

Exam Stress Induces Hormonal Changes amongst Students of the *Al-Haweeja* Technical College

Zainab A. Hassan¹, Ayoub A. Bazzaz^{2*}, Noorhan A. Chelebi²

¹Department of Clinical Analysis, Technical Institute, Kerkuk, Iraq

²Department of Basic Sciences, Faculty of Dentistry, University of Kerkuk, Kerkuk, Iraq

Email: *ayoubbazzaz@yahoo.co.uk

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Abstract

Sixty students from both genders aged 19 - 22 years old at College of Technology undertaking half-term exams of 2012-2013 are encountered in this study. Blood samples were collected twice, *i.e.* before the exam inside the halls and during the rest time, to compare levels of some hormones, *e.g.* cortisol from all students, testosterone in male only and both estrogen and progesterone in female students. The female group was further subdivided into two subgroups, 15 each *i.e.* at the first half of the menstrual cycle (follicular phase) and second group at the second half of the menstrual cycle (luteal phase). The levels of cortisol had significantly ($p \leq 0.05$) raised from 12.3 ± 3.6 to 32.3 ± 4.2 ng/mL and from 11.6 ± 1.8 to 31.6 ± 7.3 ng/mL in both male and female students, respectively during exams in comparison with rest times. However, the levels of testosterone had significantly dropped ($p \leq 0.05$) from 6.63 ± 1.8 to 2.1 ± 0.4 ng/mL during the test-time. In female students, the levels of both estrogens and progesterone had significantly ($p \leq 0.05$) increased, *i.e.* in follicular from 202 ± 38 to 365 ± 22 and from 64.6 ± 8.0 to 160 ± 37 ng/mL at luteal phases, respectively and from 0.74 ± 0.03 to 1.5 ± 0.04 in follicular and 14.4 ± 2.4 to 29 ± 4.2 ng/mL at luteal phase, respectively in progesterone during the exam in comparison with rest times. These results indicate that all students had sustained stress during the exam-time which might have disturbed the regulation of various hormones in both genders consequently leading to further health effects.

Keywords

Stress, Hormones, Examination, Cortisol, Estrogen, Progesterone

*Corresponding author.

1. Introduction

Stress, whether chronic or casual generated from different sources, could be experienced in our daily lives and may sometimes be a major life threatening *i.e.* severe illness. It can take a significant toll off us, both physically and emotionally leading to psychological sickness [1] due to its effects on immune system in the body [2]. Stress affects the body in other ways e.g. obviously, un-noticeable or uneasily detectable until it becomes more severe [1]. Stress hormones such as cortisol and epinephrine are released by the endocrine system in situations interpreted as potentially dangerous.

The mechanism of stress onsets by generating an alert which once recognized by the body then the adrenal hormone begins secretion, to increase body reflection to any unexpected situation leading to further increase in two systems in the body, the sympathetic and parasympathetic systems. The sympathetic system starts secreting noradrenaline or norepinephrine (NE) almost over 10 folds than at the normal status, *i.e.* more epinephrine (E) more than norepinephrine (NE). The stress or fear leads alert hypothalamus to receive signals from the brain which in turn activates the hormones to secrete. These hormones include cortisol, an anti-inflammatory factor that contributes to distribution of energy sources in the body which could be measured as an indicator to stress [3] [4]. Adrenal secretions of steroids are the main sources of responses to the stress which lasts a few hours and sometimes days in the blood in contrast to NE and E [5].

Cortisol is believed to affect the metabolic system while epinephrine plays a role in Attention Deficit Hyperactivity Disorder (ADHD) as well as depression and hypertension. Stress hormones are acted by mobilizing energy from storage to muscles, increasing heart rate, blood pressure and breathing rate and affect metabolic processes such as digestion, reproduction, growth and immunity [6]. Nevertheless, a subtle stress may sometimes be helpful in the life as it would activate both sympathetic and non-sympathetic nervous systems and organs to re-adapt ourselves with the so-called continuous changing environment and society [7]. Physiologically, stress, is controlled by chemicals in the body e.g. sex hormones which function to transmit certain messages from the producing glands to various body tissue through the blood circuit [8] [9]. This would lead, in turn, to certain reflections and overall behaviors. Accordingly, blood analysis could well be the most convenient tool to assess the hormonal changes in the body during various circumstances [10].

