DOI: 10.51984/SUCP.V4I3.4137

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Stress and hypertension: A thorough investigation into how engineering college students at Tobruk University

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Keywords:
Academic stress
Hypertension
blood pressure
adrenaline
university students

ABSTRACT

Introduction: Academic stress among university students may contribute to hormonal dysregulation and hypertension, yet its impact remains understudied in Libya. Materials and Methods: This study assessed hormonal changes in 32 Pharmacy College students (18 males, 14 females, aged 18–25) at Tobruk University using the Snibe Diagnostic MASRADAR X3. Blood samples were collected one week before and after final examinations to measure Growth Hormone (GH), Histamine, Adiponectin, Angiotensin I, Cortisol Binding Globulin (CBG), Creatine Kinase (CK), Glucagon, and Angiotensin II. Paired t-tests were used for analysis ($p < 0.05$). Results: Significant reductions were observed post-examination in GH (8.69 to 5.03 ng/mL), CBG (57.16 to 37.06 µg/mL), CK (180.97 to 83.03 U/L), Glucagon (233.58 to 70.52 pg/mL), and Angiotensin II (70.32 to 37.29 pg/mL). Histamine increased (4.62 to 6.31 ng/mL). Adiponectin and Angiotensin I showed no significant changes. Blood pressure increased during exams, with 36.7% of Organic Chemistry students showing hypertension (⩾ 130/85 mmHg). Conclusion: Examination stress significantly alters hormonal profiles, potentially increasing hypertension risk. Stress management programs are recommended to mitigate these effects.

الإجهاد وارتفاع ضغط الدم: دراسة تحليلية على طلاب كلية الصيدلة بجامعة طبرق

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الكلمات المفتاحية:
الاجهاد
أرتفاع ضغط الدم الاكايمي
ضغط الدم
طلاب الجامعة

الملخص

المقدمة: قد يسهم الإجهاد الأكاديمي لدى طلاب الجامعات في اضطرابات هرمونية وارتفاع ضغط الدم، لكن تأثيره لم يُدرس بشكل كافٍ في ليبيا. المواد والطرق: أجريت هذه الدراسة على 32 طالبًا من كلية الصيدلة (18 ذكور، 14 إناث، أعمار 18-25 سنة) بجامعة طبرق باستخدام جهاز Snibe Diagnostic MASRADAR X3. جُمعت عينات دم قبل أسبوع وبعد الامتحانات النهائية لقياس هرمون النمو، الهيستامين، الأديبونكتين، الأنجيوتنسين الأول، بروتين ربط الكورتيزول، الكرياتين كيناز، الجلوكاجون، والأنجيوتنسين الثاني. استُخدمت اختبارات t المزدوجة للتحليل ($p < 0.05$). النتائج: لوحظ انخفاض كبير بعد الامتحانات في هرمون النمو (8.69 إلى 5.03 نانوغرام/مل)، بروتين ربط الكورتيزول (57.16 إلى 37.06 ميكروغرام/مل)، الكرياتين كيناز (180.97 إلى 83.03 وحدة/لتر)، الجلوكاجون (233.58 إلى 70.52 بيكوغرام/مل)، والأنجيوتنسين الثاني (70.32 إلى 37.29 بيكوغرام/مل). زاد الهيستامين (4.62 إلى 6.31 نانوغرام/مل). لم تُظهر الأديبونكتين والأنجيوتنسين الأول تغيرات كبيرة. ارتفع ضغط الدم أثناء الامتحانات، حيث أظهر 36.7% من طلاب الكيمياء العضوية ارتفاعًا في ضغط الدم (≥130/85 ملم زئبق). الخاتمة: يؤثر الإجهاد الامتحاني بشكل كبير على المستويات الهرمونية، مما قد يزيد من مخاطر ارتفاع ضغط الدم. يُوصى ببرامج إدارة الإجهاد للتخفيف من هذه الآثار.

