HORMONAL AND LIPID DISRUPTION BECAUSE OF STRESS AMONG TEACHERS OF THE UNIVERSITY OF EL-OUED, ALGERIA

Nawal HOUMRI1,2,3,4, Abdelkader ADAMOU1,2, Abdelmadjid BAIRI5,6, Bachir KHEZZANI3,4, Atika GHARGHOUT7, Brahim HAMAD3, Leyla HADEF3

1 Faculty of Natural Sciences and Life, University of Ouargla, Algeria
2 Laboratory of Saharan Bioresources, University of Ouargla, Algeria
3 Faculty of Natural Sciences and Life, University of El Oued, Algeria
4 Laboratory of Biology, Environment, and Health (LBEH), Faculty of Natural Sciences and Life, University of El Oued, Algeria
5 Faculty of Sciences, University of Annaba, Algeria
6 Applied Neuroendocrinology Laboratory, Faculty of Sciences, University of Annaba, Algeria
7 Laboratory of Measurement and Psychological Studies, University of El Oued, Algeria

Received 09th Nov 2023, Accepted 30th Nov 2023
https:/ /doi.org/10.31688/ABMU.2023.58.4.02

ABSTRACT

Introduction. Work-related stress has become a significant concern in the modern world, with many individuals experiencing high pressure levels because of increasing professional demands. This issue is particularly prevalent in university teaching, where academic and administrative expectations are high.

The objective of the study was to analyze stress levels, causes, and their impact on biological indicators among high education teachers.

Material and methods. The study was conducted at the University of El Oued, Algeria, from September 2022 to July 2023, where 140 volunteer teachers were randomly selected. The teachers were questioned about their experiences with stress; subsequently, blood samples were examined to determine the levels of plasma cortisol, cholesterol, triglycerides, and total lipids.

RéSUMÉ

Perturbation hormonale et lipidique causée par le stress chez les enseignants de l’Université d’el-Oued, Algérie

Introduction. Le stress lié au travail est devenu une préoccupation majeure dans le monde moderne, de nombreux individus faisant face à des niveaux élevés de pression en raison des demandes professionnelles croissantes. Ce problème est particulièrement répandu dans le domaine de l’enseignement universitaire où les attentes académiques et administratives sont élevées.

L’objectif de l’étude visait à analyser les niveaux du stress, les causes et l’étendue de son impact sur les indicateurs biologiques chez les enseignants de l’enseignement supérieur.

Matériel et méthodes. L’étude a mené à l’Université d’El Oued, en Algérie, de septembre 2022 à juillet...
INTRODUCTION

The study of stress is a complex subject that dates back more than fifty years. This phenomenon has been the subject of numerous scientific studies, mainly in the fields of medicine and life sciences. Stress can manifest in diverse physical or psychological ways and can be either acute or chronic. In chronic or severe stress cases, the persistence of stressors hinders the recovery process. It prevents a return to balance because of the excessive secretion of hormones, particularly cortisol, which has multiple effects on lipid metabolism and increases the lipid levels in the blood.

THE OBJECTIVE OF THE STUDY

was to identify the level and causes of stress that university teachers suffer from, its physical and psychological impact, and related hormonal and metabolic imbalances.

MATERIALS AND METHODS

Study design

This research was done in the 8 faculties of the El-Oued University, Algeria, between September 2022 – July 2023. The university is located in a Saharan region characterized by a hyper-arid climate with extremely hot and dry summers, when temperatures can reach up to 45°C. At the same time, winter is relatively mild, however the temperatures could drop to freezing levels. 140 volunteer university teachers filled out paper questionnaires. Further, blood analyses were conducted in a private laboratory (Al-Majd) within the same city, to assess the hormonal and metabolic disorders resulting from stress during the academic year.

Study design and population

In September 2022, we developed a special program for each faculty at El-Oued University during the beginning and end of the academic year; then, we

Results. The results indicate that there is a highly significant difference (p < 0.001) in the level of stress among teachers at the University of El Oued at the end of the academic year, which is combined with the appearance of physical, muscular, emotional, and behavioral symptoms. The psychological disorder is followed by a hormonal disorder of plasma cortisol and a metabolic disturbance of cholesterol, triglycerides, and total lipids, where a very significant increase was noted (p<0.001) by hyperactivation of the hypothalamic-pituitary system because of chronic or repeated stress.

Conclusions. Improving the working environment for teachers and raising awareness about the importance of regular visits to psychological support centers can mitigate the impact of stress on teachers, enhance their overall well-being, and consequently improve the quality of education they provide.

Keywords: serum cortisol, cholesterol, triglycerides, total lipids, university stress, teachers.

