

Article

Hypothalamic-Pituitary-Adrenal Axis Relation with Employees in Samarra University

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Abstract: **Background:** Workplace stress activates the hypothalamic-pituitary-adrenal (HPA) axis and can lead to cortisol dysregulation, measurable through serum biomarkers. **Aim of the study:** The purpose of this study was to explore the relationship between type of job (technicians, teachers and administrators) with brain and its effect on neurotransmitter. **Methods:** This study was conducted on 90 Samarra University employees during the period from October 2023 to January 2024. Biochemical parameters included estimating the activity of cortisol, Beta Nerve Growth Factor (β -NGF), serotonin, melatonin, and dopamine. **Result:** The levels of cortisol significantly increase in teachers (174.09 ± 23.76 ng/mL) compared to administrators and technicians ($p = 0.009$). β -NGF, Serotonin, and Melatonin levels showed no significant differences between the groups ($p > 0.05$). Dopamine shows a significant increase in teachers compared to administrators and technicians ($p = 0.03$). **Conclusion:** The present study concluded that the type of work associated with the psychological and physical stress affect certain hormones and neurotransmitters, as well as some cellular and enzymatic stress markers.

Keywords: Employees, Cortisol, Beta Nerve Growth Factor, Serotonin, Melatonin, Dopamine.

Introduction

Office employees encounter particular pressures, including an increasing volume of complex knowledge work necessitating extensive formal training, expectations for elevated efficiency and inventiveness, and the requirement to work flexible hours in varying locations and situations [1]. Furthermore, the incessant mental demands and perpetual technology advancements need that employees adapt and engage in continual learning, hence heightening stress levels among office workers [2]. Prior qualitative research sought to classify self-identified sources of workplace stress. A study present a comprehensive overview of occupational stress categories for both office-based and other occupations [3]. These categories encompass working environment, job characteristics, management techniques, life events, and financial considerations. In focus group studies investigating

the experiences of occupational stress among university staff, identified several significant stressors, including job insecurity, work overload, insufficient time for research, frequent interruptions during work, and limited promotion opportunities [4], [5].

The release of corticotropin-releasing factor (CRF) occurs when the Hypothalamic-Pituitary-Adrenal (HPA) axis is activated in response to stress in the body. The anterior pituitary gland is responsible for releasing adrenocorticotrophic hormone (ACTH) when CRF binds to its receptors [6]. The adrenal cortex has receptors that the released ACTH attaches to, which triggers the adrenal glands to secrete cortisol. To regulate the body's physiological and behavioral reactions to stress, cortisol acts on a number of target tissues, one of which is the brain. elevating glucose levels in the blood and giving the organism access to an energy source. In order to get the body ready for the fight-or-flight reaction, it improves cardiovascular performance. The stress hormone cortisol also reduces the immunological response, which frees up energy for more pressing matters of survival [7].

The first piece of evidence linking stress to Nerve Growth Factor (NGF) was the finding that male mice that are socially isolated exhibit aggressive behavior and undergo changes in blood circulation and brain NGF levels [8], [9]. Stress can alter the cardiovascular and sympathetic nervous systems, although injecting NGF can reverse these effects [10]. According to recent studies in animals and humans, NGF levels in the blood and brain change significantly in response to stressful stimuli [11], [12]. NGF has a crucial function in translating environmental signals into physiological and pathological reactions, as demonstrated by its involvement in the HPA axis response to stressors [13], [14]. Aggression is greatly affected by the HPA axis modification that occurs as a result of prolonged stress. The intricate balance of neurotransmitter systems that regulate aggression, including serotonin and dopamine, can be upset by stress-induced changes in cortisol levels [15]. An important neurotransmitter for maintaining normal human behavior, mood, memory, and gastrointestinal homeostasis is serotonin, also known as 5-hydroxytryptamine (5-HT) [16]. It is in the brainstem's raphe nuclei and the intestinal mucosa's enterochromaffin cells that serotonin is manufactured [17].