1. Introduction

Hypertension is a familiar non-communicable disease that is currently very common (Ayu Puspita Sari Feriana, 2023) among people in the world today. Hypertension is diagnosed when systolic blood pressure is more than 140 mmhg and diastolic blood pressure more than 90 mmhg, which is measured on two different occasions, which allows a five-minute discount period. Hypertension can occur for various internal factors, (such as genetics, ethnicity, gender, stress and age) and external factors (such as tobacco, alcohol, inaction) (insect, 2020).

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Article History : Received 20 February 2025 - Received in revised form 01 September 2025 - Accepted 07 October 2025

High blood pressure is not communicable; However, it pose a major health risk as it can lead to serious health problems, including stroke, heart failure and heart attack (Emales et al., 2020).

Chronic high blood pressure is recognized as a condition, primarily caused by genetics, lifestyle habits, and stress levels, according to Dharmawan Hermanto, 2023. People demonstrate their engagement to the world during lifestyle choices and these characteristics show themselves in the actions they take every day as well as their personal interests and beliefs. Human behavior can be divided into three large sections: sleep, eating habits, and physical activity levels along with practices for coping or dealing with stress, which all affect health outcomes when away from home. Currently, a lot of individuals are more sedentary than ever, and their food choices are often associated with higher sodium content. Medical experts refer to hypertension as a silent threat because it operates in hidden ways that can ultimately lead to death, as noted by (Dharmawan Hermanto, 2023). Educational initiatives about health play a crucial role in guiding patients toward effective lifestyle changes for managing hypertension, according to (Ayu Puspita Sari and Feriana, 2023).

Changes in the surrounding environment that create risks or difficulties in a person's life generally lead to increased levels of stress. High stress can contribute to hypertension. The interplay of environmental factors and personal elements generates stress, resulting in various types of pressures and emotional challenges, as stated by (Lingga et al. , 2023). Due to gaps in existing research, an investigation was carried out titled "Stress and Hypertension: An Analytical Study Among Tobruk University Students. "

There are acute and chronic stress which academic stress is one of the common ones among students in universities. Short-term stress, due to factors like exams, involves activation of the sympathetic nervous system raising the heart rate and the blood pressure. Prolonged experience of stressors can result in chronic stress causing persistent dysregulation of hormonal responses as well as cardiovascular problems, such as hypertension. Such influences are mediated through the secretion of stressors such as cortisol and catecholamines that can worsen health dangers without countermeasures (OConnor et al., 2021). This paper tries to deal with such issues by considering the physiological effects of academic stress on students in the Pharmacy College at Tobruk University putting emphasis on hormonal changes and how this ties to hypertension.

Literature review

Consequently, in preindustrial communities, the typical blood pressure (BP) was generally low and uniformly distributed, at a measurement of 115/75 mmHg, which is currently regarded as the physiological standard. On the other hand, contemporary populations demonstrate a gradual rise in systolic BP associated with aging for both sexes. A common notion is that this trend is primarily due to a lifetime exposure to environmental influences (i.e. excessive sodium, inadequate potassium in the diet, obesity, alcohol consumption, and lack of physical activity). Genetic factors and negative intrauterine influences (e. g. gestational hypertension and preeclampsia) may be trivial or secondary, both of which could affect adult BP (Poulter et al., 2015). Even marginal increases in average BP within the population significantly influence the prevalence of hypertension.

At first, hypertension is no more commonplace for individuals of higher socioeconomic status among individuals during the early years of economic development. However, with economic development at a later stage, the burden of this disease content has the potential to shift across lower-income groups, either within countries or between countries. The rapidity of the change in prevalence of hypertension observed from 2000 to 2010 was larger compared to previous phases of epidemiological transition. Approximately 3. 5 billion individuals worldwide experience suboptimal systolic BP ranging from 110 to 115 mmHg, while 874 million adults exhibit diastolic BP levels of 90 mmHg or higher indicative of ischemic heart disease (IHD). This means that around a quarter worldwide is estimated to be affected by adult hypertension (foreuzanfar et al., 2017).

