

## The Biofeedback Therapy on Academic Stress among Graduate Students

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### Abstract

The study aimed at understanding the effects of Biofeedback therapy, as an intervention strategy, on academic stress of undergraduate college students in Bangalore, India. Bangalore has been dealing with an increase in student suicide rates and academic stress has been touted to be one of the reasons for this increase. Moreover, academic stress is also linked with increased anxiety and depressive symptoms. Biofeedback therapy is a relatively new method of treatment, which utilizes modern technology to address various issues such as stress, by helping the individual self-regulate and monitor their own bodily processes thereby, reducing stress. Students with higher levels of academic stress were screened using the Academic stress scale [1]. Thirty-one undergraduate students with high levels of academic stress participated in the study. Participants were trained for ten sessions of Biofeedback intervention by monitoring heart rate variability and relaxation exercises. Perceived academic stress was measured in the pre and post test setting by using the Perceived stress scale [2]. Data collected was analyzed using t-test and significant results were found.

**Keywords:** Academic Stress; Biofeedback Therapy; HRV Training

### Introduction

The college student population deals with diverse types of stressors on a daily basis. These stressors include adapting to higher education, increased academic workload, time management, dealing with interpersonal difficulties with faculty and peers, and financial strain. On account of these stressors, research has shown us that the college student population is at a high risk of developing psychopathologies such as anxiety, depression, suicidal ideation, diminished decision making ability, and an increased incidence in drop rates. The institutions of higher education must keep these aspects of academic stress in mind while creating and designing curriculum as well as provide facilities to help students when faced with such stressors. Some of the efforts taken in this direction are related to hiring counselors, therapists, and medical personnel in college campuses, however, with increased technological availability; new methods must be deliberated on.

### Academic stress

College student's interactions with stressors present in their environment such as peer and faculty interactions, their appraisal and coping with the academic-related stressors such as exams and assignments, and the psychological responses such as anxiety and depression to the stressors [3] are all aspects of academic stress. Academic stress causes mental distress among students due to the anticipated possibility of failure or poor performance. Examinations [4], excessive assignments [5], time management issues [6], poor relationships, peer competition [7], excessive expectations and demands [8] overcrowded lecture halls, semester system, and inadequate resources [9] have been identified as major sources of academic stress. Sreeramareddy, Shankar, Binu, Mukopadhyay, Ray and Menezes (2007) conducted their study in India and reported results which are consistent with these studies.

The effects of academic stress follows the Yerkes-Dodgson law (1908) of the inverted U-shaped curve, where an increase in stress till an optimum level, leads to positive performance, however, an increase in stress beyond this optimal level begins to diminish individual performance. Therefore, depending on the resources available to the student the effect of the stressor will vary. The effects of the changing levels of glucocorticoids also support the inverted-U shape nature of stress effects. Up to an optimal level, glucocorticoids can enhance cognitive performance while above this optimal level glucocorticoids impair cognitive performance [10]. Additionally, under stressful conditions, the cognitive system is overloaded, decreasing an individual's attentional resources [11]. As stress increases, attention becomes more selective, excluding information that is irrelevant to the task at hand in a process known as cue utilization reduction [11] benefitting the completion of the task for the student for instances such as submission of assignments and examination performance [12]. Alternatively, there is also evidence that the reduction of attentional resources under stress may result in a decreased ability to filter out irrelevant information from relevant information [13] leading to increased distractibility of the student leading to poor performance in examinations, poor social engagements and ineffective time management [13].

Further, working memory impairments are likely when the task load is high [14] and when performance is assessed during the stressful event itself in events such as examinations [15]. Extremely high levels of HPA axis activation will impair memory consolidation [16]. Stress impacts the human immune system as well where chronic stress suppresses a wide range of immune system parameters while acute stress stimulates certain aspects of immune functioning [17]. Specifically, acute stress can trigger aspects of an immune system acute phase response, even in the absence of an infectious agent [18].

