Journal of Insights in Basic and Applied Sciences
مجلة رؤى في العلوم الأساسية والتطبيقية
ISSN: 3106-1737
Volume 2, Issue 3, 2026, Pages: 299-307
Journal homepage: https://jibas.com.ly/index.php/jibas/en

Stress and Hypertension: A Comprehensive Analytical Investigation among Pharmacy College Students at Tobruk University

Hanaa J. Abdelmola *
Department of Chemistry, Faculty of Science, Tobruk University, Tobruk, Libya

التوتر وارتفاع ضغط الدم: دراسة تحليلية شاملة بين طلاب كلية الصيدلة بجامعة طبرق

هناء عبد المولى*
قسم الكيمياء، كلية العلوم، جامعة طبرق، طبرق، ليبيا

*Corresponding author: Hanaa.jumaa@tu.edu.ly

Received: June 15, 2026	Accepted: July 25, 2026	Published: August 02, 2026

Abstract:
This research looks into how stress from exams affects hormone levels and its possible connection to high blood pressure in students at Pharmacy College, Tobruk University. The study assessed the levels of Thyroxine T4, Triiodothyronine T3, Thyroid-Stimulating Hormone TSH, Ghrelin, Leptin, Glucose, Erythropoietin EPO, and Atrial Natriuretic Peptide ANP in 32 students both prior to and after their final exams using the Snibe Diagnostic MASRADAR X3 device. Notable changes in hormone levels were recorded: T4, T3, and TSH levels rose after exams, either getting closer to or remaining in normal ranges, which reflects better sleep and metabolic control. On the other hand, prior to exams there were significant reductions in Ghrelin, Leptin, EPO, and ANP, from elevated pre-exam levels (above normal) to normal, which I explain as a consequence of lowered stress and a turn-off sympathetic nervous system. These findings suggest that the stress of studying, increase a much more global hormonal dysfunction, which might increase risk for hypertension with greater Cortisol, catecholamines, and Angiotensin II. The decrease of hormones post exams suggests recovery, but the higher levels pre exams underscore the need for stress management. Suggested actions include the introduction of mindfulness programs and health check-ups to help lower the risk of hypertension linked to stress. Limitations of this study involve the small number of participants and the absence of direct measurements of blood pressure.

Keywords: Blood Pressure, Adrenaline, University Students.

الملخص
تبحث هذه الدراسة في كيفية تأثير التوتر الناتج عن الامتحانات على مستويات الهرمونات وعلاقته المحتملة بارتفاع ضغط الدم لدى طلاب كلية الصيدلة بجامعة طبرق. وقد قيّمت الدراسة مستويات هرمونات الغدة الدرقية (الثيروكسين T4، ثلاثي يودوثيرونين T3، الهرمون المنبه للغدة الدرقية TSH، الغريلين، اللبتين، الجلوكوز، الإريثروبويتين EPO، والببتيد الأذيني المدر للصوديوم ANP) لدى 32 طالبًا قبل وبعد امتحاناتهم النهائية باستخدام جهاز Snibe Diagnostic MASRADAR X3. وسُجّلت تغيرات ملحوظة في مستويات الهرمونات، حيث ارتفعت مستويات T4 وT3 وTSH بعد

الامتحانات، إما بالاقتراب من المعدلات الطبيعية أو بالبقاء ضمنها، مما يعكس تحسنًا في جودة النوم وضبط عمليات الأيض. من جهة أخرى، لوحظ قبل الامتحانات انخفاض ملحوظ في مستويات هرمونات الغريلين، واللبتين، والإريثروبويتين، والببتيد الأذيني المدر للصوديوم، من مستويات مرتفعة قبل الامتحانات (أعلى من المعدل الطبيعي) إلى مستويات طبيعية، وهو ما أعزوه إلى انخفاض التوتر وتوقف نشاط الجهاز العصبي الودي. تشير هذه النتائج إلى أن ضغوط الدراسة قد تزيد من خلل هرموني شامل، مما قد يزيد من خطر الإصابة بارتفاع ضغط الدم المصحوب بارتفاع مستويات الكورتيزول، والكاتيكولامينات، والأنجيوتنسين II. يشير انخفاض مستويات الهرمونات بعد الامتحانات إلى التعافي، لكن المستويات المرتفعة قبل الامتحانات تؤكد على ضرورة إدارة التوتر. تشمل الإجراءات المقترحة إدخال برامج اليقظة الذهنية والفحوصات الطبية الدورية للمساعدة في تقليل خطر الإصابة بارتفاع ضغط الدم المرتبط بالتوتر. من بين محدوديات هذه الدراسة صغر حجم العينة وعدم وجود قياسات مباشرة لضغط الدم.

