Effect of Examination stress on heart rate, blood pressure and white blood cells.

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ABSTRACT… Objectives: To analyze the effects of Examination stress on heart rate, blood pressure and white blood cells among medical college students. **Study Design:** Observational study. **Setting:** Department of Pathology, Indus Medical College, Tando Muhammad Khan Sindh. **Period:** September 2018 to April 2019. **Material & Methods:** 200 medical students were selected according to inclusion and exclusion criteria. Heart rate was measured manually. Systemic Blood pressure (BP) was recorded by Sphygmomanometer. Mean arterial BP was calculated as diastolic BP+1/3 of pulse pressure. Blood slides were stained with Leishman`s stain and white blood cells were counted using microscope. Data was analyzed by using Statistical Package for Social Sciences (ver 22.0) for windows Microsoft. **Results:** Age of study subjects was noted as 20.23±1.23 years. Body weight and Body mass index (BMI) were noted as 64.93±7.53 Kg (P=0.0001) and 27.5±5.3 (P=0.67). Of total 200, 109 (54.5%) were male and 91 (45.5%) were female (P=0.0001). Heart rate, Systolic, Diastolic and Mean arterial BP differed significantly before and after examination stress (P<0.05). White blood cells before examination were found as 7310.43±708.5 x10^3/μL compared to 8202.39±677.26 during examination stress (P=0.0001). **Conclusion:** Examination stress perturbs the physiological homeostasis as changes in heart rate, blood pressure and White blood cells are noted among medical students. Psychological and physical strategies for coping the stress should be considered for the young medical students.

Key words: Blood Pressure, Heart Rate, Stress, White Blood Cells.

INTRODUCTION

Medical education is a stressful job for young medical graduates. Large curricula are to be covered in short time duration that puts the students at risk of physiological stress particularly during examinations. Examination stress is complicated by examination patterns, competition among peers and fear of failure. These are extremely stressful conditions for the young medical graduates students.[1,2] Examination stress produces imbalance between sympathetic and parasympathetic nerves caused by psychic stimuli and disrupts the normal homeostasis.[3] Stress adversely affects the health and makes the person prone to systemic hypertension, tachycardia, atherosclerosis, etc.[4] This begets cardiovascular and cerebrovascular vascular disease of grave consequences.[5] Stress alters

the white blood cell physiology too.[6] White blood cells (WBCs) are the most important cells of inflammation and immunity that help protect the body. WBCs are also called the leukocytes and increased counts are termed as leukocytosis. A link between inflammation and systemic hypertension has been suggested previously. WBCs are raised during stressful conditions and are associated with systemic hypertension and its associated complications.[7] Physiological mechanism of association of elevated WBCs and systemic hypertension are explained by chronic inflammation.[8] WBCs have a tendency of adhering to the capillary endothelium in response to the hormones of stress. Hormone of stress such as the cortisol and catecholamines increase the adherence of WBCs to the capillary endothelia.[9] Capillary adherence of WBCs

increases the peripheral vascular resistance and a consequent rise in systemic arterial blood pressure. Capillary leukocytosis initiates low grade chronic inflammation with the microcirculation.[10] Sustained low grade chronic inflammation narrows the vascular lumina, increases the arterial blood pressure and may eventually result in sustained arterial hypertension.[11] WBCs are primary cells of immune system that adversely affect the microcirculation. Physiological stress along with associated capillary leukocytosis caused by hormones and sympathetic nerve stimulation has been implicated in the development of systemic hypertension.[12,13] A search of medical literature shows fewer studies are published despite the topic is practical and helpful for the young medical graduates. The present study was planned at the Department of Pathology, Indus Medical College to determine the physiological effects of Examination stress on heart rate, blood pressure and white blood cells among medical college students.