Serotonin is a principal therapeutic target for numerous psychiatric and neurological illnesses linked to diminished CNS and plasma serotonin levels, including major depressive disorder, post-traumatic stress disorder, obsessive-compulsive disorder, and anxiety disorders. Stress-induced alterations in dopamine (DA) concentrations inside terminal regions mostly appear to involve cells projecting from the ventral tegmental area. Findings from preclinical research indicate an inconsistent response of dopamine to various stressors. An acute and manageable physical stress was observed to induce an increased dopamine efflux in the ventral striatum, while persistent and uncontrollable exposure to the same stress diminished dopamine release [18]. The present study aimed to explore the relationship between type of job (technicians, teachers and administrators) with brain and its effect on neurotransmitter.

Materials and Methods

Study Samples

This research was performed on several employees of Samarra University in the city of Samarra from January 2025 to June 2025. The research comprised 60 samples of university personnel from diverse colleges and departments, encompassing academic, administrative, and technical workers. The personnel were categorized into three groups according to their employment type and location. The initial group (administrative staff) comprised 18 employees, the subsequent group (faculty staff) consisted of 23 employees, and the final group (technicians) encompassed 19 individuals.

Individuals utilizing corticosteroids or receiving hormone therapy were eliminated due to their possible impact on hormonal equilibrium. Pregnant women and individuals with chronic illnesses, such as diabetes, which are known to influence cortisol physiology, were also excluded.

Blood Sample Collection

Blood was obtained on the morning of the evaluation between 08:00 and 10:00 a.m., subsequent to approximately 12 hours of fasting. Biochemical analyses were performed at the Department of

Laboratory. Blood was obtained in Vacuette gel tubes, incubated on ice for 30 minutes, and subsequently centrifuged for 10 minutes at 2300 x g and stored at -20°C.

Assessment of biochemical parameters

The quantification of cortisol, B-NGF, serotonin, melatonin, and dopamine was performed utilizing an ELISA kit following the manufacturer's guidelines and carried out by qualified personnel.

Statistical Analysis

The SAS (2012) program was used to determine how different factors affected the study parameters. Analysis of Variation, (ANOVA) were used to compare means significantly. To significantly compare percentages (0.05 and 0.01 likelihood), the chi-square test was utilized.

Results

Table (1) compares the levels of certain neurotransmitters and hormones among three employee groups: administrators, technicians, and teachers. For cortisol, the results show a significant increase in teachers (174.09 ± 23.76 ng/mL) compared to administrators and technicians ($p = 0.009$). Beta Nerve Growth Factor (β -NGF) showed no significant differences between the groups ($p = 0.53$). Serotonin levels were higher in technicians (1.2 ± 0.72) compared to administrators and teachers, approaching statistical significance ($p = 0.06$). Melatonin levels did not show any significant differences between the groups ($p = 0.8$). Finally, dopamine shows a significant increase in teachers (0.98 ± 0.41) compared to administrators and technicians ($p = 0.03$).

Table 2. Effect of the type of job on the neurotransmitters.

| | Administrators | Technicians | Teachers | P-value |
|--|-------------------------|-------------------------|-------------------------|----------------|
| Cortisol ng/mL | 151.94 ± 17.56 b | 155.45 ± 32.19 b | 174.09 ± 23.76 a | 0.009 |
| Beta Nerve growth Factor (pg/ml) | 22.14 ± 1.3 a | 18.57 ± 1.2 a | 23.72 ± 0.9 a | 0.53 |
| Serotonin ng/ml | 0.99 ± 0.35 a | 1.2 ± 0.72 a | 0.94 ± 0.48 a | 0.06 |
| Melatonin ng/ml | 273.95 ± 38.51 a | 291.54 ± 43.65 a | 288.35 ± 37.01 a | 0.8 |
| Dopamine ng/ml | 0.5 ± 0.43 b | 0.61 ± 0.29 ab | 0.98 ± 0.41 a | 0.03 |

Discussion

Given the lack of previous studies on BMI among university administrators, faculty, and technicians, and the lack of significant differences by occupation or age, this may be due to the age groups studied, which were between the second and mid-fifteenth decades, ages not typically associated with obesity or overweight.

