Effect of Examination Stress on Haematological and Haemodynamic Parameters in Students

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ABSTRACT

BACKGROUND: Stress can reduce the efficiency of healthy individuals as has been shown in most of the physiological studies.

OBJECTIVES: To assess the effect of examination stress on haematological and haemodynamic parameters in higher secondary school students.

METHODS: The present study was carried out at Government Higher Secondary School, Jammu. Fifty healthy students between the age group of 16 to 19 years were selected for the study. Haemodynamic parameters recorded were pulse and blood pressure. Haematological parameters estimated were RBC, WBC, neutrophil, eosinophil, platelet, monocyte, lymphocyte and basophil count. The first sample of blood was collected under aseptic conditions between 8 a.m. to 8.30 a.m., three months prior to the final academic examination and the second sample was collected from the same subjects on the day of practical and oral part of examination.

RESULTS: Pre-examination CBC showed WBC, Neutrophil, Eosinophil and monocyte of 8221.9 ± 416.69 , 5140.7 ± 471.34 , 185.46 ± 58.18 , 273784 ± 36034.23 , 244.7 ± 82.90 , 2657.78 ± 212.92 and 21.1 ± 5.14 per mm^3 respectively. Whileas during examination counts were 8191.86 ± 417.45 , 5229.48 ± 478.07 , 161.46 ± 68.05 , 285567.26 ± 33641.45 , 228.32 ± 90.85 , 2562.9 ± 220.00 and 13.78 ± 5.58 per mm^3 respectively. Compared with pre-examination results, the blood samples taken during exams showed a significant decrease in eosinophil, basophil, lymphocyte and monocyte count. An increase in platelet and neutrophil count was also observed. No significant changes were observed in RBC count.

CONCLUSION: It is concluded that academic examinations in secondary school are stressful enough to produce changes in blood cell parameters. JMS 2012;15(2):153-56

Key words: : Stress, haemodynamic, haematological, academic examination

Stress is a psycho-physiological arousal occurring in the body as a result of a stimulus which becomes a "stressor" by virtue of the cognitive interpretation of the individual.¹ Stress is a term in psychology and biology which in recent decades has become a common place of popular prevalence. The term "stress" was first employed in 1930s by the endocrinologist Hans Selye.²

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Stress is the body's reaction to a change that requires a physical, mental or emotional adjustment or response. But excess of stress can cause discomfort and hinder to focus and achieve. Stress caused by long working hours and unfavourable conditions of temperature can indeed be hazardous to health.³

Academic stress has emerged as a major psychosocial influence on physical and mental health over recent decades. All of us are familiar with the stress we undergo during exams. This stress can vary from mild to severe. The importance of that particular exam determines the amount of stress we undergo. It is common to hear remarks such as "I forgot", "I studied but failed to recall", and "I just got confused". All of these are due to stress the examination puts on students.

A vast literature is available and studies have been conducted on lipid, hormonal and hemodynamic profile in males under stress. Little is known about and less is probed into the effect of examination stress on hematological and hemodynamic parameters in students. The objective of this study was to see whether stress affects blood parameters and haemodynamics in young students. The study was conducted to document the effect of examination stress on blood cells and haemodynamic parameters in students of Higher Secondary Part II, Government Higher Secondary School, Jammu.

Methods

About 60 students of Government Higher Secondary School, Marh, Jammu were enrolled randomly for the study. Selection was done three months prior to the final examination.

Eligibility criteria:

About 50 healthy students between the age group of 16 to 19 years were selected for the study. The students with the history of mild fever, acute rhinitis, allergy, upper respiratory tract infection, increased blood pressure, surgery, tuberculosis were excluded from the study. Also students on long-term medication such as antitubercular therapy, hormones, haematinics, vitamins etc. were also excluded from the study.

The first sample of blood was collected under aseptic conditions between 8 am to 8.30 am, three months prior to the final academic examination and the second sample was collected from the same subjects on the day of practical and oral part of exam. The anhydrous salt of EDTA (about 1.2 mg) per ml of blood was used as an anticoagulant.

