



A COMPARATIVE ANALYSIS OF THE IMPACT OF STRESS MANAGEMENT TECHNIQUES ON CORTISOL LEVELS AND LIPID PROFILES AMONG STUDENTS DURING ACADEMIC EXAMINATIONS

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KEYWORDS

Stress, Cortisol, Lipid Profile, Stress Management Techniques.

INTRODUCTION

Stress is characterized as a stimulus, whether physical or psychological, that can trigger mental or physiological responses and potentially result in illness. [1].

While we have a solid understanding of the fundamental neurochemistry underlying the stress response, there is still much to uncover regarding the intricate interactions among its components in both the brain and body [2]. Stressors present in our environment or within our bodies trigger stress, with its intensity varying based on the circumstances. In addition to the release of typical stress-related metabolites, enzymes, and hormones, the primary function of psychological stress situations involves a slow and multifaceted appearance of possible reactions and recognizable symptomatic organic changes. Stressors, psychological as well as physical, can alter humoral immunity and cell-mediated immunity in different ways, affecting the immune system [3,4]. Exposure to psychological stressors can alter the primary antibody response, and sustained high levels of stress can result in pathological changes in organs, physical alterations, and the development of psychosomatic diseases [5].

In contrast to higher and chronic stress levels, that can lead to anxiety and despair, mild stress can actually improve cognitive task performance. The pressure to excel in academic exams for better career opportunities serves as an acute stressor for students [6]. Every sort of stress, irrespective of whether they are physical or mental, induce the hypothalamic-pituitary-adrenal (HPA) axis to become more responsive, therefore increases the circulatory system's secretion of cortisol [7]. Stress response is characterized by an increase in corticosteroid release [8]. Examinations are considered naturalistic stressors that can impact human health. Stress is a common experience for all living organisms, and in professions like medicine, it is prevalent and can lead to physical fatigue and mental exhaustion [9].

Stress during examinations is specifically notable because it's one of the primary influences that can disrupt the delicate equilibrium between pro-oxidant compounds and antioxidants in human beings, that may result in a wide range of adverse effects on both physiologic and psychological health [10]. Academic exams are frequently utilized in stress studies due to their predictable, standardized nature, making them discrete examples of life stressors. Stress related to exams is linked to alterations in both mental and physical health, manifesting as heightened anxiety, mood swings, insomnia, and compromised immune function [11]. The rise in stress levels is believed to influence student performance during exams. Given that serum cortisol shares a primary structure similar to steroids (cyclopentanoperhydrophenanthrene), and lipids are typically metabolized to release, it can affect the body's lipid profile. [12]

Stress management measures, such as mindfulness and relaxation, have been found to help regulate cortisol levels among students, potentially improving their academic performance. It has been postulated that listening to music has positive health impacts via lowering stress. The fact that listening to music can trigger a variety of

cognitive processes in the brain, it stands to reason that music also affects cognitive processes associated to stress and, consequently, physiological reactions. [13] As nonpharmacologic techniques for improving general health and reducing stress and anxiety, yoga and meditation have gained widespread acceptance. Numerous populations, including college-age students, have demonstrated increases in attention and self-awareness after practicing meditation. College students may find that yoga and meditation provide them a set of coping skills that they may use both inside and outside of the classroom. [14]

This study will be conducted to investigate the impact of stress management measures such as yoga and soothing music on cortisol levels and lipid profiles students undergoing examinations.

Literature Review

According to the World Health Organization (WHO), stress can be defined as a state of worry or mental tension resulting from challenging circumstances. It is a natural human response that motivates us to address challenges and threats in our lives. While everyone experiences stress to some extent, how we manage and respond to stress significantly impacts our overall well-being. A study by Padmaja Rao et al. (2020) identified examinations as a major stressor among students, noting increased levels of cortisol, total cholesterol (TC), low-density lipoprotein (LDL), and high-density lipoprotein (HDL) during exam periods. [15] The over-secretion of stress hormones can affect the brain's memory processing and storage, potentially leading to hormonal and metabolic changes that contribute to heart disease and other health issues. Similar findings were reported by Glavas MM et al (2005) [16] and Sauro MD et al (2003). [17] Qureshi et al (2009). also observed that stress can increase visceral fat. [18] Rose H. Matousek et al (2010) concluded that cortisol is a promising candidate to assess the effectiveness of interventions intended to reduce stress, such as mindfulness-based stress reduction (MBSR), and has generally been found to be responsive to interventions geared towards reducing stress [19]. Myriam V Thoma et al (2013) in their study indicated that listening to music prior to a standardized stressor predominantly affected the autonomic nervous system and to a lesser degree the endocrine and psychological stress response. [13] Farrakhilla Hamzah et al (2019) suggested that, introducing strategies like mind-body exercise, mindfulness during their preparatory period and with the guidance of teachers or mentors may help the student to overcome the exam anxiety and enrich their performance. [20]

Study Objectives

The aim and objectives of the study are to analyze the relationship between stress management measures, serum cortisol levels, and lipid profiles among students both before and after examinations. Additionally, the study seeks to explore the impact of these stress management strategies on the physiological markers of stress and lipid metabolism.