The present study demonstrated increase level of cortisol in Teachers groups of Samarra University Employees. The results indicate a relationship between job type and job-related stress, as evidenced by elevated cortisol levels. These levels rise among teachers due to anxiety and worries related to teaching students, grades, research, and promotions. Dysregulation of HPA axis caused when exposed to chronic stress stimulation, which leading to cortisol rhythm alteration [19]. Then cause cortisol increased, which can lead to health problems like heart disease, depression, and metabolic disorders, hippocampal atrophy, systemic inflammation, and insulin resistance, thereby providing a plausible physiological basis for the link between occupational stress and physical health issues [20]–[24]. The results of this research indicate that the alterations in the measured parameters, including cortisol, may signify the primary neuro-immune-endocrine system response to environmental stressors. As a result, these traits may be seen as early biological signs of being exposed to social stressors for a long time.

The results of the current study showed that levels of Beta Nerve Growth Factor (β -NGF) not showed significantly differences between the study groups, indicating that the nature of the work were insufficient to elicit a clear biological response at the level of β -NGF. It is associated with chronic stress, but its consistent level may reflect one of two possibilities: first, that the intensity of the stress experienced by the participants was within acceptable limits that did not warrant a heightened neuronal response; or second, that the body possesses compensatory regulatory mechanisms that maintain β -NGF concentration within the normal range despite exposure to stress. Furthermore, β -NGF may be less sensitive than other markers, such as cortisol or inflammatory factors, in responding to stress or occupational burnout, and therefore may not show a significant change under the studied conditions.

As melatonin not showed any significant alteration between 3 groups this may be due to serotonin not directly affected by acute or moderate stress. Serotonin is primarily associated with mood regulation and emotional balance, and significant changes in its levels only appear with prolonged or severe stress that may lead to emotional disturbances or depression. Melatonin, on the other hand, is regulated by the circadian rhythm and is more influenced by light and sleep than by occupational stressors. Therefore, melatonin levels remain stable unless there are significant disruptions to sleep patterns or light exposure.

Consequently, the stability of serotonin and melatonin levels in this study is physiologically expected and reflects the fact that the primary effect of work-related stress was limited to activating the HPA axis and raising markers associated with the immediate stress response, without sufficiently causing profound changes in mood-related neurotransmitters or sleep-regulating hormones.

The present study showed increase dopamine in Teachers group, as compared with Technicians and Administrators of Samarra University Employees. This result indicate elevation of dopamine can be interpreted as resulting from stress-induced reorganization of reward and excitatory neural pathways, reflecting an adaptive response or a regulatory dysfunction associated with HPA axis hyperactivation. Other study on traffic police officers, showed significant increase in level of dopamine which suggested dopamine could be used as an early biological marker, valuable for the group to be employed in occupational sets, even before the onset of pathology [24]. The study demonstrated increase dopamine in laboratory technicians in high exposures to work-related psychosocial hazards [25]. The equilibrium and feedback mechanisms between dopamine and cortisol are essential for the body's reaction to stresses [26]. Dopamine and cortisol are significant neurotransmitters, and their intricate interactions constitute a crucial neuroendocrine network that regulates different physiological functions [27].

Conclusion

The study concluded a distinct influence of job type on specific physiological and enzymatic markers among employees. Teachers exhibited markedly elevated levels of cortisol and dopamine as compared to administrators and technicians. At the same time, the levels of β -NGF and melatonin showed non-significant differences between study groups. Technicians, conversely, exhibited elevated serotonin levels.

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