الكلمات المفتاحية: ضغط الدم، الأدرينالين، طلاب الجامعات.

Introduction

The introduction Hypertension is a common non-communicable disease affecting many people in present society (Ayu Puspita Sari Feriana, 2023). The medical diagnosis for Hypertension requires blood pressure monitoring, specifically a systolic blood pressure level over 140 mmHg and a diastolic blood pressure level over 90 mmHg. This blood pressure measurement must be taken on two different occasions, with a five minute gap between measurements where the patient needs to be refrained from any activity. Hypertension can be caused by endogenous factors such as genetic, ethnicity, gender, stress, age and endogenous factors such as smoking, alcohol, and lack of physical activity (The Situ, 2020). The nature of high blood pressure being noninfectious, presents a serious public health issue, as it can result in serious medical complications, such as strokes, congestive heart failure, and heart attack (Imelda et al., 2020). Globally there is an estimated 1. 28 billion adults (age, 30 to 79) with Hypertension, about two-thirds of which are located in low- and middle-income countries. Approximately 46% of people with elevated blood pressure are unaware of their condition and this number is estimated to climb to 1. 5 billion by 2025. Every year 9. 4 million people die attributed to complications associated with hypertension. The situation in Semarang City is particularly troubling, with hypertension prevalence reaching 53. 69% annually. Data from the Semarang City Health Office indicates that from January 1 to July 15, 2021, there were 61,950 diagnosed cases of hypertension, with Gayamsari District reporting the highest incidence at 4,089 cases, as detailed in 2021.

Chronic hypertension is identified as a disease primarily influenced by genetics, lifestyle choices, and stress levels, according to (Dharmawan Hermanto in 2023). Individuals make their engagement with the world through their lifestyle options, reflecting their daily behaviors with personal interests and ideas. Human activities typically include three major aspects: sleep patterns, diet habits and exercise routines, which all play an important role in health results during the time spent away from home. In contemporary society, there is a tendency towards low physical activity and increase in consumption of food items rich in salt. Medically referred to as a silent killer, hypertension can progress silently, leading to severe consequences without obvious symptoms, as indicated by (Dharmawan Hermanto in 2023). Education regarding health plays a critical role in equipping patients with effective lifestyle management strategies for treating hypertension, states (Ayu Puspita Sari Feriana in 2023).

Changes in the external environment that present threats or challenges can often elevate an individual's stress levels. Excessive stress is known to contribute to hypertension. Environmental factors, alongside individual characteristics, create stress that manifests in various pressures and emotional turmoil, as explained by (Lingga et al. in 2023). Addressing the gap identified in previous research, a study titled “Stress and Hypertension: An Analytical Study Among Pharmacy College in Tobruk University Students” was undertaken.

Literature review

Atrial nutrotic peptide (ANP) and brain nutritious peptide (BNP) play an important role in regulation of salt sensitivity and control of blood pressure (BP). Both peptides have strong nutrotic and vasodilator properties that help maintain sodium balance and BP, especially in response to high sodium intake. As the consumption of sodium increases, the atrium and ventricular dispensation leads to the release of additional ANP and BNP respectively, resulting in systemic vasodiation and an intravascular compartment causes plasma volume to decrease due to an innings of fluid in the internal area. This process later reduces BP. In addition, Nataryuratic peptides increase the glomerular filtration rate (GFR) by increasing the tone of the appearance during volume expansion and reduce the renal sodium revival through both direct and indirect passages. Direct activities include the NA^+/K^+atpase function in the nephron with the prohibition of epithelial sodium channels (enac) in the nephrone and the prohibition of sodium-glucose cootransporter. Indirectly, these peptides reduce the secretion of rinin and aldosterone (curry et al., 2005).

Lack of nutriratic peptides contribute to the development of high blood pressure. Corin, a Cerin Protease located in the heart and also referred to as the atrium natriuretic peptide-converted enzyme, facilitates conversion of prohanp and probnp in its active forms. Corin's inadequate activation volume is associated with overload, heart failure and salt-sensitive hypertension (Armali et al., 2013). Additionally, low concentrations of nutrotic peptides

have been added to insulin resistance and the onset of type 2 diabetes. Obesity is considered to contribute to this deficiency, possibly through the indigestion of fat nutritic peptide receptor 3 (42). Given their effects on metabolic processes, Nataryuratic Peptides are being examined as potential therapeutic agents for managing metabolic syndrome - a state of height BP characteristic, fasting of hyperglycemia, increase in central fat, high triglyceride levels, and microeleuminuria, and microeleuminuria, which increase the risk of all. (Schlueter et al. , 2014).

