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Original Article:

The Response of Serum Cortisol and Leptin Levels to Academic Stress

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Abstract:
Background: Medical students are subjected to various types of stress during the academic course and they react differently. This study is an attempt to establish a relationship between the coping abilities, serum cortisol and leptin levels in response to academic examination stress in first year medical students. **Methods:** Thirty four 1st year medical students between 18 to 21 yrs of age were randomly selected and their coping abilities were assessed using the State Trait Anxiety Inventory. Two fasting blood samples were drawn, one on the day of examination (Situation I) and the second after the completion of the examination (Situation II). Serum cortisol and leptin levels were estimated using a standardized RIA Kit and the levels obtained were correlated with the psychometric data. **Results:** The results showed increased levels of cortisol prior to examination in the poor adjusters in comparison to the good adjusters. The levels of cortisol decreased after examination in both good and poor adjusters with the poor adjusters showing higher levels. On the other hand, leptin levels increased in good adjusters in comparison with poor adjusters in Situation I and in Situation II the good adjusters showed a marginal decrease and poor adjusters maintained the same levels of leptin. **Conclusion:** Cortisol and leptin respond inversely to academic stress. Cortisol levels sharply decline from stressful to post-stressful situation indicating the wane of stress.
Key Words: Academic stress, Cortisol, Leptin, State Trait Anxiety Inventory.

Introduction:

Psychological stress is a reaction of the body to disturbances in homeostasis. Each individual responds to it differently. Academic examination stress is the best model to study psychological stress and its correlates. Psychological academic stress alters the human immune function.(1) The examination faced by a student fulfills the classic requirements for a psychological stressor, including non-controllable conditions and management of time.(2) Many studies report that examination stress leads to an increase in the cortisol levels.(3-5)

The variance in the perception of stress is influenced by the situation that generates the stress and other factors such as adjustment and coping skills of the individual.(6) Coping skills uniquely influence the perception of stress, as well as alter the cortisol production(7,8) and thereby affect the cognitive performance during such tasks (8).

Strong interrelations have been reported between Hypothalamo Pitutary Axis (HPA) and leptin which is a acute phase stress hormone(9-12), a product of obese (ob/ob) gene which is secreted by adipocytes.(9,13) There is ample evidence that glucocorticoids are known to increase leptin secretion.(14,15)

This study intends to find the response of serum cortisol and leptin levels to varying degrees of academic stress, its relation to trait anxiety and coping skills.

Materials and Methods:

The study was conducted in the Department of Physiology, M S Ramaiah Medical College, Bangalore, Karnataka, India and approved by the institutional ethical committee.

Medical Students, twenty one males and thirteen females, between 17 – 20 yrs (mean age 18.74) were selected randomly from the register numbers. The students with recent infection (within a month), allergic conditions, smoking, drug abuse and any other chronic illness were excluded during screening and the next number in random were selected. A written consent was obtained before the student was included in the study. The students were administered with the State Trait Anxiety Inventory (STAI), one hour prior to the examination.

The STAI(16) is also a self-administered questionnaire of 20 statements that depicts the state of the individual during stressful situation. A score of more than 40 suggests high anxiety and less than 40 suggests low anxiety.

Two blood samples were collected between 8:00 and 9:00am after an overnight fast. First, one hour prior on the day of examination (Situation I) and the second two days after the completion of the examination (Situation II). Blood samples were collected in both plain vaccutainers and in EDTA tubes. Samples were centrifuged to separate the serum and plasma. Samples were assayed in a single large batch in duplicates.

Cortisol was measured with a DSL-2100 ACTIVE® Cortisol Coated-Tube Radioimmunoassay (RIA) Kit (Diagnostic systems laboratories, Inc., Texas, USA). It uses a specific rabbit anti-cortisol antibody, and does not require prior sample extraction. Results were expressed as RIA measured in mg/dl.

