

ORIGINAL ARTICLE

PERCEPTION OF ACADEMIC EXAMINATION STRESS: EFFECTS ON SERUM LEPTIN, CORTISOL, APPETITE AND PERFORMANCE

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Background: Examination stress is a psychological stress that activate hypothalamic-pituitary adrenocortical (HPA) axis to increase circulating levels of glucocorticoids. The fat derived hormone leptin is also released in response to stress-inducing condition. To workout the role of leptin and cortisol in response to perceived levels of examination stress and their effects on academic performance. The present study was designed to monitor the relationship of self reported perceived levels of examination stress on serum levels of cortisol and leptin in female students going to appear in university examination. **Methods:** Fifty-six female undergraduate students participated in the study. Examination stress, appetite levels were assessed by a questionnaire and blood samples were collected one hour before appearing in the examination. Performance was evaluated from the marks obtained in that particular examination. **Results:** Serum cortisol levels increased with an increase in the intensity of perceived examination stress. Serum leptin levels increased only in the group under moderate stress while increases in mild and severe stress group were not significant. Mild to moderate stress enhanced performance but severe stress decreased it. **Conclusions:** The present study shows an inverted U-shaped relationship between self reported different levels of perceived examination stress and academic performance.

Keywords: Academic Stress, Cortisol, Leptin, Appetite, Performance

INTRODUCTION

Stress impairs brain functioning, which leads to learning and memory deficits.¹ Academic examination stress among students can vary from mild to severe. These different levels of stress may affect learning performance differently. Psychological stress increases the activity of hypothalamic-pituitary-adrenocortical (HPA) axis leading to increase circulating levels of glucocorticoids.^{2,3} Glucocorticoid-induced increases in plasma leptin concentration has been reported in healthy humans.^{4,5}

Psychological stressors have been shown both to increase or decrease circulating levels of leptin. Male and female Japanese workers who perceived psychological stress had higher leptin levels.⁶ In addition, post-traumatic stress disorder patients had higher leptin concentrations.⁷ On the other hand animal research shows that leptin levels decreased in rats subjected to chronic unpredictable stress.⁸ Present study concerns the role of perceived levels of examination stress on serum levels of leptin, cortisol and academic performance in female students undergoing examination. The emphasis of the investigation was to study the stress levels specifically during examination period.

MATERIAL AND METHODS

A total of 129 female students from University of Karachi, Karachi, Pakistan of ages ranging from 19–20 years participated in this study. All participants were asked to submit written consent for the use of

information contained in the questionnaire and for the donation of serum samples. Stress levels were evaluated subjectively by a standardised questionnaire⁹ on the day of their final examination. Participants rated items such as ‘How often have you felt nervous and stressed’ from 1–4 as ‘never, sometimes, fairly often or very often’.

Additional questions were asked about getting education is pleasurable, morning appetite on examination day and appetite during examination days to evaluate the acute and long term relation between different levels of perceived stress and appetite. According to the self-reported perceived stress measuring questionnaire fourteen students of each level from no, mild, moderate to severe stress were selected. A total of fifty-six students were selected for study.

Body mass index (BMI) of all subjects were calculated by dividing weight in kilograms with height taken in meter squares. Performance was evaluated from the marks obtained in that particular examination. After all aseptic measures 5 ml of venous blood was drawn from antecubital vein after answering the questionnaire. Blood was allowed to clot at 4 °C and serum was separated and stored at -70 °C until estimation of leptin and cortisol by Enzyme-linked immunosorbent assay (ELISA). The kit for serum leptin and cortisol was obtained from Bio Source Europe S.A.

Data were analysed by one-way ANOVA. Post-hoc comparisons were done by Newman-Keuls test; $p < 0.05$ was taken to be significant.