The various physical parameters recorded were age, height and weight, while haemodynamic parameters recorded were systolic and diastolic blood pressures, pulse rates, whereas haematological parameters recorded were RBC/total erythrocyte count (millions/mm³), WBC/total leucocyte count (mm³), neutrophil count (mm³), eosinophil count (mm³), basophil count (mm³), monocyte count (mm³), lymphocyte count (mm³) and platelet count (mm³).

It was made sure that no frothing of blood occurred during transferring of blood from syringe to bottle. Pulse was recorded by palpatory method and blood pressure was recorded by auscultatory method with mercury sphygmomanometer. Counting of RBCs, WBCs and platelets was done with automated hematology analyzer Sysmex K-1000 (TOA Med Elect. Co. Ltd., Kobe, Japan). Sysmex K-1000 is a fully automated qualitative hematology analyzer for in vitro diagnostic use in clinical laboratories. It provides quick screening for hematological testing.

Statistical analysis: Data so obtained was subjected to statistical analysis by "paired t-test" with $p < 0.05$ as significant, $p < 0.01$ highly significant and $p < 0.001$ as very highly significant.

Results

Fifty healthy students between the age group of 16 to 19 years were studied. Table 1 shows comparison of hemodynamic parameters before and during examination in the 50 students. As shown, the mean values of SBP, DBP and pulse rate during examination was higher and was statistically significant ($p < 0.001$).

TABLE 1. Comparison of hemodynamic parameters before - and during examination in the 50 study subjects

Parameter	Pre-examination (Mean $\pm$ SD)	During examination (Mean $\pm$ SD)	Combined (Mean $\pm$ SD)	Statistical inference	
				t-value	p-value
SBP (mmHg)	118.08 $\pm$ 2.31	124.6 $\pm$ 3.33	6.52 $\pm$ 2.61	12.49	<0.001***
DBP (mmHg)	76.44 $\pm$ 3.45	77.36 $\pm$ 3.53	0.92 $\pm$ 1.01	4.55	<0.001***
Pulse rate (beats/min)	73 $\pm$ 2.49	81.88 $\pm$ 3.24	8.88 $\pm$ 3.79	11.72	<0.001***

***indicates very highly significant

TABLE 2. Mean values of hemotological parameters (pre-examination and during examination) and statistical inference of all students (n = 50)

Parameter	Pre-examination (Mean $\pm$ SD)	During examination (Mean $\pm$ SD)	Combined (Mean $\pm$ SD)	Statistical inference	
				t-value	p-value
RBC count (million/mm ³)	4.15 $\pm$ 0.49	4.11 $\pm$ 0.47	-0.04 $\pm$ 0.25	-0.80	>0.05
WBC count (per mm ³)	8221.9 $\pm$ 416.69	8191.86 $\pm$ 417.45	-30.94 $\pm$ 33.61	-4.47	>0.05
Neutrophil count (per mm ³)	5140.7 $\pm$ 471.34	5229.48 $\pm$ 478.07	88.78 $\pm$ 95.27	4.66	<0.001***
Eosinophil count(per mm ³)	185.46 $\pm$ 58.18	161.46 $\pm$ 68.05	-24.00 $\pm$ 25.90	-4.63	<0.001***
Platelet count(per mm ³)	273784 $\pm$ 36034.23	285567.26 $\pm$ 33641.45	11782.62 $\pm$ 15620.24	3.77	<0.001***
Monocyte count(per mm ³)	244.7 $\pm$ 82.90	228.32 $\pm$ 90.85	-16.38 $\pm$ 23.49	-3.49	<0.001***
Lymphocyte count(per mm ³)	2657.78 $\pm$ 212.92	2562.9 $\pm$ 220.00	-94.88 $\pm$ 48.20	-9.84	<0.001***
Basophil count(per mm ³)	21.1 $\pm$ 5.14	13.78 $\pm$ 5.58	-7.32 $\pm$ 3.33	-10.99	<0.001***

***indicates very highly significant

Haematological parameters before and during examination in the study subjects are shown in table 2. The mean values of RBC count and WBC count during examination were lower and were statistically insignificant ($p > 0.05$).