List of abbreviations:

TC – total cholesterol
TG – triglycerides
LDL-C – low-density lipoprotein cholesterol
CRH – corticotropin-releasing hormone
AVP – arginine vasopressin
ACTH – adrenocorticotropic hormone
BlA – basolateral amygdala
HPA – hypothalamic-pituitary-adrenal
GR – glucocorticoid receptor
NPY – neuropeptide Y
announced it a few days before starting to implement the study. We have also coordinated with a private laboratory to take blood samples from professors to conduct hormone and biochemical analyses.

According to the planned program, faculty teachers were scheduled to arrive at a designated location between 8:00 and 9:00 in the morning. In this session, the participants responded to a questionnaire developed by Lafleur and Béliveau⁶. Simultaneously, they provided a blood sample to analyze serum cortisol, total cholesterol (TC), triglycerides (TG), and total lipids. This comprehensive approach allowed the evaluation of the stress exposure levels. In our study, we initially considered approximately 220 permanent university teachers who had participated in the Lafleur and Béliveau⁶ test in 2000, both at the beginning and the end of the year. To refine our sample, we established specific criteria. We excluded questionnaires that were answered only once or contained unanswered items. In addition, we excluded blood tests for hormones and biochemicals if the samples were taken only once during the specified periods, if the participant did not respond to the questionnaire, or if the sample was collected after 9:00 AM.

Only 140 professors met all the specified criteria for our study. These participants fell within the age range of 25 to 65 years.

**Measurements**

In both studies, data and blood test results were collected from university teachers during the beginning and end of the academic year. The questionnaire used in the study comprised two parts: 1) demographic information, including age, gender, and family status. 2) We inquired teachers about their experiences with stress and its impacts. The data collection instrument employed was an anonymous questionnaire crafted by Lafleur and Béliveau⁶. The survey took place from September 2022 to July 2023. Participants’ experiences of stress symptoms during this period were categorized using numerical codes ranging from 0 to 3 (not at all, a little, moderately, and a lot) successively.

Once the teachers completed the questionnaire, blood samples were obtained from each participant at the Al-Majd laboratory for medical analysis, a private medical facility in El-Oued City, Algeria. This procedure occurred from 8:00 to 9:00 in the morning. Blood samples were drawn from the bend of the elbow and promptly centrifuged at a rate of one revolution per minute. These samples were then analyzed to evaluate serum cortisol, cholesterol, triglycerides, and total lipids in participants who first provide their consent.

Plasma cortisol levels were measured using ECLIA-Cobas-Roche electrochemiluminescence technology, which operates on a competitive principle. We assessed the levels of TC, TG, and total lipids using the INTEGRA-Cobas 800 system, which operates based on the colorimetric enzymatic principle. The method for measuring TG was sourced from the research conducted by Wahlefeld (1974)⁷, in contrast the methods for quantifying TC and total lipids were adopted from the study conducted by Allian⁸. Total lipid levels were calculated using the Friedewald (1972)⁹ method.

**Data analysis**

IBM SPSS Statistics software (version 27) was used to analyze both the questionnaire responses and blood data. Parametric tests, including student’s T-test and ANOVA, were used for descriptive statistics. Statistical significance was determined at p-values of <0.05.

**Results**

Most study respondents belong to age ranges 25-35 and 35-45 years (39.29% and 37.86%), respectively (Table 1). About 62.14% of study population were men, and 93.57% were married.

There was a highly significant difference (p < 0.001) in the level of stress between university teachers during the period of the beginning and end of the academic year. This increase in stress levels, especially towards the end of the year, affects all age groups and both genders. According to our study, the most significant source of stress among university teachers is workload, accounting for 70.7%. Those who experienced a lot of stress are about 71.43%, while the others experience it moderately or infrequently (20.71%, 7.86%). At the end of the academic year, there is a well-defined imbalance whose physical, muscular, emotional, and behavioral symptoms are

<table>
<thead>
<tr>
<th>Table 1. Participants characteristics (n=140)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age range (years)</strong></td>
</tr>
<tr>
<td>25-35</td>
</tr>
<tr>
<td>35-45</td>
</tr>
<tr>
<td>45-65</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
</tr>
<tr>
<td>Women (n=53)</td>
</tr>
<tr>
<td>Men (n=87)</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
</tr>
<tr>
<td>Single (n=9)</td>
</tr>
<tr>
<td>Married (n=131)</td>
</tr>
</tbody>
</table>
the most remarkable in our population (24.94%, 23.72%, 22.43%, and 15.23%, respectively) (Table 2).

Table 3 highlights the analysis of serum cortisol, TC, TG, and total lipid levels within the teachers included in the study. The significance level attained (p < 0.001) is significantly lower than the threshold of 0.05, indicating a highly significant difference. Notably, the average levels of serum cortisol, TC, TG, and total lipids at the end of the year were markedly higher than those observed at the beginning of the year. This finding underscores the presence of a prevailing stress factor within the university, especially toward the end of the academic year.

