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COMPARISON: THE EFFECT OF PROFESSIONAL EXAMINATION STRESS ON BLOOD PRESSURE, HEART RATE AND WHITE BLOOD CELLS

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ABSTRACT:

BACKGROUND: *A study to compare the effect of professional examination stress on blood pressure, heart rate and white blood cells among medical students during their study of medical sciences -the walk to the exam is always a burden for medical students.*

AIMS & OBJECTIVE: *To compare the heart rate, blood pressure, and white blood cells resulting from professional examination stress among students in a public medical college.*

MATERIAL & METHODS: *Participant enrollment took place after collecting consent from the entire participant pool of public medical college students in Lahore. The data acquisition utilized pre-designed performa. Analyzing the data by using SPSS version 27 included frequency and percentage results as qualitative outcomes. Quantitative data is presented as Mean±SD. The research used Independent sample t along with paired t-test and chi-square test to analyze results at a significant level of p-value ≤0.05%.*

RESULTS: *Total 283 female participants showed different degree of stress level during examination period. The average age of research participants was 23.67±0.45 with age range 20-28 years. Students those having history of psychiatry was 101(35.69%) and hypertensive students were 82(28.98%). Student from second to final year of MBBS were chosen for the study as they were exposed to professional exams during their period in the college. Most of the participants enrolled in the study were from 3rd Prof with 101 students constituting 35.69% of the total. The examination stress caused subject's heart rates to rise from 69.23 ± 6.69 bpm before test time to 77.05±4.70 bpm after the test period. The study recorded BP levels between 116.08±3.78 mmHg to 118.02±5.98 mmHg for systolic BP (P=0.003) and between 70.11±5.99 mmHg to 75.00±4.85 mmHg for diastolic BP (P=0.000) after examination stress. The research data reveals a statistically important change in Mean arterial BP (P=0.004). The count of White blood cells was 7215.67±678.12 x103/µL before examination while an examination stress revealed 8745.24±677.26 x103/µL. Mean white blood cell levels display a statistically noteworthy alteration (P=0.001).*

CONCLUSION: *Examination stress has negative effects on student's physical and mental wellness as researchers observed that medical students face blood pressure changes, heart rate fluctuations and white blood cell variations. Therefore, young medical students require proper stress-coping strategies to be established.*

KEY WORDS: *Blood Pressure, Heart Rate, White Blood Cells, Examination Stress*

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Author's Contribution: FR: Create a plan to literature search and design questionnaire. TAQ: Set methods for data collection. NT: Drafting. MK: Data Collection. ZI: Analyze and interpretation of data. SA: Create SPSS sheet for data entry.

INTRODUCTION:

The worldwide prevalence of cardiovascular diseases (CVDs) keeps them at the top position as the main reason for human mortality while creating substantial challenges for public health systems and health services.[1] Heart health stands as a major influence of stress since this factor directly determines the development of both atherosclerotic cardiovascular disease and other associated complications.[2] Researchers need to investigate this matter because it [1] improves understanding of central neurophysiological pathways between psychological events and behavioral elements that trigger CVD advancement and[2] creates new brain-based methods to boost heart disease assessment and prevention possibilities. Heart function together with blood pressure has been extensively studied by researchers in their investigations. The body displays elevated heart rate and blood pressure at first which proves beneficial by providing needed energy and focus for managing stressful situations according to the fight-or-flight reaction pattern. Nonetheless, continued exposure to stress can develop into persistent cardiovascular diseases.[3]

Mental and emotional stress can trigger changes in blood pressure and heart rate, a phenomenon observed not just in laboratory settings but also in real-life situations. For example, research has shown that medical professionals, including surgeons and anesthesiologists, experience increased heart rates and elevated blood pressure during high-stakes moments, such as surgeries or being on call. Even medical students face cardiovascular stress responses during critical exams, yet this remains an underexplored area of research.[4-5]

Stress can arise from both external pressures and internal struggles, affecting both physical and mental well-being. It disrupts the body's balance, leading to significant changes in brain and body function.[6-7] Uncontrolled high blood pressure, often linked to stress, can be particularly harmful to the brain, increasing the risk of strokes, brain hemorrhages, and even neurodegenerative conditions such as vascular dementia and Alzheimer's disease.[8-9]

Stress directly impacts heart function by altering heart rate (HR), which may increase or decrease depending on the body's autonomic nervous system response. Another significant effect of stress on cardiovascular health is its influence on blood pressure. When stress activates the sympathetic nervous system, it leads to heightened vasoconstriction, potentially raising blood pressure, increasing blood lipid levels, disrupting clotting mechanisms, and inducing vascular changes that contribute to atherosclerosis. These effects can increase the risk of cardiac arrhythmias and even heart attacks. Research also indicates that psychological stress can stimulate alpha-adrenergic receptors, leading to increased HR and oxygen demand. Over time, chronic stress in

students' lives may result in significant cardiovascular dysfunction and long-term health risks. [10]

Given these serious implications, it is crucial to further explore the connection between stress, cardiovascular health, and brain function. By deepening our understanding, we may develop better strategies to manage stress and protect both heart and brain health in the long run. This study set out to examine heart rate (HR) and blood pressure (BP) in students experiencing exam anxiety. We also explored how factors like sex, hypertension family history, and medication use might influence these cardiovascular responses. Additionally, we assessed how accurately students perceived their own cardiovascular parameters including HR, systolic and diastolic BP, mean arterial BP, and white blood cell (WBC) count by comparing their perceptions to actual measured values before and after the exam.