MATERIAL & METHODS
The present cross sectional study was conducted prospectively at the Department of Pathology, Indus Medical College, from September 2018 to April 2019. Two hundred medical students of MBBS were selected for the study purpose. Both genders, age between 17- 23 years, undergoing examination were included in the present study. Volunteers were asked to sign the consent form. Permission was taken from the ethical review committee (ERC). Medical students with history of high Blood Pressure (BP), alcoholism, drug intake, excessive caffeine and tea intake, smoking, and Diabetes mellitus (DM) were excluded from the study protocol. Volunteer medical students were asked for the understanding of study procedure. They were informed that the researcher wants to examine heart rate, and systemic blood pressure before and during examinations, so they have to cooperate to come before examination. The students were directed to sleep soundly, have a breakfast and free from anxiety a day before examinations to come for the check up and data collection. Principal researcher was assigned to fill the data to meet the inclusion and exclusion criteria on a pre- structured proforma. Proforma was filled as vis-à-vis student interview by the principal researcher. Heart rate was measured manually. Systemic Blood pressure was recorded by Sphygmomanometer. Mean arterial BP was calculated as diastolic BP+1/3 of pulse pressure. Same parameters were studied and noted during the examination day whether students feeling stress or not. Medical students were asked to abide by the study protocol as this may help to make strategies for alleviating examination stress in the future. Medical students were asked for compliance and unconditioned full cooperation maintains a proper research protocol. Heart rate and blood pressure were noted according to JNC-VIII criteria.[14] These were checked after 5–10 minute rest.[14] Formula of Systolic BP + 1/3 Pulse pressure was used for the calculation of Mean arterial pressure (MAP).[14] Systemic BP was measured using a mercury sphygmomanometer. This was followed by 2 ml of venous blood sampling. A tourniquet was applied above the cubital fossa. Prominent engorged vein was noted in the ante-cubital fossa. Blood sample was collected by pricking 24 G disposable syringe. Blood was poured in CP bottles containing sodium fluoride anticoagulant. Blood slides were stained with Leishman`s stain and white blood cells were counted using microscope. WBC counts were checked a day before and during examinations stress. Principal researcher was responsible for maintaining the confidentiality of student Biodata and laboratory findings. Students were informed that the information will be used for academic purpose only. Data was analyzed by calculating on SPSS (version 21.0) software for the windows. Continuous variable results were presented as mean and standard deviation (SD) calculated by Student`s t-test. Cross tabulation of categorical variables done by Chi- square test and results presented as frequency and percentage (%). Statistical α- level of significance was taken at 95% confidence interval (P≤ 0.05).

RESULTS
Age of study subjects was noted as 20.23±1.23 years (P=0.0001). Body weight, height and BMI were noted as 64.93±7.53 Kg (P=0.0001), 5.6±1.2 inches and 27.5±5.3 (Kg/m^2) (P=0.67). Of total 200, 109 (54.5%) were male and 91

(45.5%) were female (P=0.0001) (Table-I). Male predominated with M: F ratio of 1.19:1 in the present study. Heart rate before examination was 63.31±5.48 compared to 78.04±8.60 bpm during examination stress. Systolic and Diastolic BP were noted as 119.07±2.65 vs. 120.60±4.76 mmHg (P=0.0002) and 66.23±4.78 vs. 70.21±5.78 mmHg (P=0.0001) before and during examination stress respectively. Mean arterial BP also shows statistically significant differences (P=0.0003). White blood cells before examination were found as 7310.43±708.5 x10³/μL compared to 8202.39±677.26 during examination stress. Mean white blood cell counts show significant difference (P=0.0001).

Demographics		P
Age (years)	20.23±1.23	0.0001
Male	109 (54.5%)	0.0001
Female	91 (45.5%)	
Body weight (Kg)	64.93±7.53	0.0001
Height (inch)	5.6±1.2	0.0001
BMI (Kg/m²)	27.5±5.3	0.67

Table-I. Demographic features of study subjects (n=200)

	Before Exam	During Exams	P-Value
Heart Rate (bmp)	63.31±5.48	78.04±8.60	0.0001
Systolic BP (mmHg)	119.07±2.65	120.60±4.76	0.0002
Diastolic BP (mmHg)	66.23±4.78	70.21±5.78	0.0001
Mean Arterial BP (mmHg)	90.0±3.71	95.0±5.3	0.0003
WBC (x10³/μL)	7310.43±708.5	8202.39±677.26	0.0001