### Table 2. Stress level in the study group and distribution of associated factors

<table>
<thead>
<tr>
<th>Stress</th>
<th>n=140</th>
<th>Mean±SD</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress</td>
<td></td>
<td>31.86±14.22</td>
<td>&lt; 0.001***</td>
</tr>
</tbody>
</table>

**Stress according to**

- Age range: 0.466NS
- Gender: 0.648NS
- Marital status: 0.158NS

**Cause of stress**

<table>
<thead>
<tr>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timetable</td>
</tr>
<tr>
<td>Workload</td>
</tr>
<tr>
<td>Others</td>
</tr>
</tbody>
</table>

**Frequency of stress**

<table>
<thead>
<tr>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A little</td>
</tr>
<tr>
<td>Moderate</td>
</tr>
<tr>
<td>A lot</td>
</tr>
</tbody>
</table>

**Stress symptoms at the end of the year**

- Physical symptoms: 24.94
- Muscular tension: 23.72
- Emotional tension: 22.43
- Behavioral symptoms: 15.23
- Motivational symptoms: 9.12
- Intellectual symptoms: 4.56

Legend: NS: no significant; ***p < 0.001 highly significant difference

### Table 3. Effect of stress level on blood parameters (means±SD).

<table>
<thead>
<tr>
<th>Average level</th>
<th>Beginning of the year (n = 140)</th>
<th>End of the year (n = 140)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cortisol (nmol/L)</td>
<td>106.53±34.98</td>
<td>118.46±40.94</td>
<td>&lt;0.001***</td>
</tr>
<tr>
<td>Total cholesterol (g/L)</td>
<td>1.91±0.456</td>
<td>2.01±0.566</td>
<td>&lt;0.001***</td>
</tr>
<tr>
<td>Triglycerides (g/L)</td>
<td>1.67±0.996</td>
<td>2.18±1.368</td>
<td>&lt;0.001***</td>
</tr>
<tr>
<td>Total lipids (g/L)</td>
<td>6.27±1.894</td>
<td>7.29±2.42</td>
<td>&lt;0.001***</td>
</tr>
</tbody>
</table>

*** p < 0.001 highly significant difference

### DISCUSSION

Stress is an issue increasingly discussed by the professional medical societies, and is often regarded as the ailment of the century, especially in the workplace². Numerous studies confirm a specific hardship observed across professions requiring moral accountability, such as teaching and education¹.

Our research focused on a sample of 140 randomly chosen volunteer university teachers from the University of El Oued, south Algeria. According to the results of our study, the majority of teachers are aged between 25 and 45 years old, indicating that the institution is relatively new. These teachers experience psychological pressures for various reasons, including their lack of experience, challenges related to establishing a new family, and their ambition to advance quickly in their careers. All these factors contribute to this pressure.

As in many other studies, most teachers in our sample experience high levels of psychological stress, particularly towards the end of the academic year, which manifests in several symptoms, including musculoskeletal, physical, and behavioral symptoms. The variation in stress levels between the beginning and end of the academic year can be attributed to the positive impact of the summer vacation period on teachers’ well-being at the start of the year. In addition, the end of the academic year coincides with demanding events such as exams, deliberations, and students’ diploma preparations.

Moreover, the University of El Oued is situated in the El Oued province of southeast Algeria, known for its arid climate and soaring temperatures from May onwards¹². This heat has a stressful effect, as noted by Rahmoune and Bouchama¹³, who observed an increase in stress protein synthesis in muscle tissue, monocytes, and plasma due to heat, leading to behavioral alterations.

The rise in stress levels is noted by a highly significant difference in plasma cortisol levels (p<0.001), particularly toward the end of the academic year, attributed to workload. These results align with Glavas and Weinberg¹⁴, who reported excessive cortisol secretion in response to stressors.
The increase in observed stress hormones could result from the stimulation of adrenocorticotropic hormone (ACTH) secretion by stress stimuli, which stimulate the synthesis of adrenaline and cortisol precursors. In response to a stressor, corticotropin-releasing hormone (CRH) and vasopressin (VP) released from parvocellular neurons in the hypothalamic paraventricular nucleus into the pituitary portal circulation, bind to receptors on the anterior pituitary corticotropes triggering the secretion of ACTH, which stimulates the adrenal gland to release cortisol into the bloodstream. This hormone operates through its receptor (GR), which interacts with receptors in various target tissues, including the hypothalamic-pituitary-adrenal (HPA) axis. This interaction results in the inhibition of ACTH secretion from the pituitary and CRH secretion from the hypothalamus through complex feedback mechanisms, which leads to the inhibition of cortisol synthesis by the adrenal cortex.

