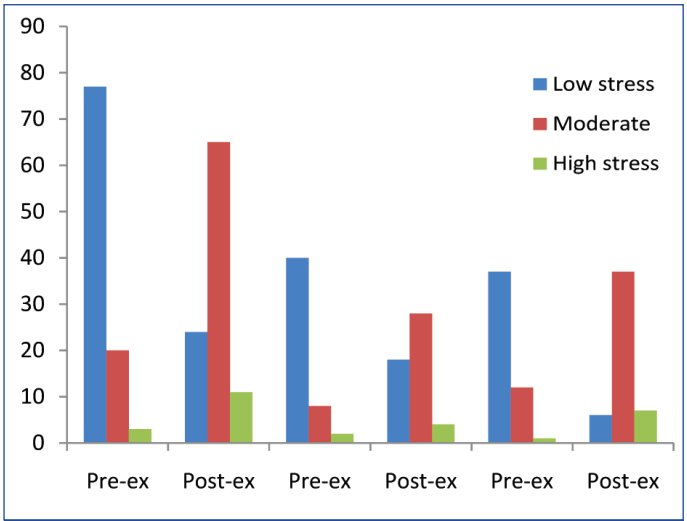
The PSS score of the 3 groups, the low stress, moderate stress and the high stress groups were subjected to statistical analysis and the scores before the examinations were compared with those after the examinations.

The PSS was compared among the groups before and after the examination [Table/Fig-1]. In the low stress group, the score was found to increase after the examination from 8.94 ± 1.77to 9.75 ± 1.31. This was statistically significant ($p<0.05$). However, the numerical statistics suggested that this increase was very less. The

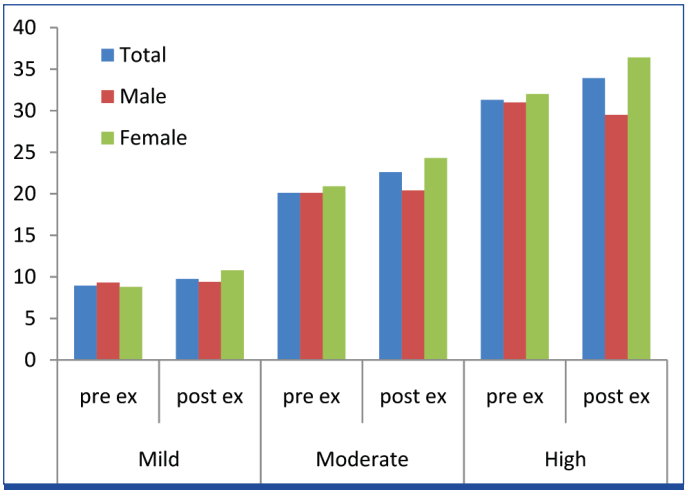
Grade- stress PSS score	Pre-ex total 100	Post-ex Total 100	Pre-Ex Male 50	Post-Ex Male 50	Pre-Ex Female 50	Post-ex Female 50
Low stress PSS=0-13	(n-77) 8.94±1.77	(24)** 9.75±1.31	(40) 9.3±2.43	(18)** 9.39±1.58	(37) 8.79±1.74	(06)** 10.83±1.21
Moderate Stress PSS=14-26	(n-20) 20.05±2.03	(65)** 22.62±2.85	(08) 20.12±2.53	(28)** 20.39±3.01	(12) 20.92±1.86	(37)** 24.30±2.59**
High Stress PSS=27-40	(n-03) 31.33±1.16	(11)** 33.91±3.78	(02) 31±1.41	(04) 29.5±3.83	(01) 32	(07) 36.43±1.27**

[Table/Fig-1]: Comparison of the PSS scores in the Low Stress, Moderate stress and the High Stress groups one month before and immediately after the examination.

** Highly significant changes in the Pre-examination Vs the Post-examination period ($p<0.001$). Pre-ex = Pre-examination; Post-ex = Post-examination.



[Table/Fig-2]: Number of students in each of the three groups during the pre-examination and the post-examination period.
Significant increase in number in the "Moderately stressed" group ($p<0.01$).
Pre-ex = Pre-examination; Post-ex = Post-examination



[Table/Fig-3]: PSS scores in the Pre and Post-examination period.
Females showed increased mean PSS levels when compared to their Pre-examination period PSS.
Pre-ex = Pre-examination; Post-ex = Post-examination

number of students in low stress group fell drastically in the post-examination period. There were 77 students who were grouped in the low stress group in the pre-examination period, which fell to 24 in the post-examination period. There was an increase in the number of students in the moderate stress group from 20 to 65. In the moderately stressed group, among the males, the number of boys increased from 08 to 28 (pre to post-examination), and the number of females showed an increase from 12 to 37 [Table/Fig-2]. In the high stress group, during the pre-examination period, there were only 3 students. The number increased to 11 in the post-examination period.There were only two boys in the high stress group (PSS 31±1.41), which increased to four boys (PSS 29.5±3.83), but due to the low number and the high SD, the value was not significant even though there was a marginal decline in the PSS score [Table/Fig-1].There was a shift in the student groups from low stress to moderate and high stress as per the increase in the PSS data.