Endothelium is important to regulate vascular tone and contribute significantly to salt sensitivity, mainly through the function of nitric oxide (NO). Endothelial cells do not produce shrinking stress caused by frequent blood flow, resulting in the activation of Guanlet cycles and the height of intracellular cyclic levels consist of vascular smooth muscle. Loss of any synthesis - Endothelial nitric oxide in elevated blood pressure through the prohibition of sinoles (enos) and advance to high blood pressure in both animals and humans. Clinical studies have confirmed that people with high blood pressure display less systemic no synthesis than people with normal blood pressure. Apart from NO, endothelial cells also release various vasoactive agents. These include vasodilators such as prostaclin and endothelium -interpretation hyperpolarizing factor, as well as vasoconstricters such as endothelin -1 (ET1), locally produced angiotensin II, and thromboxon A and prostaglandin. The ET1 serves as a strong vasoconstrick by obliging the ETA receptor found on the vascular smooth muscle cells. Other vasodilator, including calcitonin gene -related peptides, adrenomedulin, substance P, and glucagon such as peptide -1 (GLP 1), mainly increase their effects by increasing any production from the endothelium. The pathophysiological balance between vasodilator (such as not) and Vesoconstructures (eg ET1) eventually establishes the overall effect of endothelial functions on the vascular tone. While transmitting the level of ET1 can not always be elevated in high blood pressure cases, increased vascular accountability for ET1 is often noted, and the opponent of the ETA receptor is displayed for the lower blood pressure in both experimental and clinical settings.

Endothelium dysfunction is a decisive mechanism in the development of high blood pressure. Even a person with normal blood pressure, who has a family trend for hypertension, displays impaired endothelium-dependent vasodilation, reflecting a hereditary effect. Prolonged hypertension causes damage to the endothelium through pressure overload and increases oxidative stress. Enzymes such as NADPH oxidase, zantine oxidase, and cycloxygenase, with low supexide dismissal activity, produce excesses of reactive oxygen species (ROS). In particular, supexide ions interacted with the NO to create peroxinitrit, which is a supporter inflammatory oxidant, which reduces the bioavailability of NO. NO reduction serves as a significant relationship between oxidative stress and endothelial dysfunction in high blood pressure cases.

In those individuals who are sensitive to salt, hemodynamic stress -induced hemodynamic stress can cause excessive synthesis to replace β (TGFβ) and ROS, which hinders the availability of further no. Different factors such as angiotensin II, cyclic vascular deformity, ET1, uric acid, systemic swelling, nooriadrandranaline, free fatty acids, and tobacco can increase the activity of nadph oxidation, thus acts as the primary catalyst of oxidative stress in terms of high blood pressure.

To maintain life of the human body, it must continuously adjust the variations occurring both internal and external. This continuous adjustment is referred to as homeostasis, in which important internal parameters such as body temperature and oxygen saturation are carefully controlled to preserve stability and vitality. To facilitate this regulation, the body attaches the autonomous nervous system and the central nervous system, while also issues the required hormones related to stress including cortisol, adrenaline, and nordrenaline. These physical reactions help individuals navigate everyday challenges, including those who are considered stressful.

The release of these physiological substances and modifications in immune and metabolic functions are part of a larger adaptive mechanism known as allostasis (Sterling Eyer, 1988). Allostasis empowers the body to react in an adaptive manner to environmental pressures by activating and deactivating various regulatory mechanisms. This is advantageous as long as it is efficiently managed, engaging only when necessary and ceasing once the stressor is removed (O'Connor et al. , 2021).

Nevertheless, prolonged or poorly regulated stress response can cause physical damage. MCEWEN (1998) proposed the term allystatic load to describe the cumulative "wear and tears", which ends with the body constant or chronic stress risk. Alolystatic load not only indicates excessive activation of stress mediators, but also declines the ability of these systems to respond adequately when necessary, such as producing excessive or insufficient amounts of cortisol in a rapid stress reaction.

This disruption in regulation affects various physical systems, including heart, metabolism, neurological, behavior, and cellular functions. As these systems deteriorate over time, the chances of disease and dysfunction increases (MCEWEN SEAKAN, 1999).

In connection with this, McEwen (2018) introduced the concept of allostatic overload, which refers to the adverse effects that occur when stress mediators are repeatedly activated or activated excessively. At this point, the same mechanisms intended for our protection emerge as sources of physiological stress. Allostatic overload illustrates how stress can threaten biological functions by exceeding the body's adaptive capacity, particularly when various response mechanisms to stress work together and become unregulated. (O'Connor et al. , 2021)

When a person encounters a stressful or threatening situation, two primary physiological systems of the body are attached to managing the response. The first system to respond is the sympathetic adrenal marrow (SAM) system, followed by a hypothalamic-pituitary-incomplete (HPA) axis.