Sex hormones such as testosterone, estrogen, progesterone, oxytocin, and vasopressin are involved in sex motivation activity in most mammalian species which control the ability to engage in sexual behaviors [11]. Testosterone, the male hormone associated with the development of male characteristics, is present in both, but, in much smaller amounts in women than in men. It has a wide range of essential functions for a woman's health *i.e.* maintaining libido and sexual function [12] [13], maintain the normal growth and renewal of muscles, bone and other tissues [14], protect breast health at a cellular level [15]. Estrogen, produced by ovaries, is the second female hormone, makes cells grow, develops the uterus, breasts, periods, pregnancy and the egg within the ovary; however, an excess of it becomes toxic to the body. Progesterone is the sister hormone to estrogen, does work in a tandem to regulate and protect the health of the reproductive system throughout women fertile years. It also governs the second half of the menstrual cycle (Luteal phase) and is essential to maintain a pregnancy to term [12] [16]. It also plays a part in the regulation of blood sugar levels, has inherent calming properties, and protects breast, brain and bone health. When it comes to breast cancer prevention, the most important role of progesterone in the body is to balance estrogen [16]. The disturbance of these two hormones causes stress which could lead to many unexpected health defects in the life of females.

Stress could decrease the sexual stamina and weaken the sexual performance. In women it could also disturb the menstrual cycle and may decrease the fertility [17]. Over-increase in cortisol, in women, could completely stop the menstrual cycle [5] and could 50% increase the incidents of miscarriage and underweight newborns [18].

Neurophysiological and clinical studies have provided convincing evidence that altered stress hormone regulation that was frequently observed in depression and anxiety is caused by elevated secretion of the hypothalamic neuropeptides corticotrophin releasing hormone (CRH) and vasopressin produced a number of anxiety- and depression-like symptoms, which resulted in extensive validation of CRH₁ receptors as potential drug target [19]. Expression of neuronal tryptophan hydroxylase 2 (TPH2) mRNA and protein in midbrain serotonergic neurons was elevated, as well as increased in brain serotonin turnover in depressed suicide patients. The mechanisms underlying these changes are uncertain, but genetic influences, adverse early life experiences, or acute stressful life events, all of which can alter serotonergic neurotransmission and have been implicated in determining vul-

nerability to major depression [20]. Emerging evidence suggests that there are several different stress-related subsets of serotonergic neurons, each with a unique role in the integrated stress response [20].

The final-term exam stress is chosen as exams represent 60% of the final marks which imply determination of students fate in hunting best job opportunities. The objective of this research was to use these sexual hormones to assess the stress amongst students involved in final term-examinations at *Haweeja* Technical College.

2. Materials and Methods

Sixty University healthy students aged 20 - 22 years from both genders of College of Technology at *Haweeja* County were involved in this study during the sub-final tests (2012/2013) to assess the effects of stress on hormonal levels. The students have emphasized that the exams are their only worries at that stage. Five mL of blood samples were collected from all students at 09:00am inside the invigilating halls prior the onset of tests. Same amount of bloods were also collected from them during the rest time for comparison purposes. Levels of Cortisol, testosterone, estrogen and progesterone in the serum were measured according to ELISA obtained from Medical Supplied Enterprise in Iraq [21]. Biostatistics analysis was performed using two ways ANOVA Student-T-test.

3. Results

Levels of cortisol hormone were significantly increased ($p \leq 0.05$) in male students by almost three folds from 12.3 ± 3.6 ng/mL at the rest time to 32.3 ± 4.2 ng/mL in males and from 11.6 ± 3.8 ng/mL to 31.6 ± 7.3 ng/mL in female students in comparison with the final test times (**Table 1**). All students showed signs of anxiety and worries during the test time *i.e.* panic attacks and phobia. Interestingly, in male student, however, the levels of testosterone had significantly ($p \leq 0.05$) decreased three folds from 6.6 ± 1.8 ng/mL to 2.1 ± 0.4 ng/mL during the examination time.

In female students, the levels of estrogen hormone levels had significantly ($p \leq 0.05$) increased from 202 ± 38 to 365 ± 22 ng/mL at follicular phase and from 64.6 ± 8.0 ng/mL to 160 ± 37 ng/mL at luteal phase ($p \leq 0.05$). The levels of progesterone hormone had significantly ($p \leq 0.05$) doubled from 0.74 ± 0.03 to 1.5 ± 0.04 ng/mL for follicular phase and significantly ($p \leq 0.04$) from 14.1 ± 2.4 ng/mL to 29.0 ± 4.2 ng/mL at luteal phase. Surprisingly, the changes of these two hormones represented almost 60% for both phases during test times in comparison with the resting time.

Table 1. The mean values and standard deviations (\pm SD) of sex hormone levels in both male and female students during exams and a resting time; (n = 30 in each batch); Biostatistics used was two-ways ANOVA; (F) Follicular phase and (L) Luteal phase.