OBJECTIVE:

The aim of this study was to evaluate how medical students perceive changes in their cardiovascular parameters—HR, systolic & diastolic BP, mean arterial BP, and WBC count compared to their actual readings before and after their medical examination. The study was conducted at a public-sector medical college in Lahore.

MATERIAL AND METHODS:

Each year, approximately 283 medical students take their final exams at Fatima Jinnah Medical University, Lahore. These exams are extensive, consisting of multiple assessments across different clinical disciplines one such examination, the ambulatory general internal medicine assessment, is conducted in the Medical Outpatient Department and consists of three sections.

1.Initial Stage: A 10-minute session focused on observed history-taking.

2.Clinical Evaluation: A 60-minute period dedicated to unobserved data collection and physical examination.

3.Final Review: A 20-minute oral presentation and discussion with an examiner regarding the patient's case and management plan.

RESULTS:

The study engaged all 283 students who had scheduled the examination. Each student consented to participate through a written form obtained before the examination started. The Ethical Committee of Fatima Jinnah Medical University authorized the research and its enrollment included students from the second to the final year of MBBS.

The mean age of the research participants was 23.67 years (±0.45), with ages ranging from 20 to 28 years. Among them, 101 students (35.69%) had a history of psychiatric conditions, while 82 students (28.98%) were hypertensive. The study focused on students from the second to final year, as they had already been exposed to professional exams during their time in medical college. The highest number of

Table 1 Demographic of Research Participants.

Characteristics	Frequency (%)			
Age	23.67±0.45			
Group Age n(%)	20-24 years	154(67.00%)		
	25-28 years	129(33.00%)		
History of Psychiatry	Yes	101(35.69%)		
	No	182(64.31%)		
History of Hypertension	Yes	82(28.98%)		
	No	201(71.02%)		
Professional Year	2nd Prof	3rd Prof.	4th Prof	Final Prof
	53(18.73%)	101(35.69%)	83(29.33%)	46(16.25%)

Table 2: Frequency Distribution of Medical Students Monitored for Blood Pressure (BP) before and after Examination.			
	Before Exam	**After Exam**	**p-value**
Heart Rate (bpm)	69.23 ± 6.69	77.05±4.70	0.002
Systolic BP	116.08±3.78	118.02±5.98	0.003
Diastolic BP	70.11±5.99	75.00±4.85	0.000
Mean Arterial BP (mmHg)	88.01±2.81	97.34±7.23	0.004
WBC (x103/ µL)	7215.67±678.12	8745.24±677.26	0.001

Table 3: Symptoms of stress among Students.			
Factors	**Yes**	**No**	**p-value**
Feel increased heart beat?	179 (63.25%)	104(36.75%)	0.001
Experience disrupted sleep patterns?	193(68.20%)	90(31.80%)	0.000
Face tachycardia by the fear of exams?	173(61.13%)	110(38.87%)	0.005
Experience weight gain or loss during examination?	178(62.90%)	105(37.10%)	0.045

Table 4: Level of Exam Anxiety among students based on Visual Analogue Scale.			
	Level of Stress (Visual Analogue Scale)		
	Mild (0- 35)	**Moderate (36-65)**	**Maximum (66-100)**
Before Exam	70(24.73%)	159(56.18%)	54(19.08%)
After Exam	101(35.69%)	132(46.64%)	50(17.67%)

participants came from the third-year (3rd Prof.) group, with 101 students (35.69%) enrolled.

This observational study explored how exam stress impacts physiological factors like heart rate (HR), blood pressure (BP), and white blood cell (WBC) count in medical students. Participants were observed for heart rate before exam as 69.23 ± 6.69 compared 77.05±4.70 after examination, systolic blood pressure noted as before and after as 116.08±3.78 and 118.02±5.98 respectively. similarly, diastolic blood pressure was 70.11±5.99 and 75.00±4.85, Mean Arterial BP (mmHg) was 88.01±2.81 and after 97.34±7.23, white blood cells WBC (x103/ μL) was 7215.67±678.12 and 8745.24±677.26 with statistically significant p-value as < 0.05.

Table 3 shows the comparison of exam anxiety symptoms among female students. Significant students felt increased heartbeat, disrupted sleep and tachycardia. Weight gain/loss during exams period was also showed significant difference as p-value <0.05.

Students were requested to rate their self-perceived exam stress on a scale from 0 to 100.The results distributed at three levels. As evident from the results, 70(24.73%) and 101(35.69%) of students showed mild stress before and after exams respectively, 159(56.18%) showed moderate stress before and 132(46.64%) after exam, but 54(19.08%) and 50(17.67%) showed maximum stress levels before and after examination respectively.