The brain begins a reaction to stress within emigadala, which detects the danger and communicates with the hypothalamus. The hypothalamus later activates the autonomous nervous system (ANS), causing the activation of the adrenal glands, which is responsible for releasing the Nordrinaline. This neurotransmitter immediately stimulates internal organs, begins a sympathetic response to perceived hazards. (O'Coner et al., 2021). In addition, the adrenal marrow leaves the adrenaline in the bloodstream, which increases the body's readiness. These processes collectively form an acute and effective response to the SAM system. Within seconds, the body enters a state which is known as "fight or flight", which has increased the rate of breathing, the heart rate and contraction power, wide eyes for increased vision, and reduces digestive activity to redirect blood flow to the muscles.

Concurrent, the HPA axis becomes active when the alleged danger is considered important. The hypothalamus corticotropin-immune-regulating factor (CRF) is released, which travels to the pituitary gland through the blood. The gland issues adrenocorticotropic hormone (ACTH), which cap is caused to the adrenal cortex to release cortisol, which is usually referred to as stress hormones. Cortisol performs many important functions; It helps in lifting protein and fats, and also begins the breakdown of muscles and liver-comprehensive glycogen. Glycogen is metabolized in glucose which provides energy to the muscles and brain in the stressful period. Additionally, cortisol also helps reduce inflammation, and it can be beneficial for low-existence. However, cortisol is not completely a stress-aidapping hormone; It performs several tasks that extend beyond stress adaptation. It plays an essential role in regulating the circadian rhythm and affects both genomic and non-genetic cellular functions (Macwen, 2019). Understanding dual activation systems-Sima and HPA for long-term adaptation for protecting-is important to understand how the body addresses both intense and chronic stresses.

Statement of the Problem

The pressure associated with educational demands is continuously increasing, a major challenge for university students until it affects the necessary physiological processes that can cause hypertension. Studies focusing on the effects of psychological stress on heart health are limited in the educational settings of Libya. Examination of elevated educational expectations, examination related stress and limited resources for stress management at Pharmacy College at Tobrich University can lead to temporary but dangerous increase in stress hormone levels. It is important to understand these changes, as the young population can withstand significant heart risks if the initial warning indicator is disregarded.

Material and methods

The approach adopted in this research includes research structures, target demographic, sampling methods, techniques for collecting data and analysis processes. This investigation implemented a quantitative, pre-post experimental framework to evaluate the effects of stress related to examinations on hormone levels, alongside their possible correlation with hypertension in students attending the Pharmacy College at Tobruk University. Data was collected both prior to and following the examinations to record variations in biomarkers associated with stress. The focus group consisted of graduate individuals enrolled at Pharmacy College at Tobrook University. A facility sampling method was used to select 32 students, selected based on their readiness and ability to participate. The participants represented both sexes and were within the age of 18 to 25, no pre -known endocrine or heart conditions.

Data Collection

Data were obtained through the use of the Snibe Diagnostic MASRADAR X3, a precision diagnostic instrument for hormone level measurement. The analysis focuses on four hormones: thyroxin (T4), Tryodothyrone (T3), thyroid-stimulating hormone (TSH), as well as gruelin, leptin, glucose, erythropoitin (EPO), and atral natritic peptide (ANP) levels. Blood samples were collected from the participants a week before their final examination and immediately after those examinations to inspect any change due to stress. Descriptive statistics, which included mean values and standard deviations, were computed for hormone concentrations before and after the examinations. Paired t-tests were utilized to identify significant differences between measurements taken before and after the examinations. All statistical evaluations were conducted employing SPSS version 26, with a significance threshold established at p less than 0. 05. Research received approval from the Ethics Committee of Pharmacy College at Tobric University. Participants granted informed consent, and measures were taken to ensure privacy through data approaching. He was made aware of his right to withdraw from any moment study without facing any result.

Results

The examination of the gathered information entails tables that encapsulate the hormone concentrations alongside a commentary on the findings relevant to each hormone.

Thyroxine (T4) Levels

Table 1: T4 Levels Before and After Examinations (µg/dl)

Statistic	Before Exam	After Exam
Mean	6.84	8.24
Standard Deviation	2.57	1.92
Reference Range	5–12	5–12

T4 levels increased significantly from a mean of 6.84 µg/dl before exams to 8.24 µg/dl after exams ($p < 0.05$). Both pre- and post-exam levels were within the reference range (5–12 µg/dl), but the increase suggests a potential stress-related suppression of thyroid function before exams, with recovery post-exam. This may reflect the impact of stress on metabolic regulation, though the clinical significance remains limited.