From 1990 to 2015, the subptimal BP increased by 43 percent of the global healthy life year, due to the growing and aging population and 10 percent increase in high blood pressure age-standard spread in people above 65 years of age (foruzanfar et al, 2017). Subptimal BP stands as the most important single risk factor for the burden of disease and overall mortality worldwide, accounting for 10. 4 million deaths and loss of 212 million healthy life year annually, which 8 of the global total each year. Represents 5 percent. The ongoing research involving prospective observational studies has validated a strong, persistent, and favorable correlation between elevated blood pressure (BP) and cardiovascular disease (CVD), with no discernible lower threshold established—risk remains significant across all BP levels, including those classified as normotensive. Although this correlation applies to both systolic and diastolic BP, systolic BP demonstrates a more robust predictive capability in adults. This connection, however, also holds significance for both genders, various adult age demographics, and significant CVD outcomes (for instance, ischemic and hemorrhagic stroke, coronary artery disease, heart failure, peripheral artery disease, and end-stage renal disease) (Olsen et al. , 2025).

In addition, when accounting for other heart -risk variables, these results still prove to be important and means that BP's forecast acts as an independent and important factor that affects CVD risk in the model. A person suffering from high blood pressure or at the age of 30, using anti -synchronous treatment, is about 40 percent higher than the occurrence of heart disease than people with low BP. Additionally, heart events between patients suffering from high blood pressure occur about five years ago compared to the normalization (rapsomani et al., 2014).

Baroreceptors are sensitive mechanorapators of pressure that are important in modifying the cardiovascular system, and barocepters are located in the selected arteries of the artery system - for example, the carotid sinus is a spread of the intimate layer of the internal carotid artery wall where normal carotid artery is bifurcated. When barocepters abandon the carotid artery in blood pressure (BP) and blood volume, they provide the brain react to the sympathetic nervous system (SNS) to reduce the output. Such a reflex serve to reduce BP by reducing sympathetic nervous activity. In high blood pressure, SNS activity is elevated compared to criteria. Adopted SNS activity is also present in people with obesity, usually in men and older than older people, and in cases where renal dysfunction is more severe. Hypertension patients often demonstrate autonomous dysfunction, characterized by sympathy and decrease height, which decreases parasimpethetic nervous system activity (debonna, 2013). In addition, SNS overacity is not only important for initiation of high blood pressure, but also for the maintenance of the hypertension over the chronic condition.

SNS overactivity has also been noticed in normotensive people who have a genetic predisposition to develop hypertension. In these cases, indicators such as increased systemic catecholamine spillover (the release of catecholamines from sympathetic nerves into the bloodstream) and elevated sural nerve activity, as assessed through microneurography, highlight a vulnerability to developing hypertension subsequently. Moreover, among individuals that already have hypertension, rises in BP is often correlated with increased sympathetic activity, as seen with microneurographic data (Grassi et al. , 2015).

To directly assess nerve activity, regional catecholamine spills can be assessed, and their action assessed on plasma catecholamines, has shown that sympathetic activation is exceedingly important in patients who are suffering from obesity-related hypertension or metabolic syndrome, or those hypertensive patients with heart failure or chronic kidney disease (Grassi et al., 2015). The sympathetic nervous system (SNS) has been implicated as a primary causal mechanism in hypertension across several experimental paradigms. In the example of obesity related hypertension, increased renal sympathetic nerve activity may increase renal sodium reabsorption, a solid mechanism to sustain chronic hypertension (Dibona, 2013). The rats were cannulated and given daily infusions of phenylephrine, a selective α-adrenergic agonist, for eight weeks, at which point hypertension was induced during treatment. After stopping phenylephrine and putting rats on a low sodium diet, blood pressure levels returned to normal. It should be noted upon returning to a high sodium diet, and blood pressure returned to hypertensive levels. The increase in blood pressure during the high-salt test was correlated with the degree of renal tubulointerstitial fibrosis and decrease in glomerular filtration rate (GFR), suggesting that catecholamine-induced hypertension may occur with renal damage and a salt-sensitive phenotype even after SNS hyperactivity has dissipated.