MATERIALS AND METHODS

A cross-sectional study was conducted among 100 students from

various faculties (Ayurveda, Dental, Engineering) at C.S.M.S.S. College, Chhatrapati Sambhajnagar. A written informed consent was taken from all the participating students. Ethical approval for the research was obtained from the institution's Ethical Committee (CSMSS/DCH/EC/SS/2023-13).

A sample size of 100 was considered, with students randomly selected from different faculties within the 19-24 age group. Blood samples (5 ml) were collected between 10:30 am and 11:30 am to avoid diurnal variations, drawn from the antecubital vein and dispensed into plain bulbs, then transferred to the lab for analysis. Students were divided into two groups of 50 each, and the analysis was conducted in two phases: 3 days before the exam and 3 days after the exam.

Group A: Without stress management measures

Group B: With stress management measures

Group A's cortisol and lipid profiles were analysed both 3 days before and 3 days after the exam without any stress management measures, while Group B's profiles were analysed under the same conditions but with the inclusion of stress management measures such as yoga and soothing music.

The stress management measures included yoga and pranayama. Pranayama, including Surya Bhedna, Nadi Shodhana, Kapalabhati, and Anulom Vilom, was accompanied by Shavasana, where participants lay on their backs fully relaxed, with hands away from the body and eyes closed, focusing on breathing and body sensations. Shavasana was recommended for 5-7 minutes, while pranayama was suggested for 15-20 minutes, both to be performed in the early morning. Additionally, participants listened to parasympathetic nervous system-stimulating music for 30 minutes during meditation sessions.

Laboratory methods used for estimation were as follows:

1. Serum cortisol - Chemiluminescent Immunoassay (C.L.I.A)
2. Lipid profile:
 - a) Total cholesterol - CHOD – PAP
 - b) HDL - Phosphotungstic Acid Method
 - c) Triglycerides - GPO – POD
 - d) LDL - Calculated as Total Cholesterol minus HDL minus (Triglycerides divided by 5)

OBSERVATIONS & RESULTS

The obtained results were subjected to statistical analysis using the SPSS software and Python programming. A p-value greater than 0.05 was considered not significant, p-values between 0.01 and 0.05 were deemed significant, and p-values less than 0.01 were considered highly significant. Moreover, a p-value less than 0.001 was considered very highly significant. The correlation between serum cortisol levels and lipid profile was assessed using Pearson's correlation coefficient (r) method.

Table 1. Comparison of Age, Serum Cortisol Levels, and Lipid Profile Levels of Students Before and After Examinations.

Group A: Without stress management measures				
Parameters	Pre Examination	Post Examination	T-Value	P Value
	Mean±SD (n=50)	Mean±SD (n=50)		
Age (Years)	19.56±1.23	19.5±2.24	0.284	0.89(NS)
Cortisol(ng/ml)	45.52±1.96	34.34±11.02	-9.43	0.000***
Total Cholesterol (mmol/l)	169±31.42	134.16±23.68	5.35	2.000**
HDL (mmol/l)	81.2±38.10	76.20±33	-14.07	0.000***
LDL (mmol/l)	102.84±32.79	64.04±23.59	1.68	1.98**
Triglycerides (mmol/l)	113.36±40.43	97.52±30.69	2	0.010***
p>0.05: Not Significant(NS), *p: <0.05: Significant(S),				
***p: <0.01: Highly significant(HS), *** p: <0.001: Very highly significant.				
Group B: With stress management measures				
Parameters	Pre Examination	Post Examination	T-Value	P Value
	Mean±SD (n=50)	Mean±SD (n=50)		
Age (Years)	19.5±2.24	19.56±1.23	0.284	0.89(NS)
Cortisol(ng/ml)	26.49±14.58	14.72±8.73	1.67	0.000***

Total Cholesterol (mmol/l)	110.52±53.37	99.52±32.07	-3.07	0.000**
HDL (mmol/l)	117.72±44.10	63.72±28.30	-17.07	0.000***
LDL (mmol/l)	24.34±11.02	23.73±11.19	-2.54	0.05**
Triglycerides (mmol/l)	84.06±1.92	73.20±2.06	4.78	0.000***

p>0.05: Not Significant(NS), *p: <0.05: Significant(S),
***p: <0.01: Highly significant(HS), *** p: <0.001: Very highly significant.

Table 2. Correlation Analysis of Serum Cortisol Levels with Lipid Profile Values Before and After Examinations.