The mean values of neutrophil count was higher, while that of eosinophil count was lower during examination and were statistically significant ($p < 0.001$).

The mean values of platelet count was higher, while that of monocyte count was lower during examination and both were statistically significant ($p < 0.001$).

The mean values of lymphocyte count and basophil count were lower during examination and were statistically significant ($p < 0.001$).

Discussion

Stress is a condition of mental and physical exertion brought about as a result of dissatisfying elements in the environment. Work stress has emerged as a major psychosocial influence on physical and mental health over decades. Stress refers to the conditions that arouse anxiety and fear. Anxiety is defined as an emotion characterized by feelings of anticipated danger, tension and distress, and by tendencies to avoid or escape. Delay, failures, losses, restrictions, conflicts and pressure events place adjustment demands or stress on us.

This study employed real life stress situation of acute nature i.e., examination and demonstrated that the stress of higher secondary school examination in students was significant enough to produce changes in blood cell parameters. The common observation of transient rise in vital parameters like SBP, DBP and pulse rate was also demonstrated in the study.

Exams in higher secondary school are particularly stressful as they involve much study and also that the results do affect the future study or future of the professional training course of the student. The confidence of the subject is not enough if the student is emotionally upset. Fear of failure or poor performance further aggravates the stress.

In the present study, when hemodynamic parameters of the 50 eligible students were analysed, it was observed that the mean value of SBP during examination (124.6 mmHg) was significantly higher ($p < 0.001$) as compared to that during pre-examination (118.08 mmHg) period.

Gregg *et al* reported increase in SBP in the study conducted using foreign students.⁴ Qureshi *et al*, observed rise in SBP by an average of 15 mmHg in 85% of students during examination as compared to pre-examination reading.⁵ Sharma *et al*, demonstrated mean SBP of 117.07 ± 10.23 mmHg before exams and mean SBP reading of 122.84 ± 12.38 mmHg at the time of examination confirming highly significant difference.⁶ Sechar *et al*, also demonstrated statistically significant increase in SBP in the subjects at the time of mental stress.⁷ This study is in compliance with the above mentioned studies.

In the present study, mean value of DBP during examination (77.36 mmHg) was significantly ($p < 0.001$) higher as compare to that during pre-examination (76.44 mmHg) period.

The present study findings are in compliance with the studies conducted by Sharma *et al* and Sechar *et al*, who reported

significant increase in DBP in their respective studies.^{6,7}

Mean value of pulse rate in the present study was also significantly ($p < 0.001$) higher during examination.

This finding is in compliance with the study conducted by Gregg *et al*, Sharma *et al* and Sechar *et al*.^{4,6,7}

Physiological stress has shown that stress from any source can influence on the endocrine, hemopoietic and immune system. Cytokines and cortisol seem to play an important role in the communications between these systems. The well documented changes that occur are increase in neutrophils and platelets, whereas lymphocytes, eosinophils and monocytes decrease in number.⁸

In the present study, hematological parameters were assessed and their findings are discussed as follows:

The mean value of RBC count during exam was lower (4.11 million/mm³) as compared to pre-examination (4.15 million/mm³) period. The difference was statistically insignificant.

This finding is consistent with the study conducted by Qureshi *et al*, who also reported non-significant change in RBC count.⁵ Roohi *et al*, also reported non-significant decrease of 2% in RBC count in traffic policemen as compared to control group.⁹

Mean value of WBC count in the present study was lower during examination (8191.86/mm³) as compared to that during pre-examination (8221.9/mm³) period. The relationship was statistically insignificant.

This finding is in compliance with the study conducted by Qureshi *et al*, who also demonstrated decline in the mean value of total leucocyte count.⁵ However, this finding is not in compliance with the studies conducted by Roohi *et al*, and Mantur and Murthy, both of whom reported elevation in total leucocyte count during stress.^{9,10}

In the present study, the mean value of neutrophil count was significantly ($p < 0.001$) higher during examination (5229.48/mm³) as compared to that of pre-examination (5140.7/mm³) period.