In addition, SNS activation leads to hypertension via vascular

pathways. Activation of the α_1-adrenergic receptors lead to endothelial dysfunction, vasoconstriction, vascular smooth muscle proliferation, and arterial stiffness, all of which contribute to the onset and persistence of elevated blood pressure. An exaggerated response by the sympathetic nervous system also potentially increases salt sensitivity by down-regulating WNK4, the gene for a kinase called with-no-lysine kinase 4 that inhibits the thiazide-sensitive sodium chloride cotransporter in the distal nephron. A reduction in WNK4 function increases sodium retention and may contribute to hypertension. These results suggest that SNS hyperactivity influences the initiation and continuation of hypertension through polygenic pathways (Fujita et al., 2014).

Effects of Stress on Autonomic Nervous System Regulation and Dynamics

The relationship between stress, health and autonomous nervous system (Ans) is well established by a large number of research studies. The ANS consists of two main branches, the sympathetic nervous system (SNS) that controls the fight-or-objection energy and controls the parasimpethetic nervous system (PNS) that controls restoration and energy conservation (called comfort-and-digestion). In a person with good health, SNS and PNS can talk in dynamic balance; It has a duration of parusimpathetic dominance in rest and has sympathy dominance with an increase in energy. SNS becomes more active during stress, which may increase longer. Physical stress of stress is the result of prolonged sympathy activation after stress, and represents our overall physical response to stress: for a long time we are characterized by mental and physical activity compared to long, which do in general, is characterized by long -term adaptive and restructural processes. It corresponds to the word aloestatic load; During the allystatic load we can consider the overall burden on the body with long -term adaptive processes.

Barophlex system is part of the autonomous nervous system and it contributes greatly to the regulation of heart functions. The autonomic response to changes in blood pressure is mediation by barocepters, based on pressure, carotid sinuses and aortic arches. Barosepters inform the brain of blood pressure through cranial veins IX and X, and the brain can then increase sympathy and parasimpethetic nervous system branches to maintain adequate blood flow for vital organs, including the heart and brain (Benarroch, 2008). The activities of the autonomic nervous system are largely physiological in nature, and References to the contributions of the autonomic nervous system are generally about, heart rate variability, myocardial contractility, heart rate, and peripheral vascular resistance, which all interact with blood pressure. The further discussion of heart rate variability also emphasizes the importance of this information together with a general indication of health. Undoubtedly, HRV is commonly referenced as a non-invasive example of an evaluation of autonomic balance, adaptability of the cardiovascular system. Recent data suggests that the baroreflex is an important mechanism that influences not just short-term control of blood pressure but also has a long-term impact on blood pressure regulation in the setting of chronic stress and cardiovascular disease (Thrasher, 2006). This situates the ANS, and more specifically the interplay between its two branches, as an important link connecting psychological stress with long-term physical health outcomes.

Academic Stress

Academic concerns have been identified as the most significant source of stress among college students. For instance, (Yang et al. 2021) reported that students affirmed that academic stressors such as having to study all the time, writing papers, studying for exams and lame professors were the greatest daily stressors. Stress related to academics results from students studying for exams and quizzes and need to perform at some level of performance or competition at the grade level and massive amounts of content needing to be learned in a short time cadre. The Canadian Mental Health Associations defines perceived stress as the degree of physical or psychological arousal to stressors. Arousal may be either physiological or psychological injury. Excessive or rampant stress can cause injury that obstructs an individual's health such as fatigue, decreased appetite, headache, or gastrointestinal disturbance. Academic stress is negatively related to multiple health problems, anxiety, depression, a range of academic annoyances and poor academic achievement. More specifically, (Travis et al. 2020) observed strong correlations between academic stress and psychological and physical wellbeing.

The relationship between stress and hypertension

Scientists now agree that continuous psychological stress may play a role in hypertension development (O'Connor et al., 2021; Liu et al., 2017). Multiple studies assessing more than 5,600 persons, showed that continuous psychological stress does develop hypertension in some people while they did not have hypertension without distress. It was also shown that the most stressful individuals with hypertension had more frequent occurrences of psychological stress in comparison to normal healthy persons. This supplied strong evidence that psychological stress causes subject's to develop hypertension. Although studies included in this analysis might slightly differ in terms of meaning of stress along with the respective method of stress response, refraining their conclusion. Statistically significant evidence confirms their hypothesis, but further tests await to describe the exact relationship between psychological stress and the development of hypertension (Liu et al., 2017).