Table-II. Heart rate, blood pressure and white blood cells (n= 200)
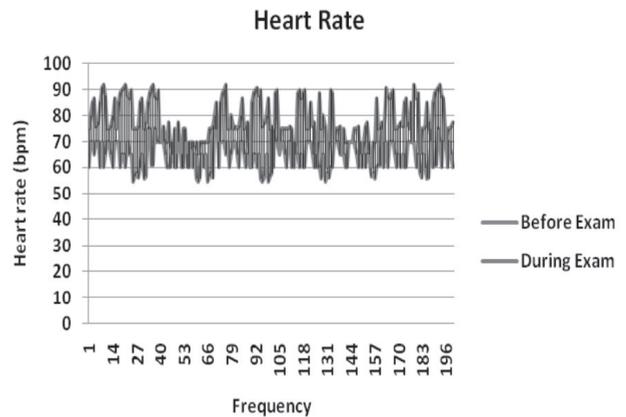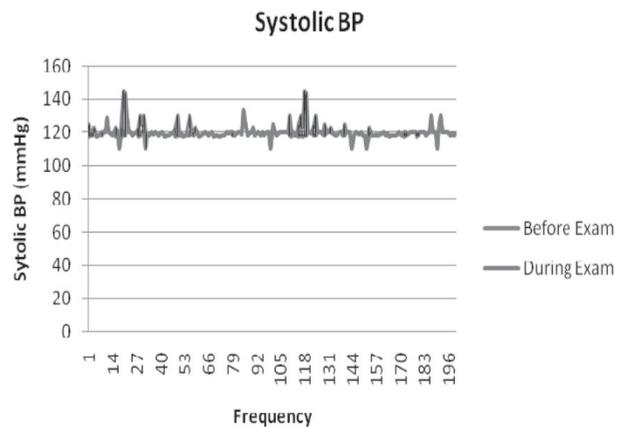

Figure-1. Heart rate distribution
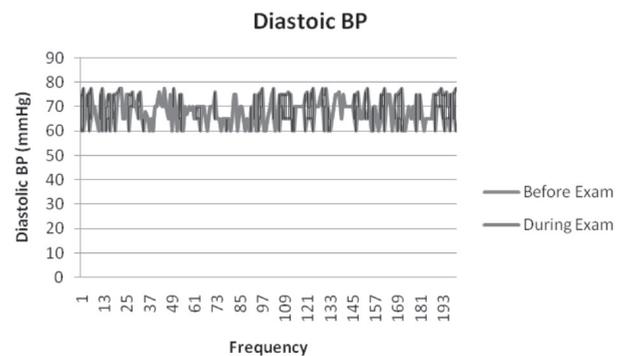

Figure-2. Systolic BP distribution

Figure-3. Diastolic BP distribution

DISCUSSION

The present observational study determined the physiological effects of Examination stress on heart rate, blood pressure and white blood cells among medical college students.
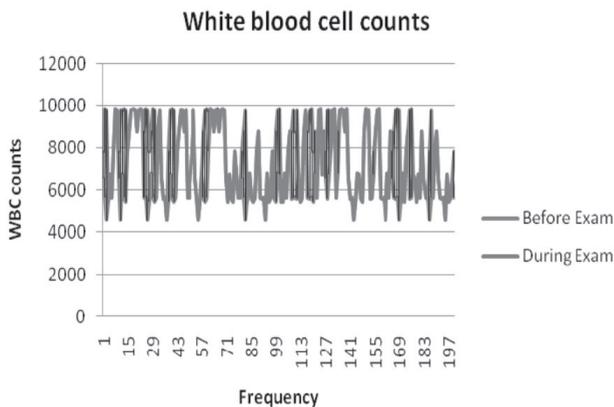
White blood cell counts