In the Indian context, academic stress has been termed as a "career stopper" [19] According to the statistics published by National Crime Records Bureau in 2015, there is one student every hour that commits suicide in India [20] and a major reason for the suicides were due to failure in examinations. A 2012 Lancet report claimed that the age group between 15-29 years old in India have the highest rate of suicide in the world [21]. Several studies have identified academic stress as the primary cause of suicide rates and therefore is a significant cause of concern [22].

Various Indian studies have shown that Indian students exhibit many symptoms of depression, high anxiety, frequent school refusal, phobia, physical complaints, irritability, weeping spells, decreased interest in school work. Arun and Chavan (2009) and Wilbum and Smith (2005) have also seen that there is a direct relationship between stress and suicidal ideations. Failing in academic performance is associated with a five-fold increased likelihood of a suicide attempt [23].

From the above findings it can be concluded that stress has an impact on the physiological systems and other cognitive functions. Impairment in cognitive functions leads to memory, attention and concentration impairment. This further leads to increased suicidal ideations which reduces the holistic wellbeing of the students. Therefore, it is important for educational institutions to maintain a well balanced academic environment conducive for better learning with a focus on the students' personal needs.

### Interventions for academic stress

The aforementioned effects of academic stress clearly show that stress adversely affects student well being. When a student is exposed to chronic stress their everyday autonomic balance shifts toward a sympathetic-predominant state which alternatively, results in para-sympathetic withdrawal. This persistent weakening of parasympathetic activity may deteriorate the regulatory capability of physiological functions in dealing with external stressors [24]. In the long run, if the sympathetic-predominant autonomic balance is not recovered smoothly the students could be vulnerable to physical and/or psychiatric disorders. Various methods like yoga, meditation, biofeedback, CBT, life-skills training have been used for managing stress.

Students mainly use two methods of coping mechanisms to deal with academic stress. "The first is problem focused coping, which involves analysis of the main sources of difficulty with a view to seeing whether changes are possible" [25]. Emotion-focused coping is the second method used by the students to deal with stressors. Emotional support from friends and family provide social support to the students which is an essential aspect of using emotion focused coping as behavioural and/or cognitive strategies in order to deal with the stressors.

The cognitive therapeutic approach can also help college students manage stress effectively. Additionally, relaxation therapy is another intervention that has been found to be successful in easing stress for the college student population [26]. Relaxation techniques are helpful in calming any muscles that may be stiff due to stress. Supportive counseling therapy also helps students to come up with different methods of handling their stress or anxiety, especially for test anxiety [26]. Further, techniques such as Yoga are considered a helpful strategy for interventions to decrease academic stress in the student population [27].

### Biofeedback

Biofeedback intervention training is a relatively newer concept in comparison to the traditional methods of cognitive behavior therapy to reduce stress. It is a self-regulation technique through which the participants learn to voluntarily control bodily processes which were once considered to be involuntary in nature [28]. Biofeedback requires specialized equipment to convert physiological signals into meaningful visual and auditory cues, as well as a trained biofeedback practitioner to guide the therapy. Using a screen such as a computer monitor, patients get feedback that helps them develop control over their physiology. It's a mind-body technique in which individuals learn to modify their physiology. Thereby, with active participation, the individuals can improve physical, mental, emotional and spiritual health. Clinical biofeedback has been found helpful to manage disease symptoms as well as to improve overall health and wellness through stress management training. Research has shown that biofeedback interventions are efficacious in treating a variety of medical conditions.

Military personnel after being exposed to biofeedback training showed greater heart rate variability (showing less arousal) during a combat stimulation, indicating that biofeedback played a role in altering the parasympathetic regulation of their cardiac activity. Further, biofeedback training has been found to be efficient in teaching self-help skills to reduce the psychological harm that may come after being exposed to trauma. It is because the training allows for a reaction to stress that has been modulated parasympathetically and thus, is a coping tool that can be used after a stressful situation.

Similarly effects were also found in a study conducted by Zwan, Vente, Huizink, Bogels and Bruin (2015) where they compared the

effects of self-help physical activity (PA), mindfulness meditation (MM) and heart rate variability biofeedback (HRV-BF) in bringing down stress levels and the symptoms associated with it. 76 individuals between the ages of 18-40 participated in the study and were randomly allotted to PA, MM or HRV-BF groups. The participants were introduced to the specific intervention techniques and were asked to practice the same at home for 5 weeks. Results indicated that all three interventions were equally effective in reducing the stress levels and its related symptoms.