Leptin was measured with a DSL-23100 ACTIVE® Leptin Coated-Tube Immunoradiometric Assay (IRMA) Kit developed to sensitively measure low levels of human leptin (Diagnostic systems laboratories, Inc. Texas, USA). The assay uses a polyclonal antibody raised in rabbits against highly pur-

ified recombinant human leptin calibrators and 1st labeled tracer was prepared with recombinant human leptin. Results were expressed as IRMA measured in ng/ml.

Statistical Analysis(17): The data was analyzed by using SPSS 11. The results were expressed as mean ± SD. Results were analyzed for significance between the groups, using Mann Whitney U test for leptin, and student t test for cortisol. Results were considered significant when $p \leq 0.05$.

Results:

Cortisol and Leptin responded inversely to academic stress in both the situations. (Table-1)

Table 1: Difference between the levels of Cortisol and Leptin

Parameter	Situation I (Mean ± SD)	Situation II (Mean ± SD)	p value
Cortisol (mg/dl)	21.44 ± 6.40	12.34 ±4.71	p<0.001
Leptin (ng/dl)	21.11 ± 15.30	19.14 ± 13.41	p<0.015

Situation I: On the day of examination; Situation II: After completion of examination

The anxiety perceived by the students during and after the stressful situation is represented in Table-2 in stressful situations, high anxiety students were found to have higher levels of cortisol and lower levels of leptin in comparison to low anxiety students. A similar response was noticed even in post stressful situation although statistically not significant.

Table 2: Relationship between Cortisol and Leptin with respect to STAI score

Parameter (mean ± SD)		STAI score		p value	d (effect size)
		< 40 - Low Anxiety	> 40 - High Anxiety		
Cortisol	Situation I	19.82 ± 4.93	23.06 ± 7.39	0.142t	0.50
	Situation II	11.75 ± 4.61	12.94 ±4.89	0.485t	0.24
Leptin	Situation I	21.84 ± 16.98	15.82 ±8.44	0.237m	0.47
	Situation II	19.31 ± 14.22	15.26 ± 8.70	0.377m	0.35

p values obtained by: m: Mann Whitney U test; t: student t test.; Situation I: On the day of examination; Situation II: After completion of examination

Discussion:

In this study, academic examination stress was used as a model, employing STAI scores. These scores were used to evaluate how coping skill and perception of stress affect in the immune system of an individual.

The cortisol levels in the students was significantly higher in stressful situations in comparison to post-stressful situation ($p<0.001$). This indicates a high stress perception by the students during academic stress. The average levels of leptin also showed a similar trend. As indicated by other studies, glucocorticoids are known to increase both appetite and leptin secretion.(14,15)

Anxiety during any situation depends on the nature of the situation. Studies have shown that various factors like accustomed / unaccustomed situation, presence or absence of control over the situation, importance of the situation from personal or said point of view, predictiveness of the situation, adjustment / coping abilities of the person determines the level of anxiety.

In this study, the average levels of cortisol showed a direct relationship with anxiety. Average levels of leptin on the other hand showed an inverse relationship. Based on STAI score, the leptin levels were considerably higher among less anxious students in comparison to highly anxious students in both the stressful and post-stressful situations. Earlier observations have explained a possible negative feed back inhibition by leptin on the HPA axis that is crucial for adapting to chronic stress (13). Also leptin follows a circadian pattern that is a mirror image with that of cortisol and ACTH.(9,18) The high anxiety students with relation to STAI score, showed a considerably higher levels of cortisol among the poor adjusters in both situations than good adjusters. Leptin also showed a similar pattern as observed with anxiety states. This may be explained by the inverse relationship between leptin and cortisol.

These observations suggest that cortisol and leptin behave in exactly the similar way in anxiety states and with respect to coping skill. This suggests a probable strong inter-relationship between the coping skills, anxiety states and the response to stress. When the parameters, anxiety state and coping skills are considered, cortisol levels sharply decline from stressful to post-stressful situation indicating the wane of stress.

Conclusion:

This study suggests that cortisol and leptin may respond inversely to academic stress. Cortisol levels sharply decline from stressful to post-stressful situation indicating the wane of stress.

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