RESULTS

The mean age was 19.8 years old. Table-1 shows the different levels of stress (no, mild, moderate and severe), BMI, cortisol and leptin levels. Data analysed by one-way ANOVA (df=3, 52) showed no significant difference between stress and BMI (F=0.98, $p>0.05$). A significant difference was observed between different levels of stress and cortisol (F=33.2, $p<0.01$), leptin (F=10.85, $p<0.01$) levels. Post-hoc test following one-way ANOVA showed that levels of cortisol were higher in mild, moderate and higher stress than no stress group. Cortisol levels were greater in higher stress group than mild and moderate stress groups. Leptin levels were higher in moderate stress than no and mild stress group. Leptin levels were lower in higher stress than moderate stress group.

Figure-1 shows different levels of perceived stress and ‘morning appetite on examination day’. Data analysed by one-way ANOVA (df=3, 52) showed significant difference between stress and morning appetite (F=4.4, $p<0.01$). The post-hoc test showed that morning appetite decreased in moderate stress but the decreases were greater in higher stress group than mild stress group.

Table-1: Effect of different levels of stress on BMI, cortisol and leptin levels in female students

Values are Mean±SD (n=14). Significant difference by Newman Keuls test *+ $p<0.01$ from no stress, mild stress and moderate stress in leptin and cortisol following one-way ANOVA

Parameter	Not Tense	Mild Tense	Moderate Tense	Very Tense	1-way ANOVA (df=3,52)
BMI (Kg/m ²)	21.7±1.72	20.3±2.58	20.1±2.25	20.4±3.79	F=0.986 $p>0.05$
Cortisol (ng/ml)	73.3 ±9.6	98.1±10.7*	103.8±13.9**	123.4±17.7**#	F=33.22 $p<0.01$
Leptin (ng/ml)	3.78±0.3	4.2±0.43	5.14±0.87*+	4.34±0.85#	F=10.85 $p<0.01$

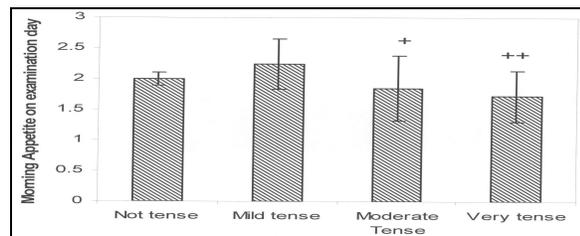


Figure-1: Effect of different levels of stress on morning appetite on examination day

Values are Mean±SD (n=14). Significant difference by Newman Keuls test + $p<0.05$, ++ $p<0.01$ from mild stress following one-way ANOVA

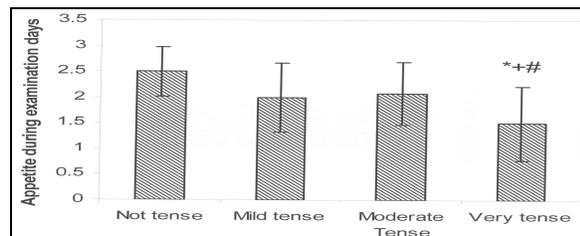


Figure-2: Effect of different levels of stress on ‘appetite during examination days’

Values are Mean±SD (n=14). Significant difference by Newman Keuls test * $p<0.01$ from no stress, + $p<0.05$ from mild stress, # $p<0.05$ from moderate stress following one-way ANOVA

Figure-2 shows different levels of stress and ‘appetite during examination days’. Data analysed by one-way ANOVA (df=3, 52) showed significant difference between stress and appetite during examination days (F=5.4, $p<0.01$). Post-hoc analysis showed that appetite during examination days decreased in higher stress group than no, mild, and moderate stress group.

Figure-3 shows different levels of stress and ‘getting education is pleasurable’. Data analysed by one-way ANOVA (df=3, 52) showed significant difference between stress and getting education is pleasurable (F=31.9, $p<0.01$). Post-hoc analysis showed that pleasurability of getting education increased in mild, moderate and higher stress than no stress group.

Figure-4 shows different levels of stress and academic performance. Data analysed by one-way ANOVA (df=3, 52) showed significant difference between stress and academic performance (F=35.6, $p<0.01$). Post-hoc analysis by Newman-Keuls test showed that academic performance increased in mild and moderate stress than no stress group but decreased in higher stress group than no, mild and moderate stress groups.