DISCUSSION:

This observational study assessed the impact of examination stress on blood pressure, heart rate, and white blood cell count among medical students. The finding of current study showed that the average age of research participants as 23.67±0.45 with age range 20-28 years. Students those having history of psychiatry as 101(35.69%) and hypertensive students were as 82(28.98%). From the second to final years were chosen for the study as they were exposed to professional exams during their period in the college. Maximum

students of 3rd Prof. were enrolled as 101(35.69%)

A similar study conducted by Soomro et al[11]. reported an average participant age of 20.23 ± 1.23 years (P=0.0001), which aligns with our findings. [11]

Prevalence estimates ranged across assessment modalities from 9.3% to 55.9%. Depressive symptom prevalence remained relatively constant over the period studied (baseline survey year range of 1982-2015; slope, 0.2% increase per year [95% CI, -0.2% to 0.7%]). In the 9 longitudinal studies that assessed depressive symptoms before and during medical school (n = 2432), the median absolute increase in symptoms was 13.5% (range, 0.6% to 35.3%).[12] The study the magnitude and causes of stress among first-year medical students of Kurnool Medical College, Kurnool, Andhra Pradesh, India. Analysis shows that 78.19% of the respondents experienced stress. Girls (52.88%) perceived greater stress when compared with boys (47.12%); however, the difference did not reach statistical significance. Stress levels are more common in students aged ≤18 years. Poor performance at the examination, large amount of content to be learnt, and lack of time to revise were the major causes of stress among the students.[13]

Sujatha et al, reported mild degree anxiety in 45.99% of students, moderate degree anxiety in 37.99% and severe degree anxiety in 15.99% during examinations.[14] In another study conducted at Coimbatore in 50 students 40% had moderate examination anxiety, 36% low anxiety, and 24% severe examination anxiety. This study supports many of the findings of previous studies, [15,16,17,18,19,20,21] in that majority of the medical students experience some level of anxiety during exams.[15]

The total prevalence of stress was 63%, and the prevalence of severe stress was 25%. The prevalence of stress was higher ($p<0.5$) among females (75.7%) than among males (57%) (odds ratio=2.3, chi2=27.2, $p<0.0001$).

This study examined the relationship between stress and fluctuations in blood pressure (BP) and heart rate (HR) during the examination period.. Zhang et al.[17] conducted research involving 64 college students (average age of 20 years) to track these variations. BP and HR measurements were taken both in the morning and evening across three distinct phases: prereview, review, and examination periods. The deviations from baseline values were analyzed, and participants also completed the Self-Rating Anxiety Scale (SAS) questionnaire on the first day of the exam period. An SAS score exceeding 50 was indicative of significant anxiety.

Research data demonstrated that blood pressure together with heart rate steadily increased between the prereview phase and examination period. Students who experienced anxiety showed substantially increased systolic blood pressure reading by 4.3 ± 1.3 mmHg with diastolic blood pressure by 4.4 ± 1.5 mmHg above baseline levels compared to participants without anxiety who did not show such elevations (0.3 ± 0.5, 1.0 ± 0.5 mmHg, $P < 0.05$). Their heart rate presented a larger increase (9.7 ± 2.1 vs. 1.9 ± 0.9 bpm, $P < 0.05$). The evaluation and examination periods of the study revealed an intense positive relationship between SAS scores and simultaneously rising blood pressure and heart rate measurements. Smokers and students with hypertension in their families experienced elevated scores of anxiety together with larger changes in blood pressure and heart rate measurements. Data results show that anxiety plays a major role in raising blood pressure and heart rate measurements throughout academic stress periods.

The study of Shaikh et al.[18] revealed that stress levels were more pronounced among first- and final-year students compared to those in their third and fourth years. This was attributed to the heavier academic workload, combined with exams and viva-voce assessments that students in these years face. Similarly, Sani et al. [19] identified long study hours, demanding academic schedules, language barriers, and exams especially viva-voce as key stressors for students.

Elevated blood pressure (BP) is a well-established risk factor for cardiovascular disease, and stress can play a role in the

development of systemic hypertension by activating the sympathetic nervous system and promoting the release of stress hormones like cortisol and catecholamines. These hormones, along with heightened sympathetic nervous activity, raise peripheral resistance, leading to increased BP. Moreover, research suggests that when stress is combined with other risk factors, the likelihood of developing hypertension is significantly amplified.[20]

These findings are consistent with previous research, which suggests that stress triggers the release of pro-inflammatory cytokines. These cytokines stimulate the production of hematopoietic cells and influence the movement of white blood cells (WBCs) in the body. Studies have shown that stress can cause WBCs to redistribute within the bloodstream. Under normal conditions, WBCs remain relatively inactive within the blood vessels, but during stressful events, they become more active and mobile, responding to the body's heightened state of alert.[21]

CONCLUSION:

Stress related to examinations results in disturbed physical body equilibrium which subsequently affects medical students' heart rate, blood pressure and white blood cell counts. Identifying efficient coping strategies remains vital for health professionals to support students' welfare. Expanded research using strong methodologies should probe this matter at its deepest levels.

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