Figure-4. White blood cell distribution

Age of study subjects was noted as 20.23±1.23 years (P=0.0001). These findings are in agreement with previous studies.[6-11] Body weight and BMI were noted as 64.93±7.53 Kg (P=0.0001) and 27.5±5.3 (P=0.67). Of total 200, 109 (54.5%) were male and 91 (45.5%) were female (P=0.0001). Male predominated with M: F ratio of 1.19:1 in the present study. The findings are consistent with previous studies.[6-11] Heart rate before examination was 63.31±5.48 compared to 78.04±8.60 bpm during examination stress. Systolic and Diastolic BP were noted as 119.07±2.65 vs. 120.60±4.76 mmHg and 66.23±4.78 vs. 70.21±5.78 mmHg before and during examination stress respectively (P=0.0001). Mean arterial BP also shows statistically significant differences (P<0.05). The findings are consistent with previous studies.[7-11] Stress is a normal physiological phenomenon among medical students during examinations. An examination is a common stressor for the medical students.[15] Stress physiology shows changes in cardiovascular, endocrine, immune cell and hematopoietic systems. Changes of stress physiology are attributed to the cytokine (IL & TNF-α) and cortisol as they play essential communication role among systems.[16] It is suggested that the stress and disease are caused by lack of integration and communications among various physiological systems.[17] A breach in physiological homeostasis creates changes in milieu interior, these results in changes throughout the body. Cardiovascular system shows a change in heart beating and blood pressure driven by sympathetic stimulation. Evidence suggests the

physiological responses of stress are accelerated by sympatho- adrenal axis, and atherosclerosis has been the results of sympathetic excitation.[17,18] The findings of present are supported by previous studies.[19,20] Shaikh[19] reported high frequency of anxiety stress among first and final year students compared to third and fourth year batches. It was justified that the first and final professional students have more academic work load superadded with examinations and viva-voce. Sani et al[20] reported the long study hours, tight academic schedule, place and language problems and examinations in particular the viva voce as the major factors of stress. High BP is linked to increased risk of cardiovascular disease. The stress may cause systemic hypertension though sustained rise in systemic BP through stimulation of sympathetic nervous system and stress hormone (cortisol, catecholamines, etc) secretion. Sympathetic nerves raise the peripheral resistance and hormone of stress doing the same. It has been suggested that when one risk factor is coupled to another stress, this multiplies the risk for high blood pressure to happen.[21]

The present study reported significant changes in the medical students during examinations. Heart rate, blood pressure and WBCs counts were altered during examination compared to baseline values. In present study, the WBC before examination were found as 7310.43±708.5 x10^3/μL compared to 8202.39±677.26 during examination stress. Mean WBC counts differed significantly (P=0.0001). The findings are supported by previous report that the stress releases pro-inflammatory cytokines that stimulate hematopoietic cell proliferation[22], & WBC trafficking modulation. Redistribution of WBCs among circulation has also been reported. In normal circulation, the WBCs are resting in the vessels and become mobile during stress events.

A previous study[23] reported similar findings of elevated WHCs counts during examination stress. A recent study[24] analyzed 100 medical students for heart rate, blood pressure and differential leukocyte counts. They reported a rise in the heart rate and blood pressure and significant rise of neutrophil counts. As the neutrophil comprises

most of WBC counts in the circulation, the findings of present study are supported by above study. The present study witnessed significant changes in heart rate, systolic and diastolic BP and WBC counts. Limitations of present study include; first – a small number of medical students were included, second – only first and second year medical students were selected, and third – the sample size is not representative of total study population, hence results are not generalizable. However, strength of study lies in its prospective study design and full compliance of students.

CONCLUSION
Examination stress adversely affects physiological homeostasis as changes in heart rate, blood pressure and White blood cells were noted among medical students. Strategies to cope with the stress should be ascertained for the young medical students. Further large scale studies with adequate methods are recommended.
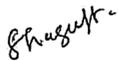**Copyright© 25 June, 2020.**

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