Several studies lend support to relaxation and biofeedback stress management techniques as a means to reduce stress and can simultaneously be implemented in college settings as a means of supporting student mental wellness.

Several research studies suggest that academic stress has serious consequences for students. Most of the existing literature pertains to the measuring academic stress, anxiety, exploring the sources of academic stress, finding the relationship with performance, or outcomes such as suicide. A number of the studies have shown that stress has a direct relationship with performance but few studies have suggested solutions or any interventions to help deal with the problem. Moreover, with reports suggesting that due to high academic stress there has been 80% rise in the suicidal rates in Bangalore city within 2012-13 calls for strategies to be developed to help students manage academic stress (National Crime Records Bureau, 2014). The combination of relaxation training and biofeedback HRV intervention that is solely dedicated to reducing academic stress would be beneficial in this context.

### Objective of the Study

To investigate the effectiveness of a newly designed relaxation training and biofeedback HRV intervention among students with high academic stress.

### Hypotheses

There will be a difference in perceived stress score of students with high academic stress before and after the biofeedback intervention.

### Methods

#### Sample

The participants consisted of 31 undergraduate students aged 18-25. There were 11 males and 20 females from commerce, sci-

ence, management and humanities stream in the final sample. Perceived stress scale was administered and only participants who were high on stress were selected for the study. Participants who dropped out without completing the intervention were excluded. Students practising yoga and other forms of relaxation were not involved in the study. Informed consent was collected and the intervention was conducted.

### Measures

#### Academic stress scale

The academic stress scale [1] is a 40-item questionnaire designed to understand the sources of stress among students. The items are marked on a five-point measure ranging from 0 (no stress) to 5 (extreme stress). The academic stress scale is an adapted version with Indian norms of the Students' Academic Stress Scale (SASS) developed by Kim in 1970.

#### Perceived stress scale (Cohen,1988)

This is a ten-item scale that assesses the degree to which one perceives situations as stressful. The questions are designed to assess the current levels of experienced stress and the scale has a cronbach alpha value of .70 (Lee, 2012). The scale contains positively and negatively worded items. Participants are asked to rate how they have been feeling in the past four weeks on a five-point scale ranging from 0 (never) to 4 (very often). Due to the temporal nature of the scale, administration after four to six weeks accounts for accurate results.

#### Data collection

Participants were screened for high academic stress using the Academic Stress Scale. The selected participants answered the Perceived Stress Scale prior to the intervention. The intervention was conducted in the cognitive lab and extraneous variables such as temperature and noise were controlled. The intervention lasted for ten sessions where they were trained in biofeedback HRV through monitoring and relaxation exercises. Measurements such as heart rate, blood volume pulse, heart rate variability and time for completing the task were manually noted for each participant. Each session lasted for 25-30 minutes. At the end of ten sessions, post test was conducted and the participants answered the perceived stress scale again. Participants were also briefed about methods of controlling their stress by discussing strategies they could follow at home. The scores obtained on the perceived stress scale prior to

and after the intervention were analyzed using IBM SPSS.

#### Ethical consideration

Participation in the study was voluntary and the participants were informed that they could withdraw from the study at any given time. Informed consent was taken from the participants briefing them about the study. Confidentiality of the participants was maintained. All identifying information linked to any participant was translated to number codes. Participants were informed that the results of the study would be used for presentation and publication purposes. Participants were free to contact the researchers for the results of the study. No monetary compensation was given for participation. The principal investigator and/or the research assistant were present at the cognitive lab during the intervention sessions.

#### Results

Participants who obtained a high score were contacted for the intervention phase of the study. Those who provided consent were briefed about the objectives of the intervention and schedules were prepared for each participant. 31 undergraduate students participated in the study.

Perceived Stress Scale developed by Cohen was administered before the start and at the end of the intervention programme. Shapiro-Wilk's normality test revealed that the variables were normally distributed; therefore, parametric tests were adopted to test the level of significance of the study.