Upon acute exposure to stress, the body initiates a triple response encompassing behavioral changes, hormonal fluctuations, and autonomic nervous system activation. This adaptive reaction is temporary and aids the organism in dealing with stressful stimuli. The effects of stress and cortisol differ in various brain regions, causing dendritic shrinkage not only in CA3 and dentate gyrus neurons of the hippocampus, but also in the medial amygdala, while the dendrites of the basolateral amygdala (BLA) and orbitofrontal cortex dilate. These alterations have been involved in increased anxiety. According to many studies, reduced levels of glucocorticoid receptors (GR) and impaired GR function are observed in the brains of patients suffering from depression.

Overproduction of stress hormones affects the brain, where memories are processed and stored. It can lead to hormonal and metabolic changes that contribute to heart diseases and other health issues. The excess production of cortisol in teachers can lead to hormonal and metabolic changes that contribute to heart diseases and other health issues. Macfarlane et al. and Magomedova and Cummins show that the effect of cortisol results in reducing peripheral glucose absorption and stimulating hepatic gluconeogenesis by inducing a state of insulin resistance, reducing its basal pulsatility of secretion, promoting hyperglycemia, and stimulating lipolysis. According to Maduka et al., stress affects the lipid profile in the body.

The increase of biochemical parameters values in our population can stem from both endocrine and exocrine factors, where cortisol promotes lipid breakdown to supply the required energy; thus, it decreases the activity of lipoprotein lipase to increase TG levels and also reduces the number of LDL receptors to elevate LDL-cholesterol and TC levels. Moreover, exocrine factors such as diet, especially high in fats and sugars, can lead to an increase in blood lipids.

High cortisol levels are associated with increased circulating free fatty acid levels, primarily stemming from the breakdown of TG mainly through lipolysis. According to many researches, stress not only tends to increase calorie intake but also directs consumption toward high-calorie snacks that are normally avoided. Some studies indicate that individuals with high cortisol levels tend to consume more calories on stressful days than those with lower levels of this hormone.

Xu et al. and Enko et al. showed that high cortisol levels are associated with increased circulating free fatty acid levels, primarily stemming from the breakdown of TG, mainly through lipolysis. In the study of Enko et al., adverse lipid patterns in depressive disorders are associated with lifestyle-related factors, and individuals with depression were reported to eat more foods high in energy density compared with healthy controls.

The alteration in eating habits results from elevated cortisol secretion, which in turn stimulates the release of neuropeptide Y (NPY) in specific brain regions; this process enhances appetite and may lead to overeating, particularly with high-calorie and high-fat foods.

In this context, incorporating biological indicators can serve as a valuable tool for predicting physical and mental health issues related to stress. This study provides additional evidence to the existing knowledge regarding the challenges faced by university teachers due to stress in the workplace. As per La Marca Schneider et al in 2023 and Wettstein et al in 2023, stress experienced by teachers has substantial adverse effects on their own health, their families, communities, student motivation, and the country's economy.

Urgent solutions are required for both short-term and long-term alleviation of this situation. Therefore,
it is crucial to implement effective strategies for managing various stressors to safeguard the physical and mental well-being of teachers.

An urgent solution involves attentively addressing teachers’ daily concerns and enhancing the work environment. Additionally, it’s crucial to raise awareness about the significance of regular visits to psychological assistance centers. In the long run, all administrative entities associated with teachers must actively participate in accurately identifying potential stressors.

**Conclusions**

University teachers face multiple factors that affect their physical and mental health, with workload being a significant contributor, particularly leading to chronic stress towards the end of the academic year. This stress manifests in various physical, muscular, and emotional symptoms. Our observations revealed higher levels of plasma cortisol, TC, TG, and total lipids. It is important for educators to implement effective strategies to manage their workload and minimize stress, thereby improving their overall well-being. Ignoring these factors could lead to severe long-term health issues.

**Author Contributions:**
- Conceptualization, N.H., A.A., A.B., B.K., B.H. and L.H.; methodology, N.H., A.A., A.B. and B.K.; investigation, N.H.; data curation, N.H and A.G.; writing—original draft preparation, N.H., A.A. and A.B.; writing—review and editing, N.H., B.K., A.A. and A.B.; supervision, N.H., B.K. All the authors have read and agreed with the final version of the article.

**Compliance with Ethics Requirements:**
- "The authors declare no conflict of interest regarding this article"
- "The authors declare that all the procedures and experiments of this study respect the ethical standards that were approved by the scientific council of the Faculty of Natural Sciences and Life at the University of El Oued, Algeria. Informed consent was obtained from all the participating teachers in this study."
- "No funding for this study"

**Acknowledgements**

We would like to thank all volunteer teachers at the University of El-Oued, Algeria, for their cooperation in carrying out this research.

**REFERENCES**