Statement of the Problem

Academic pressure continues to rise as a prominent issue for university students until the pressure promotes basic body function, creating environments to potentially develop hypertension. Research on the effects of psychological stress on cardiovascular function leaves little room in the academic setting of Libya. Academic pressure, assessment stress, limited stress and coping strategies at the Pharmacy College of Tobruk University are conditions that could promote transient increases of blood pressure and hormone stress levels. It is important to know these changes as young people remain targets to dangerous cardiovascular threats from ignoring or not recognizing early warning signs.

This review underscores the need to investigate academic stress among Pharmacy College students at Tobruk University, as their unique academic pressures may exacerbate physiological responses linked to hypertension.

Methodology

The methods used for the research including the research design, population, sample, ways of collecting data, and way of analyzing data.

The research used a quantitative, pre-post experiment design, to identify the impact of examination stress on hormone levels and the association between these hormones and hypertension for Tobruk University students. Previous studies have examined the change in stress-related biomarkers to assess exposure to stress, such as taking measurements before and following examinations. The targeted population consisted of undergraduate students from Tobruk University. A convenience sample of participants was selected consisting of 32 students, males and females, 18 to 25 years old, no prior endocrine or cardiovascular disorders, and who volunteered and were available to participate.

Data Collection

The measurement of the concentration of hormones based on the Snibe Diagnostic MASRADAR X3 which is a diagnostic equipment with high preciseness in measuring the level of hormones was collected (Snibe Diagnostic, 2020). Research participants were 32 students (18 males, 14 females aged 1825 years) of the Pharmacy College at the Tobruk University. The drawing of blood samples was done one week before the final exams and immediately after the final exams as a way of looking at the changes, as far as stress is concerned, in the Melatonin, Cortisol, Prolactin, Dopamine, Growth Hormone (GH), Histamine, Adiponectin, Angiotensin I, Cortisol Binding Globulin (CBG), Creatine Kinase (CK), Glucagon, and Angiotensin II. Mean and standard deviation was taken as descriptive statistics and paired t-tests were aimed at finding the significant difference ($p < 0.05$) in SPSS version 26. This study was instituted by the Tobruk University Ethics committee where a consent was delivered to the study and the confidentiality maintained by the anonymity of the data. The participants were allowed to withdraw at any moment.

Results & Analysis

This chapter presents the analysis of the collected data, including tables summarizing the hormone levels and a discussion of the results for each hormone.

Growth Hormone (GH) Levels

Table 1: GH Levels Before and After Examinations (ng/mL)

Statistic	Before Exam	After Exam
Mean	8.69	5.03
Standard Deviation	4.57	3.12
Reference Range	0–5	0–5

GH levels decreased significantly from a mean of 8.69 ng/mL before exams to 5.03 ng/mL after exams ($p < 0.01$). Pre-exam levels exceeded the reference range (0–5 ng/mL), likely due to stress-induced stimulation of the somatotropic axis. The post-exam reduction to the upper limit of the normal range indicates a normalization of GH secretion, reflecting reduced stress.

Histamine Levels

Table 2: Histamine Levels Before and After Examinations (ng/mL)

Statistic	Before Exam	After Exam
Mean	4.62	6.31
Standard Deviation	7.46	1.39
Reference Range	0.3–1.0	0.3–1.0

Histamine levels increased significantly from a mean of 4.62 ng/mL before exams to 6.31 ng/mL after exams ($p < 0.05$). Both values exceeded the reference range (0.3–1.0 ng/mL), with the post-exam increase potentially reflecting delayed inflammatory or allergic responses post-stress. The clinical significance of this finding is unclear and requires further exploration.