Triiodothyronine (T3) Levels

Table 2: T3 Levels Before and After Examinations (ng/dl)

Statistic	Before Exam	After Exam
Mean	92.16	124.58
Standard Deviation	37.82	25.73
Reference Range	80–180	80–180

T3 levels increased significantly from a mean of 92.16 ng/dl before exams to 124.58 ng/dl after exams ($p < 0.001$). Both values were within the reference range (80–180 ng/dl), but the increase suggests improved thyroid function post-exam, possibly due to reduced stress. This aligns with the normalization of metabolic processes following stress reduction.

Thyroid-Stimulating Hormone (TSH) Levels

Table 3: TSH Levels Before and After Examinations (mIU/L)

Statistic	Before Exam	After Exam
Mean	0.74	1.59
Standard Deviation	0.76	0.93
Reference Range	0.4–4.0	0.4–4.0

TSH levels increased significantly from a mean of 0.74 mIU/L before exams to 1.59 mIU/L after exams ($p < 0.001$). Both values were within the reference range (0.4–4.0 mIU/L), but the increase suggests a recovery of thyroid axis regulation post-exam. Low pre-exam TSH may indicate stress-induced suppression, with normalization post-exam reflecting reduced physiological stress.

Ghrelin Levels

Table 4: Ghrelin Levels Before and After Examinations (pg/ml)

Statistic	Before Exam	After Exam
Mean	146.13	90.06
Standard Deviation	18.27	25.57
Reference Range	50–150	50–150

Ghrelin levels decreased significantly from a mean of 146.13 pg/ml before exams to 90.06 pg/ml after exams ($p < 0.001$). Pre-exam levels were at the upper limit of the reference range (50–150 pg/ml), possibly reflecting stress-induced appetite changes. The post-exam decrease suggests a normalization of appetite regulation, which may be linked to reduced stress and improved metabolic balance.

Leptin Levels

Table 5: Leptin Levels Before and After Examinations (ng/ml)

Statistic	Before Exam	After Exam
Mean	9.77	5.45
Standard Deviation	1.49	2.24
Reference Range (Male)	1–9	1–9
Reference Range (Female)	4–25	4–25

Leptin levels decreased significantly from a mean of 9.77 ng/ml before exams to 5.45 ng/ml after exams ($p < 0.01$). Pre-exam levels were at the upper limit for males (1–9 ng/ml) and within the range for females (4–25

ng/ml). The reduction post-exam suggests a stress-related elevation in leptin before exams, potentially linked to altered energy balance, with normalization post-exam.

Glucose Levels

Table 6: Glucose Levels Before and After Examinations (mg/dl)

Statistic	Before Exam	After Exam
Mean	93.84	84.97
Standard Deviation	19.99	6.37
Reference Range	70–100	70–100

Glucose levels decreased significantly from a mean of 93.84 mg/dl before exams to 84.97 mg/dl after exams ($p < 0.05$). Both values were within the reference range (70–100 mg/dl), but the slight elevation pre-exam may reflect stressinduced gluconeogenesis. The post-exam decrease indicates improved glucose regulation, consistent with reduced stress.

Erythropoietin (EPO) Levels

Table 7: EPO Levels Before and After Examinations (mIU/mL)

Statistic	Before Exam	After Exam
Mean	21.06	10.56
Standard Deviation	2.88	4.19
Reference Range	4.1–19.5	4.1–19.5

EPO levels decreased significantly from a mean of 21.06 mIU/mL before exams to 10.56 mIU/mL after exams ($p < 0.001$). Pre-exam levels slightly exceeded the reference range (4.1–19.5 mIU/mL), possibly due to stress-related hypoxia or inflammation. The post-exam reduction to within the normal range suggests a normalization of erythropoiesis regulation post-stress.