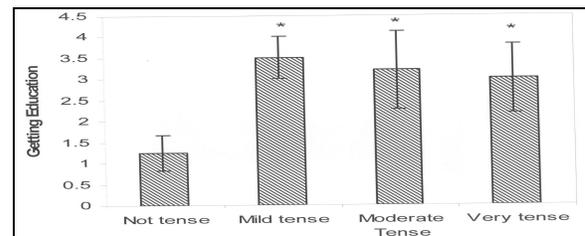


Figure-3: Effect of different levels of stress on ‘getting education was pleasurable’

Values are Mean±SD (n=4). Significant difference by Newman Keuls test * $p<0.01$ from no stress following one-way ANOVA

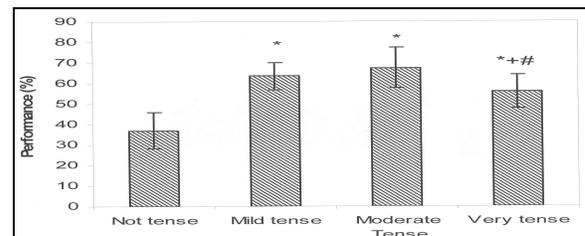


Figure-4: Effect of different levels of stress on ‘performance (%)’

Values are Mean±SD (n=14). Significant difference by Newman Keuls test * $p<0.01$ from no stress, + $p<0.05$ from mild stress, # $p<0.01$ from moderate stress following one-way ANOVA

DISCUSSION

Male and female workers who perceived psychological stress exhibited higher serum leptin levels with an increase in the level of stress perception.⁶ A direct relationship between serum leptin levels and human posttraumatic stress disorder after a major earthquake has been also reported.⁷ Important finding of the present study is that serum leptin levels did not significantly increase in mild and severe stress group compared to no stress group but the group that perceived moderate examination stress exhibited higher serum leptin levels (Table-1). On the other hand serum cortisol levels increased with an increase in the level of stress.

Exposure to stress inducing situation activates both sympathetic nervous system (SNS) and the HPA axis,^{10,11} which result in an increase in circulating levels of catecholamines¹² and glucocorticoids^{2,3} respectively. Increased levels of glucocorticoids are reportedly capable of increasing the leptin level through a direct action on adipose tissue.^{4,5} The lack of increase in leptin levels in higher stress group are largely explainable in terms of an inhibitory effect of SNS on leptin response to stress.¹³

Clinical studies show dual effects of stress on food intake.¹⁴ Studies on mild to moderate stress show enhancement of appetite leading to obesity,¹⁵ while severe stress has been shown to suppress appetite leading to anorexia nervosa¹⁶. In the present study the group which perceived highest examination stress exhibited a decrease in appetite on and during examination days (Figures-1, 2). However an increase in appetite that may lead to obesity was not seen in response to examination stress.

It is interesting to note that students who were under examination stress accepted that getting education was pleasurable for them and performed better than no stress group (Figures-3 and 4). It is relevant with the inverted-U relationship between stress and performance.¹⁷ When there is little stress to do an important task, we put our little effort and performance increases little. As stress increases on us, we do our best performance and this healthy stress helps to focus on our task but not so much to disrupt our performance. But if this stress continues it affects our performance and high stress previously has been shown to decrease performance level.¹⁸

It is tempting to relate the better academic performance (Figure-4) of groups who perceived mild and moderate examination stress with high circulating levels of leptin (Table-1). Animal research shows that stress-induced decrease in sucrose preference in chronically stressed rats was reversed by systemic

administration of leptin.⁸ Leptin injection also decreased immobility and increased swimming time in forced swim test (FST) suggesting that circulating levels of leptin have an antidepressant like effect.⁸

CONCLUSION

There is an inverted U-shaped relationship between self reported different levels of perceived examination stress and academic performance while moderate level of stress increases academic performance. Higher circulating levels of cortisol decrease academic performance while higher circulating levels of leptin enhance academic performance.

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