The statistical analysis of the data revealed that the blood pressure (systolic and diastolic) was higher in all the students in the post-examination period [Table/Fig-2]. The students whose PSS scores increased to the "moderately stressed" level and those who were in the high stress group showed significantly increased systolic and diastolic BP.

The number of students in the low stress group was highest in the pre-examination period, but in the post examination period, this changed. The moderate stress group enlarged in size, showing larger number of students.

DISCUSSION

The Perceived Stress Score can be used as an easy tool for the evaluation of the level of stress by providing the subject with a simple set of questions. We, in this study, attempted to evaluate the stress which was induced by the examination system in India, because academic behaviour is something which is of great concern to parents, teachers and the students themselves. Stress in adolescence and its long term effects of positive and negative academic behaviour have been known [13]. The increased anxiety which is caused due to tests has debilitating effects on the students' performance [18].

Blood Pressure	Pre-ex total 100	Post-ex Total 100	Pre Ex Male 50	Post Ex Male 50	Pre Ex Female 50	Post Ex Female 50
Low stress(SBP) PSS=0-13	n-77 112.44±2.86	24 114.5±1.97*	40 113.07±2.08	18 115.5±1.46	37 111.08±3.003	06 114.67±3.27*
DBP	n-77 76.21±2.48	24 78.64±2.14	40 76.15±2.81	18 77.89±1.28	37 76.27±2.116	06 79.67±1.5*
Moderate stress(SBP) PSS=14-26	n-20 120.05+2.59	65 126.30+2.76**	08 121.75+2.96	28 124+1.89*	12 119.67+2.06	37 128.05+2.08**
DBP	n-20 78.6±2.60	65 83.48±2.33**	08 77.75±2.92	28 81.86±1.51**	N=12 78.73±2.32	N=37 84.81±2.025**
High Stress PSS=27-40(SBP)	n-03 126.6±1.155	11 133.81±2.6**	02 127±1.41	04 131±1.154	01 126	07 135.43±1.51*
DBP	n-03 82±1.154	11 86.9±1.64**	02 85±1.41	04 88±1.63	01 84	07 86.29±1.38*

[Table/Fig-4]: Comparison of Systolic and Diastolic blood pressure in the Low Stress, Moderate stress and the High Stress groups one month before and immediately after the examinations.
Pre-examination Vs Post- examination SBP & DBP.* = $p<0.05$, ** = $p<0.001$). Pre-ex = Pre-examination; Post-ex = Post-examination

The Indian Medical Curriculum has evolved from the pre-Independence British system, which has seen only a symbolic modernization. Unlike in other countries, the average age of the students who are admitted to the Medical College in India is about 18 years, which is lesser than that of the students in Europe (23years – Harvard University) and United States (20-33 years – Johns Hopkins University) [19,20] Considering this difference, the stress response of the first year medical students may vary considerably from country to country, including the student's ways of coping with stress.

The students from our study group showed an elevated stress response immediately after the examination. Those students who were grouped in the 'low stress' group also showed responses of moderate stress during the examination. Therefore, the number of the 'moderately stressed' students increased and number of students in the low stress group decreased. The female students showed more tendencies to be stressed, because we observed more females in the moderately stressed group than males. This observation suggested that examinations do cause stress. But severe stress responses were shown only in about 10% students during the post-examination period. The elevated BP and the shift in the PSS data were comparable in most of the instances. Why do we see this kind of stress response? The novelty of the first-year professional examination and the pressures in performing increased the propensity to be stressed. Peer pressure and parental expectation could compound it. But the moderate rise in BP, which always remained in the 'normal range', could be considered as a normal part of the GAS. An evaluation of the time response in the days of the post- examination period will reveal the very vital issue of the recovery process from the stress, which we are currently working on.

Janet Di Pietro et al [21], argued that there was a wrong perception that stress was always harmful. The author suggested that most of the people do their best under mild to moderate stress. Therefore, some amount of stress could produce positive effects, as was suggested by Spencer Rathus [22] in 'Psychology: Concepts and Connections', where he argued that stress was necessary to keep us alert and occupied. Posttraumatic growth is a positive outcome of stress, leading to beneficial effects and there is a biochemical and scientific bias that stress is bad, but anecdotally and clinically, it is quiet evident that it can do good for some people.