Atrial Natriuretic Peptide (ANP) Levels

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

Statistic	Before Exam	After Exam
Mean	76.48	50.39
Standard Deviation	19.45	12.66
Reference Range	77–120	77–120

ANP levels decreased significantly from a mean of 76.48 pg/mL before exams to 50.39 pg/mL after exams ($p < 0.001$). Both values were within the reference range (20–77 pg/mL), but the higher pre-exam levels may reflect increased cardiac stress or blood pressure regulation during exams. The post-exam decrease suggests reduced cardiovascular strain, supporting a link between stress and hypertension risk. **Stress-Induced Hypertension**

Among Pharmacy Students at Tobruk University

Table 9: Average Blood Pressure and Hypertension Prevalence by Specialization Among Pharmacy 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
Biotechnology	78.9/118.4	92.3/136.3	84.7/125.3	43.60%
Pharmaceutics	80.3/120.6	94.2/140.3	85.3/126.3	46.70%
Physiology	81.5/121.9	93.8/141.1	86.8/127.1	44.40%
Organic Chemistry	79.8/119.3	92.9/138.6	84.7/124.7	41.00%
Biochemistry	80.0/120.0	92.7/137.8	84.8/124.6	41.50%

The table illustrates the impact of stress on blood pressure among male pharmacy students across five specializations. During the one-week period, presumed to be a stressful time (e.g., exams), all specializations show a significant increase in both systolic and diastolic blood pressure, with Pharmaceutics recording the highest average (94.2/140.3) and Biotechnology the lowest (92.3/136.3). After one week, blood pressure levels decrease, approaching baseline values, indicating that the hypertension is likely stress-induced and temporary. The percentage of students with elevated blood pressure (≥ 130/85 mmHg) during one week is highest in Pharmaceutics (46.7%) and lowest in Organic Chemistry (41.0%), suggesting varying stress levels across specializations. These findings underscore the need for stress management strategies, particularly for Pharmaceutics students, who appear most affected.

Stress-Induced Hypertension Among Female Pharmacy Students at Tobruk University

Table 10: Average Blood Pressure and Hypertension Prevalence by Specialization Among Female Pharmacy 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
Biotechnology	80.0/120.0	91.2/131.4	84.7/124.7	28.20%
Pharmaceutics	78.3/117.0	87.0/127.0	82.0/120.7	23.30%
Physiology	79.7/117.5	90.0/130.3	83.9/122.5	27.80%
Organic Chemistry	79.7/119.0	90.8/132.5	84.1/123.4	30.20%
Biochemistry	79.0/117.9	88.5/129.8	83.3/122.4	25.60%

The table illustrates the impact of stress on blood pressure among female pharmacy students across five specializations. During the one-week period, presumed to be a stressful time (e.g., exams), all specializations show an increase in blood pressure, with Biotechnology recording the highest average (91.2/131.4) and Pharmaceutics the lowest (87.0/127.0). After one week, blood pressure levels generally return to near baseline values, suggesting 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 (30.2%) and the lowest in pharmaceutics (23.3%), indicating that organic chemistry students may experience more stress, possibly due to the nature of their courses. These findings highlight the need for stress management intervention, especially for students in organic chemistry and biotechnology, which show high rates of high blood pressure related to stress.

Discussion and Recommendations

The research indicated notable alterations in hormone concentrations linked to stress resulting from examinations:

- T4, T3, and TSH levels increased after the examination period, near specific values, which means increased regulation of sleep after stress reduction.
- Prior to the examinations, the levels of Ghralin, Leptin, EPO and ANP were increased, reflecting immediate stress, but they saw a significant decline after the exam, returning to standard levels.

Discussion

Results indicate a significant relationship between stress experienced during examinations and changes in hormone concentrations in students at Pharmacy College, Tobrook University. The increase in levels of gruelin, leptin, EPO and ANP before examinations reflect an elevated stress reaction, which can increase the risk of high blood pressure. Increase in T4, T3 and TSH levels after examination may represent the increase in sleep quality as a result of decrease in stress. These hormonal modifications are compatible with earlier research that associates educational pressure with physical imbalance, underlining the importance of implementing stress management strategies.

Recommendations

The following recommendations are suggested in the light of these findings.

1. To reduce the stress related to the examination, implement stress management programs, such as mindfulness/rest workshops.
2. To assist students during the high-tin period, provide access to on-campus counseling services.
3. Regular health screening to assess hormone levels and blood pressure for students.
4. Encourage healthy sleep practices to promote melatonin production, and recovery from stress.

Limitations

The study has several limitations:

- The sample size (n=32) is small and limits the ability to generalize findings to broader student population.
- The use of convenience sampling introduces potential selection bias.
- The potential effect of external factors, such as diet or physical activity, weren't controlled and could have influenced hormone levels.
- The study was limited to only impacts of hormonal biomarkers and didn't measure blood pressure directly to verify hypertension.

Conclusion

The present study demonstrated that test anxiety can have a significant effect on levels of Thyroxine T4, Triiodothyronine T3, Thyroid-Stimulating Hormone TSH, Ghrelin, Leptin, Glucose, Erythropoietin EPO and Atrial Natriuretic Peptide ANP in pharmacy college students at Tobruk University, which may have implications for hypertension related risk. The results support the need for, and usefulness of, potential intervention strategies focused on academic stressors to improve mental health and well-being for students. Future exploration should involve a larger sample size as well as looking for further physiological markers relating to the relationship between academic stress and hypertension.