Group A: Without stress management measures				
	Pre- Examination		Post Examination	
	r-value	p-value	r-value	p-value
Total Cholesterol (mmol/l)	0.36	0	0.36	0
HDL (mmol/l)	0.06	0	0.06	0
LDL (mmol/l)	-0.03	0	0.03	0
Triglycerides (mmol/l)	0.24	0	0.24	0
Group B: With stress management measures				
	Pre- Examination		Post Examination	
	r-value	p-value	r-value	p-value
Total Cholesterol (mmol/l)	-0.570	0.85	-0.58	0.1
HDL (mmol/l)	-0.49	0.6	-1	0.61
LDL (mmol/l)	-0.77	0.4	0.46	0.29
Triglycerides (mmol/l)	0.27	0.05	1.23	0.07

DISCUSSION

In this study, it was noted that examinations led to a significant increase in stress hormone levels (serum cortisol) and blood lipid profiles. Table 1 demonstrates Comparison of age, serum cortisol levels, and lipid profile levels of students before and after examinations, and Table 2 shows correlation analysis of serum cortisol levels with lipid profile values before and after examinations. We can appreciate a notable rise in serum cortisol and blood lipid levels i.e TC, LDL and HDL before examinations among students.

Excessive secretion of stress hormones can impact the brain's memory processing and storage, potentially leading to hormonal and metabolic changes that contribute to heart disorders. Similar findings were reported by Glavas MM et al. and Sauro MD et al [16,17]. The lipid profile also showed a marked increase in total cholesterol and LDL levels, which are considered detrimental to health.

The observed rise in plasma cortisol could be the consequence of stress-induced stimulation of ACTH release, which in turn triggered the production of cortisol precursors. Neurons with cell bodies in the paraventricular nuclei of the hypothalamus release arginine-vasopressin (AVP) and corticotrophin releasing hormone (CRH) into the hypophyseal portal system in response to a stressor. The activation of the pituitary and adrenal glands by the CRH via the HPA is corroborated by Burtis C et al and Sabyasachi S et al. [15,21,22].

This increase in stress levels could be attributed to the anxiety associated with examinations and their outcomes, affecting students' performance. Since excessive stress hormone secretion may also have an impact on students' exam performance results, the examinations might not be a reliable indicator of awareness of this group of anxious students. According to the current study, exam-related anxiety may be the cause of the increased stress response shown during the exam. This could also be related to the caution and awareness of what happened to prior students who performed poorly on tests of a similar nature. It has also been noted that some students did not take their studies seriously until the examination date was revealed, which meant they were never prepared for the corresponding exams. These students experience extreme stress when studying and have a persistent fear of exams. Introducing stress management measures is crucial in such scenarios. Pranayama, a form of breathing exercise, was employed to enhance concentration, while soothing music was used to relax the body and mind. Pranayama helped students calm their minds and improve concentration, while soothing music aided in relaxation, especially during periods of exhaustion. Shavasana was included to alleviate stress and tension, reduced anxiety and depression and enhanced concentration and energy levels [17,23]. Soothing music effectively reduced stress levels, as evidenced by lowered heart rate, blood pressure, and cortisol levels [16]. Post-examination tests revealed a significant decrease in serum cortisol and blood lipid levels, attributed to the stress management techniques employed. These measures not

only reduced stress levels among students but also mitigated their fear of exam results to some extent.

CONCLUSION

The primary objective of this study was to investigate the correlation between stress management techniques and serum cortisol levels, as well as blood lipid profiles, among students before and after examinations. The findings revealed a significant increase in cortisol and lipid profile levels before examinations. However, after implementing stress management measures, there was a notable decrease in cortisol and lipid profiles. Hence, the study suggests that stress management techniques are effective in mitigating stress and enhancing performance in daily tasks. Specifically, the use of soothing music was found to reduce stress levels and serum cortisol levels among students. Furthermore, the study underscores the importance of promoting stress-reducing activities within educational institutions. It recommends allocating at least 30 minutes regularly for pranayama and yoga sessions, as these practices aid in stress reduction and improve concentration, ultimately enhancing academic performance. Combining soothing music, pranayama, and yoga could further reduce stress levels among students and improve their performance in examinations.

Summary

The objective of this study was to investigate the association between stress management measures and serum cortisol levels, as well as blood lipid profiles, among students before and after examinations. The study included a sample size of 100 students who were selected based on their participation in ongoing exams. A null hypothesis was formulated and analysed using the SPSS software and Pearson's correlation method. Sample collection and analysis were conducted under sterile conditions, and the resulting reports were meticulously examined. The levels of cortisol and lipid profiles were found to be significantly elevated before the exams and significantly reduced after the exams. These findings indicate that stress management measures had a positive impact on the students.

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