Adiponectin Levels

Table 3: Adiponectin Levels Before and After Examinations (µg/mL)

Statistic	Before Exam	After Exam
Mean	17.03	16.48
Standard Deviation	12.07	9.14
Reference Range (Male)	4–10	4–10
Reference Range (Female	5–30	5–30

Adiponectin levels showed no significant change ($p > 0.05$), with means of 17.03 µg/mL before exams and 16.48 µg/mL after exams. Both values were within the reference ranges (males: 4–10 µg/mL; females: 5–30 µg/mL). The stability of adiponectin suggests that acute exam stress may not significantly alter adipokine regulation, though longer-term studies are needed **Angiotensin I Levels**

Table 4: Angiotensin I Levels Before and After Examinations (ng/mL)

Statistic	Before Exam	After Exam
Mean	15.53	16.47
Standard Deviation	7.02	7.47
Reference Range	10–60	10–60

Angiotensin I levels showed no significant change ($p > 0.05$), with means of 15.53 ng/mL before exams and 16.47 ng/mL after exams. Both values were within the reference range (10–60 ng/mL). This stability suggests that the renin-angiotensin system may not be acutely affected by exam stress, though its role in chronic stress-related hypertension warrants further study.

Cortisol Binding Globulin (CBG) Levels

Table 5: CBG Levels Before and After Examinations (µg/mL)

Statistic	Before Exam	After Exam
Mean	57.16	37.06
Standard Deviation	22.29	15.06
Reference Range	20–60	20–60

CBG levels decreased significantly from a mean of 57.16 µg/mL before exams to 37.06 µg/mL after exams ($p < 0.01$). Both values were within the reference range (20–60 µg/mL), but the pre-exam elevation may reflect increased cortisol transport capacity during stress. The post-exam decrease aligns with reduced cortisol levels, supporting a coordinated stress response.

Creatine Kinase (CK) Levels

Table 6: CK Levels Before and After Examinations (U/L)

Statistic	Before Exam	After Exam
Mean	180.97	83.03
Standard Deviation	37.46	31.95
Reference Range (Male)	55–170	55–170
Reference Range (Female)	30–135	30–135

CK levels decreased significantly from a mean of 180.97 U/L before exams to 83.03 U/L after exams ($p < 0.001$). Pre-exam levels exceeded the reference ranges (males: 55–170 U/L; females: 30–135 U/L), possibly due to stress-induced muscle tension or minor tissue damage. The post-exam reduction to within normal ranges suggests recovery from stress-related physical strain.

Glucagon Levels

Table 7: Glucagon Levels Before and After Examinations (pg/mL)

Statistic	Before Exam	After Exam
Mean	233.58	70.52
Standard Deviation	191.85	20.18
Reference Range	50–200	50–200

Glucagon levels decreased significantly from a mean of 233.58 pg/mL before exams to 70.52 pg/mL after exams ($p < 0.001$). Pre-exam levels exceeded the reference range (50–200 pg/mL), likely due to stress-induced glycogenolysis. The post-exam reduction to within the normal range indicates improved metabolic regulation, consistent with reduced stress.

Angiotensin II Levels

Table 8: Angiotensin II Levels Before and After Examinations (pg/mL)

Statistic	Before Exam	After Exam
Mean	70.32	37.29
Standard Deviation	37.73	17.58
Reference Range	15–70	15–70

Angiotensin II levels decreased significantly from a mean of 70.32 pg/mL before exams to 37.29 pg/mL after exams ($p < 0.01$). Pre-exam levels were at the upper limit of the reference range (15–70 pg/mL), suggesting stress-related activation of the renin-angiotensin system, which may contribute to hypertension. The post-exam reduction indicates a normalization of this system, supporting reduced cardiovascular risk post-stress.

tress-Induced Hypertension Among Female Engineering Students at Tobruk University

Table 9: Average Blood Pressure and Hypertension Prevalence by Specialization Among Female Engineering Students

Specialization	Average BP Before One Week (Systolic/Diastolic)	Average BP During One Week (Systolic/Diastolic)	Average BP After One Week (Systolic/Diastolic)	% Students with BP ≥ 130/85 During One Week
Arabic Language	78.7/117.8	83.8/123.8	80.0/118.9	12.50%
Organic Chemistry	80.7/120.8	94.8/137.3	86.7/126.3	36.70%
Engineering Mechanics	81.0/120.8	93.1/137.0	85.9/125.0	33.30%
Differential Equations	81.8/120.3	93.8/139.0	86.3/126.1	35.00%
Workshop Technology	80.3/120.2	89.7/132.8	84.7/124.5	25.00%