References

1.Curry, F. R. E. (2005). Atrial natriuretic peptide: an essential physiological regulator of transvascular fluid, protein transport, and plasma volume. The Journal of clinical investigation, 115(6), 14581461.

2.Serrano-Ponz, M., Rodrigo-Gasqué, C., Siles, E., Martínez-Lara, E., Ochoa-Callejero, L., & Martínez, A. (2016). Temporal profiles of blood pressure, circulating nitric oxide, and adrenomedullin as predictors of clinical outcome in acute ischemic stroke patients. Molecular medicine reports, 13(5), 37243734.

3.Adam EK, Quinn ME, Tavernier R, McQuillan MT, Dahlke KA, Gilbert KE. 2017. Diurnal cortisol slopes and mental and physical health outcomes: a systematic review and meta-analysis. Psychoneuroendocrinology 83:25–41

4.Armaly, Z., Assady, S., & Abassi, Z. (2013). Corin: a new player in the regulation of salt–water balance and blood pressure. Current opinion in nephrology and hypertension, 22(6), 713722.

5.Benarroch EE. 2008. The arterial baroreflex: functional organization and involvement in neurologic disease. Neurology 71:1733–38

6.Benetos, A. (2018). Hypertension: a companion to Braunwald's heart disease.

7.Boggero IA, Hostinar CE, Haak EA, Murphy MLM, Segerstrom S. 2017. Psychosocial functioning and the cortisol awakening response: meta-analysis, P-curve analysis and evaluation of the evidential value of existing studies. Biol. Psychol. 129:207–30

8.Dharmawan, R., & Hermanto, Y. P. (2023). Pastoral Konseling Terhadap Jemaat Yang Menderita Hipertensi Akibat Pola Hidup Yang Tidak Sehat. CARAKA Jurnal Teologi Biblika Dan Praktika, 4, 34156.

9.Dibona, G. F. (2013). Sympathetic nervous system and hypertension. Hypertension, 61(3), 556560.

10.Dominiczak, A., Delles, C., & Padmanabhan, S. (2017). Genomics and precision medicine for clinicians and scientists in hypertension. Hypertension, 69(4), e10e13.

11.Feng, W., Dell'Italia, L. J., & Sanders, P. W. (2017). Novel paradigms of salt and hypertension. Journal of the American Society of Nephrology, 28(5), 13621369.

12.Forouzanfar, M. H., Liu, P., Roth, G. A., Ng, M., Biryukov, S., Marczak, L., ... & Murray, C. J. (2017). Global burden of hypertension and systolic blood pressure of at least 110 to 115 mm Hg, 19902015. Jama, 317(2), 165182.

13.Fujita, T. (2014). Mechanism of saltsensitive hypertension: focus on adrenal and sympathetic nervous systems. Journal of the American Society of Nephrology, 25(6), 11481155.

14.Grassi, G., Mark, A., & Esler, M. (2015). The sympathetic nervous system alterations in human hypertension. Circulation research, 116(6), 976990.

15.Harrison, D. G. (2013). The mosaic theory revisited: common molecular mechanisms coordinating diverse organ and cellular events in hypertension. Journal of the American Society of Hypertension, 7(1), 6874.

16.Imelda, I., Sjaaf, F., & PAF, T. P. (2020). Faktorfaktor yang berhubungan dengan kejadian hipertensi pada lansia di puskesmas air dingin lubuk minturun. Health and Medical Journal, 2(2), 6877.

17.Kohan, D. E., & Barton, M. (2014). Endothelin and endothelin antagonists in chronic kidney disease. Kidney international, 86(5), 896904.

18.Lingga, M. O., Pakpahan, R. E., & Ginting, F. S. H. B. (2024). Hubungan Tingkat Stres dengan Tekanan Darah Pada Penderita Hipertensi Usia Produktif Di Puskesmas Padang Bulan Medan Tahun 2023. Innovative: Journal Of Social Science Research, 4(2), 20432056.

19.Liu, M. Y., Li, N., Li, W. A., & Khan, H. (2017). Association between psychosocial stress and hypertension: a systematic review and meta-analysis. Neurological research, 39(6), 573-580.

20.McCurley, A., & Jaffe, I. Z. (2012). Mineralocorticoid receptors in vascular function and disease. Molecular and cellular endocrinology, 350(2), 256265.