Hormonal values (mean & \pm sd)	Cortisol (ng/mL)	Testosterone (ng/mL)	Estrogen (ng/mL)	Progesterone (ng/mL)
Male (Rest time)	12.3 ± 3.6	6.6 ± 1.8	-	-
Male (Stress time)	32.3 ± 4.2	2.1 ± 0.4	-	-
(Student T-test)	$p \leq 0.05$	$p \leq 0.05$	-	-
Female (Rest time) F	11.6 ± 1.8	-	202 ± 38	0.74 ± 0.03
Female (Stress time) F	31.6 ± 7.3	-	365 ± 22	1.5 ± 0.04
(Student T-test)	$p \leq 0.05$	-	$p \leq 0.05$	$p \leq 0.05$
Female (Rest time) L	-	-	64.6 ± 8	14.4 ± 2.4
Female (Stress time) L	-	-	160 ± 37	29.1 ± 4.2
(Student T-test)	-	-	$p \leq 0.04$	$p \leq 0.05$

4. Discussion

Although, the causes of stress are particular to the individual, it is difficult to make generalized statements about them; however, there are certain triggers that might cause stress [22]. The main cause, in this study, has been exam's hassle which seems to be common between students in both genders. Exam stress is normal but can give rise to anxiety which can interfere with performance of individual. Most students will have endured the trauma

of exams at some stage in their lives, usually at school, college or university. Stress can be inevitable, however, the looming prospect of having to answer questions on most hated subjects often means that even the most laid-back of personalities will have experienced feelings of anxiety, worry and exam stress. Accordingly, body hormones will inevitably be changed dependent on degree of body response to the exam event.

Hormonal balance is an essential bio-factor in lives of both genders which its disturbance could cause many unexpected health consequence *i.e.* anxiety, stress, breast cancer, menstrual cycle [23]-[25]. By ignoring any other unexpected factors, the drop of cortisol hormone in both genders reflects the level of stress and anxiety the student were in during the examinations. Both genders, were at the same ages had undergone similar decline in cortisol levels. This may indicate the irrelevant correlation of stress and consequent hormonal imbalance to the gender. Exam stress and anxiety are a common phenomenon amongst Iraqi students, on almost all levels of academic studies as most students do not revise enough, on daily basis during the terms unless a few days prior to the exams. Accordingly, it could lead to personal self-under-trust amongst themselves in facing the exams due to mal-preparation. Such a phenomenon remains a must to be changed amongst the Iraqi students for a better performance.

Normally, the sex hormone disorders do occur during either an overproduction or underproduction of the hormones responsible for sexual characteristics and development. They eventually lead to motivation of individuals and vice versa [12] [26] [27]. In males, it is not produced enough they may experience a decline in libido (sex drive), erectile dysfunction, loss of muscle and loss of body hair [23]. The testosterone hormone had significantly declined during the exam. Assumingly, no sexual motivation did exist during the exam time due to such stress. However, stress in females could have caused un-overseen consequent effects *i.e.* disturbance in menstrual cycle, likelihood to carry female babes and could further lead to breast cancer in women [17]. The consequence of hormonal disturbance in students therefore, alerts the risk of blood toxicity and further changes in body performance, psychology and other un-overseen outcome both on short and long run.

The estrogen and progesterone, the two prominent hormones in woman, closely interrelated in many ways [28] are responsible for a lot of changes within the woman's body [13] [29] [30]. They both work in tandem, providing the body with necessary functions, balancing each other perfectly [31]. Exam stress in the present study could therefore, have disturbed their balance and caused serious changes in the body via misbalancing these two hormones on both short and long term. Unfortunately, the blood glucose levels have not been measured in current research with the hormone levels due to lack of finance. The blood glucose level could have provided important information regarding the correlation with hormone levels, under exam stress conditions. This would however be our next goal to achieve in similar work currently undertaken on other student samples at Kerkuk University.

As a response to stress which may exert many profound effects on human biological systems, the level of various hormones does change. Reactions to stress are associated with enhanced secretion of a number of hormones including glucocorticoids, catecholamines, growth hormone and prolactin, the effect of which is to increase mobilization of energy sources and to adapt the individual to its new circumstance [32].

5. Conclusion

It is concluded that cortisol could increase while sex hormones may well drop down due to stress generated from unnecessary extra anxiety during examination times amongst Iraqi students which, in turn, may lead to further harm to the body in both genders. Techniques that may help reduce stress include self-enhanced trust, regular revision of curricula, scheduling time off, relaxing, enough sleep, etc.

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