This finding is consistent with the study conducted by Qureshi *et al*, who reported increase in mean value of neutrophil count during examination which was statistically significant.⁵ Mantur and Murthy also showed significantly higher number of neutrophil count during the examination period.¹⁰

The mean value of eosinophil count in the present study was lower during examination as compared to pre-examination period (161.46/mm³ vs 185.46/mm³) and the difference was statistically significant ($p < 0.001$).

Qureshi *et al*, also reported significant decrease in the mean value of eosinophil count during examination as compared to pre-examination period.⁵

The mean value of platelet count in the present study was significantly ($p < 0.001$) higher (285567.26/mm³) during examination period as compared to that during pre-examination (273784/mm³) period.

This finding is in compliance with the study conducted by Qureshi *et al*, who reported significant ($p < 0.0001$) increase in platelet count during examination period.⁵ Roohi *et al*, also

indicated significant ($p < 0.05$) elevation of 15% in platelet count of traffic policemen when compared with the control group.⁹

In the present study, mean value of monocyte count was significantly ($p < 0.001$) lower ($228.32/\text{mm}^3$) during examination period as compared to that of pre-examination ($244.7/\text{mm}^3$) period.

This finding is in compliance with the study conducted by Qureshi *et al*, who reported decrease in monocyte count during examination and the same was statistically significant ($p < 0.01$).³ However, present study finding is inconsistent with the study conducted by Mantur and Murthy who reported significantly higher number of monocytes during examination period.¹⁰

The mean value of lymphocyte count was lower during examination ($2562.9/\text{mm}^3$) period as compared to that of pre-examination ($2657.78/\text{mm}^3$) period and was statistically significant ($p < 0.001$).

The present study result of lymphocyte count complies with the result of Qureshi *et al*,⁵ who reported significant ($p < 0.001$) decrease in lymphocyte count during examination period.⁵

The mean value of basophil count was lower during examination ($13.78/\text{mm}^3$) period as compared to that of pre-examination ($21.1/\text{mm}^3$) period and was statistically significant ($p < 0.001$).

Qureshi *et al*⁵ also reported significant decline in basophil count during the examination period as compared to the earlier period.

Exposure to stress causes a change in adrenocorticotrophic hormone (ACTH levels) followed by greatly increased adrenocortical secretion of cortisol. Cortisol secretion depends upon anticipation of the stressful event more than its actual happening. Cortisol is vital for the resistance of humans to stress. It is suggested that endocrine factors released during stress modulate leucocyte trafficking and result in the redistribution of leucocytes between the blood and other immune compartments.¹¹

The magnitude of stress induced changes is significantly reduced in adrenalectomised animals. The activation of sympathetic nervous system also have a role to play. During stressful states, not only does the peripheral secretion of catecholamines increase but ratio of epinephrine to norepinephrine also changes. Lymphocytes and monocytes express receptors for several stress hormones including norepinephrine and epinephrine. Thus, stressful events could alter the immune function due to decrease in lymphocytes and basophils which were found in the subjects of present study, confirming the stress related changes reported in the literature.

In this world of competition, unfortunately the exams are currently the only means to judge the student's knowledge. In the foreseeable future trend does not seem to change. As stress in school cannot be eliminated, teachers can do better job and provide review of academics and exam schedules, more leisure time activities, better interaction with the teachers and proper guidance. Advisory services and counseling by teachers can do a lot to reduce the stress. Interventions like reduction of stress,

perceived by students approaching exams can be planned while laying more emphasis on regular day by day reading, work examinations, and use of question banks which could alienate the fear and anxieties associated with exam. Students need to adjust themselves so as to cope with pre-stress effectively. Students should be regular with fixed duration of time for studies. The teachers, instructors and other staff members have an important role in behavioural therapy to students. Psychology lectures or counseling by psychologists should be held in school to prevent the stress among students. High social support seems to attenuate magnitude of changes in immune cells suggesting a role for social support in protecting against immune decrements during times of stress. This will enable students to cope adequately with exam stress and will improve their performances. The study is a preliminary work and there is still a need to extend the study on a larger scale in order to generate more elaborate data base.

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