In the present study group, we observed that some amount of stress was there in the students during the examinations. However, this increased stress did not affect the outcome of the examination results. Ninety two percent (92% in the June 2010 university examination) of the students passed in the first-year MBBS examinations. There was no case of nervous breakdown or any serious symptoms of stress. This observation supported the suggestion that the examinations did not produce long lasting stress symptoms in most of the students.

From the present study, we reiterate that academic examinations could produce stress responses.This stress response is short-lived and recovery takes place soon after the examination. We would like to present our opinion in this article, that examination stress could be viewed as the conditioning process in the life of the young medical students. It is very well known that doctors often are required to be able to cope with situations. Mild forms of stress could be useful for the conditioning of individuals. The rewards of the positive results will reinforce self-confidence in them and the students may emerge stronger.

REFERECNES

[1] Selye H. A syndrome produced by diverse nocuous agents. *Nature*, 1936;138:32.
[2] Selye H. The general adaptation syndrome and the disease of adaptation. *J Clin.Endocrinol.Metab*. 1946;6:117.
[3] Malarkey WB, Pearl DK, Demers LM, Kiecolt-Glaser JK, Glaser R. Influence of academic stress and season on the 24-hour mean concentrations of ACTH, cortisol, and beta-endorphin. *Psycho-neuroendocrinology*. 1995:20(5);499-508.
[4] Gopal A, Mondal S, Gandhi A, Arora S, Bhattacharjee J. Effects of integrated yoga practices on the immune responses in examination stress – A preliminary study. *Int J Yoga*. 2011;4(1):26-32.
[5] Brown RP, Gerbarg PL, Sudarshan K. Yogic breathing in the treatment of stress, anxiety, and depression. Part II--clinical applications and guidelines. *J Altern Complement Med*. 2005;11(4):711-17.
[6] Malathi A, Damodaran A. Stress due to exams in medical students--role of yoga. *Indian J PhysiolPharmacol*. 1999;43(2):218-24.
[7] Kant GJ, Pastel RH, Bauman GR, Meninger, Maughan KR, Robinson TN, et. al. Effect of chronic stress on sleep. *Physiolbehav*. 1995; 57(2):359-65.
[8] Vogel WH. The effects of stress on toxicological investigations. *Human Exposure Toxicology*. 1993;12:265-71.
[9] Brambilla F. Social stress in anorexia nervosa: a review of immuno-endocrine relationships. *Physiolbehav*. 2001;73:365-69.
[10] Miller SP, Redlich AD, Steiner H. The stress response in anorexia nervosa. *Child Psychiatry Hum Dev*. 2003;33(4):295-306.
[11] Muller JE, Kohn L, Stein DJ. Anxiety and medical disorders. *Curr PsychiatryRep*. 2005; 7(4):245-51.
[12] Ang RP, Huan VS. Relationship between academic stress and suicidal ideation: testing for depression as a mediator by using multiple regressions. *Child Psychiatry Hum Dev*. 2006;37(2):133-43.
[13] Ystgaard M. Life stress, social support and psychological distress in late adolescence. *Soc Psychiatry Psychiatr Epidemiol*. 1997;32(5):277-83.
[14] Riese H, Van Doornen LJP, Houtman IL, De Geus EJC. Job strain with respect to ambulatory blood pressure and heart rate among female nurses. *Scand J Work and Health* 2004;30(6):477-85.
[15] Carroll D, Smith GD, Shipley MJ, Steptoe A, Brunner EJ, Marmot MG. Blood pressure reaction to acute psychological stress and the future blood pressure status: A 10 year follow-up of men in the Whitehall II study. *Psychosomatic Medicine*, 2001; 63: 737-43.
[16] Harshfiled GA, Treiber FA, Davis H, Kapuku GK. Impaired stress induced pressure natriuresis is related to the left ventricle structure in blacks. *Hypertension* 2002; 39: 844-47.
[17] Cohen S., Kamarck T., and Mermelstein R. A global measure of perceived stress. *Journal of Health and Social Behav* 1983;24: 386-96.
[18] Ellison KW. Stress and the Police Officer, 2nd ed., Charles C. Thomas Publishers, Springfield, IL, 2004;71-86.
[19] Johns Hopkins University.http://www.college-admission- essay.com/med johnshopkinsuniversity.html
[20] Harvard university.http://hms.harvard.edu/admissions/default.asp?page=admissions.
[21] Dipietro JA, Millet S, Costigan KA, Gurewitsch E, Caulfield LE. Psychosocial influences on weight gain attitudes and behaviors during pregnancy. *J Am Diet Assoc*. 2003;103(10):1314-19.
[22] Spencer AR. Psychology: Concepts and Connections, 10th Edition, Publisher: Wadsworth, Belmont, CA, USA.2008; 498 onwards.

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