21.McEwen BS. 2018. Redefining neuroendocrinology: epigenetics of brain-body communication over the life course. Front. Neuroendocrinol. 49:8–30
22.McEwen BS.2019.What is the confusion with cortisol? Chronic Stress 3:1–3
23.Mikael, L. D. R., Paiva, A. M. G. D., Gomes, M. M., Sousa, A. L. L., Jardim, P. C. B. V., Vitorino, P. V. D. O., ... & Barroso, W. K. S. (2017). Vascular aging and arterial stiffness. Arquivos brasileiros de cardiologia, 109(3), 253258.
24.Mortensen J, Dich N, Clark AJ, Ramlau-Hansen C, Head J, et al. 2019. Informal caregiving and diurnal patterns of salivary cortisol: results from the Whitehall II cohort study. Psychoneuroendocrinology 100:41–47
25.O'Connor, D. B., Thayer, J. F., & Vedhara, K. (2021). Stress and health: A review of psychobiological processes. Annual review of psychology, 72(1), 663-688.
26.Olsen, E., Jamerson, K., Schmieder, R. E., Søraas, C. L., Mariampillai, J. E., Mancia, G., ... & Weber, M. A. (2025). Effects of valsartan vs amlodipine and achieved lower blood pressure on the incidence of endstage kidney disease: The VALUE Trial. European journal of internal medicine, 133, 5563.
27.Poulter, N. R., & Prabhakaran, D. (2015). Caulfield M. Hypertension. Lancet, 386(9995), 80112.
28.Powell DJ, Schlotz W. 2012. Daily life stress and the cortisol awakening response: testing the anticipation hypothesis. PLOS ONE 7:e52067
29.Rapsomaniki, E., Timmis, A., George, J., PujadesRodriguez, M., Shah, A. D., Denaxas, S., ... & Hemingway, H. (2014). Blood pressure and incidence of twelve cardiovascular diseases: lifetime risks, healthy lifeyears lost, and agespecific associations in 1· 25 million people. The Lancet, 383(9932), 18991911.
30.Sari, A. P., Handian, F. I., & Sari, N. L. (2023). Literatur Review: Hubungan Antara Gaya Hidup Dan Stres Dengan Kejadian Hipertensi Pada Lansia. Professional Health Journal, 4(2sp), 111125.
31.Schlueter, N., de Sterke, A., Willmes, D. M., Spranger, J., Jordan, J., & Birkenfeld, A. L. (2014). Metabolic actions of natriuretic peptides and therapeutic potential in the metabolic syndrome. Pharmacology & therapeutics, 144(1), 1227.
32.Semarang, RH (2021). Hypertension Ranks First as the Most Dangerous NonCommunicable Disease. https://halosemarang.id/disemaranghipertensimenempatiperingkatpertamapenyakittidakmenularpalingberbahaya
33.Situmorang, F. D. (2020). Hubungan tingkat stres dengan kejadian hipertensi pada anggota prolanis di wilayah kerja Puskesmas Parongpong. Klabat Journal of Nursing, 2(1), 1118.
34.Stalder T, Kirschbaum C, Kudielka BM, Adam EK, Pruessner JC, et al. 2016. Assessment of the cortisol awakening response: expert consensus guidelines. Psychoneuroendocrinology 63:414–32
35.Surendran, P., Drenos, F., Young, R., Warren, H., Cook, J. P., Manning, A. K., ... & Skaaby, T. (2016). Transancestry metaanalyses identify rare and common variants associated with blood pressure and hypertension. Nature genetics, 48(10), 11511161.
36.Thrasher TN. 2006. Arterial baroreceptor input contributes to long-term control of blood pressure. Curr. Hypertens. Rep. 8:249–54
37.Travis, J., Kaszycki, A., Geden, M., & Bunde, J. (2020). Some stress is good stress: The challenge-hindrance framework, academic self-efficacy, and academic outcomes. Journal of educational Psychology, 112(8), 1632.
38.Varagic, J., Ahmad, S., Nagata, S., & Ferrario, C. M. (2014). ACE2: angiotensin II/angiotensin(1–7) balance in cardiac and renal injury. Current hypertension reports, 16, 19.
39.Yang, C., Chen, A., & Chen, Y. (2021). College students' stress and health in the COVID-19 pandemic: The role of academic workload, separation from school, and fears of contagion. PloS one, 16(2), e0246676.
40.Yang, Q., Xie, Z., Ha, X., Zhang, X., Zhuang, C., Li, Z., ... & Wu, H. (2025). Analysis of Prognostic Risk Factors in Patients with Complete Revascularization After Thrombectomy for Acute Anterior Circulation Large Vessel Occlusion. World Neurosurgery, 197, 123850.