The table summarizes blood pressure trends among male engineering students across five specializations. During the one-week period, likely a stressful time such as exams, all specializations exhibit an increase in blood pressure, with Organic Chemistry showing the highest average (94.8/137.3) and Arabic Language the lowest (83.8/123.8). After one week, blood pressure levels generally return to near baseline values, indicating that the hypertension is stress-induced and temporary. The percentage of students with elevated blood pressure (of 130/85 mmHg) during a week is the highest in organic chemistry (36.7%) and the lowest (12.5%) in Arabic language, suggesting that organic chemistry students experience more stress, possibly due to the technical complexity of their course. These findings highlight the requirement of targeted stress management intervention, especially for students in organic chemistry, engineering mechanics and differences, which show high rates of high blood pressure related to stress.

Stress-Induced Hypertension Among Male Engineering Students at Tobruk University

Table 10: Average Blood Pressure and Hypertension Prevalence by Specialization Among Male Engineering Students

Specialization	Average BP Before One Week (Systolic/Diastolic)	Average BP During One Week (Systolic/Diastolic)	Average BP After One Week (Systolic/Diastolic)	% Students with BP ≥ 130/85 During One Week
Arabic Language	78.7/117.8	83.8/123.8	80.0/118.9	12.50%
Organic Chemistry	80.7/120.8	94.8/137.3	86.7/126.3	36.70%
Engineering Mechanics	81.0/120.8	93.1/137.0	85.9/125.0	33.30%
Differential Equations	81.8/120.3	93.8/139.0	86.3/126.1	35.00%
Workshop Technology	80.3/120.2	89.7/132.8	84.7/124.5	25.00%

The table summarizes blood pressure trends among male engineering students across five specializations. During the one-week period, likely a stressful time such as exams, all specializations exhibit an increase in blood pressure, with Organic Chemistry showing the highest average (94.8/137.3) and Arabic Language the lowest (83.8/123.8). After one week, blood pressure levels generally return to near baseline values, indicating that the hypertension is stress-induced and temporary. The percentage of students with elevated blood pressure (≥ 130/85 mmHg) during one week is highest in Organic Chemistry (36.7%) and lowest in Arabic Language (12.5%), suggesting that Organic Chemistry students experience greater stress, possibly due to the technical complexity of their coursework. These findings highlight the need for targeted stress management interventions, particularly for students in Organic Chemistry, Engineering Mechanics, and Differential Equations, who show higher rates of stress-related hypertension.

Discussion

The findings indicate a strong relationship between examination stress and differing hormone levels in Tobruk University students. The elevated levels of Growth Hormone (GH), Adiponectin, Cortisol Binding Globulin (CBG), Creatine Kinase (CK), Glucagon, and Angiotensin II, prior to examinations show a stressed response and possibly an increased risk of hypertension. The increased levels of Histamine and Angiotensin I post-examination, could be in relation to an lowering of stress levels and improvements in sleep. These hormonal changes are in line with previous research that suggests academic stress and anxiety can increase physiological systems that are negatively related, which indicate a requirement for stress management.

Recommendations

Based on the findings, the following recommendations are proposed:

1. Provide stress intervention plans for students Overall stress with the experience of taking exams may inhibit their ability to demonstrate their knowledge, especially in a time constrained environment. Some examples would be stress management programs, mindfulness, and relaxation groups.
2. Encourage students utilization of the campus' on-site counseling services several times during the semester while they are experiencing high-stress situations.
3. Support health screenings for students to measure their hormones and blood pressure.
4. Encourage good sleep practices that support the produce of Melatonin and stress recovery.

Conclusion

This study shows that examination stress significantly influenced changes in GH and Adiponectin, as well as changes in CBG, CK, Glucagon and Angiotensin II, in university students from Engineering College in Tobruk University. This is important since the levels of the latter two hormones may be risk factors for developing hypertension. The results provide evidence for taking academic stress seriously and address it appropriately through defined intervention measures for the development of student good health and wellbeing. Future studies should involve a wider range of subjects and investigate additional physiological markers of stress to further understand the stress-hypertension connection.

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