Perceived stress scale was used as the measure to understand changes in stress levels prior to and after the intervention. Results mentioned in table 2 show that there was a significant difference in academic stress scores obtained by the participants between the pre-test and post-test at .645 ( $p < 0.01$ ) indicating a significant effect of the intervention providing support to the hypothesis.

Along with the standardized measure, other recordings were also obtained from the participants such as heart rate variability, time taken to complete the task, and overall score obtained for completing the task. The score variable was embedded in the task and reflected the goal of the participants during the task, which was to reduce the score value in successive sessions. These variables were also subjected to parametric test of analysis to understand if there were any considerable changes in the scores.

Variables	Mean	Std Dev	df	t-test
Pre-test	22.03	6.58	31	.941*
Post-test	17.39	7.04		.064*

**Table 1:** Showing test of normality conducted for pre-test and post-test scores.

Variables	N	Mean	Std Dev	df	Sig
Pre-test	31	22.03	6.58	31	.645*
Post-test		17.39	7.04		

**Table 2:** Showing significance result scores obtained for pre-test and post-test on perceived stress scale.

\*p < 0.01.

Variables	Mean	Std Dev	df	Sig
HRV1	21.32	19.24	31	.659
HRV2	27.52	16.53		
Time1	1307.29	55.79	31	.778
Time2	1288.84	78.72		
Score1	629.10	21.55	31	.029*
Score2	612.52	31.76		

**Table 3:** Showing significance test results obtained for heart rate variability, time and scores obtained by participants.

\*p < 0.05.

It can be understood from table 3 that heart rate variability and time taken to complete the task did not have any significance difference. The score obtained by the participants however, did show a significance difference at .029(p < 0.05) indicating that the intervention did have an effect on the score, which implies that the participants were able to successfully satisfy the objective to complete the intervention tasks at a lower score in successive sessions.

### Discussion and Conclusion

It is crucial to recognize and identify students who are undergoing high stress and target at improving their psycho-social well-being. Participants were also interviewed after the completion of the tenth session to understand their general satisfaction with the intervention and to take into account any suggestions. Most of them reported a complete sense of relaxation and comfort after the sessions. Some of them implied that they were better able to control their anger and practice being patient, which was earlier absent in

their behaviour. There were reported improvements in concentrations levels as well which is consistent in findings of the effect of biofeedback training reported by Calderon and Thompson (2004).

Biofeedback intervention has been found to be a useful method to deal not only with stress, but other medical conditions as well [28]. The results from this phase of the study indicate that there was an overall reduction in the students' stress levels after the intervention and the qualitative report also contribute to the same findings. Biofeedback HRV training was found to aid relaxation and improve scores in participants in a study conducted by [29] which is consistent with the present study as well. Although understanding stressors help in greater self-awareness, improving on self-resources to cope with stress builds resilience and improves mental health. The training is essentially a method to alleviate stress by focussing on the stress response or reaction rather than the stressor.

Similar results have been demonstrated in a study conducted by Lee, Kim, Wachholtz (2015) where significant differences were found in trait-anxiety levels between undergraduate students who participated in HRV biofeedback training and no-treatment group. The former study had a relatively smaller sample size of five participants per group, the present study found significant differences in stress scores after the biofeedback intervention with a sample of 31 students, though it may be beneficial to include a control group in future studies.

Strengthening the reflexes of the homeostatic system forms the crux of biofeedback HRV training wherein, the body improves the functioning of the parasympathetic system [30]. The significant reduction in stress levels reported by the participants are also in line with the results reported in the conducted by Kotozaki, *et al.* (2014) which showed reduction in stress levels for daily hassles following biofeedback training.

In the current study, the intervention for each participant was conducted in a time span between four to six weeks. The significant change in the stress scores may be a result of this as previous studies report that changes start occurring at the physiological level within three weeks [31]. Comparable result was demonstrated in a biofeedback HRV intervention conducted to reduce stress among public health students whereby significant changes in stress levels were noted after a four-week intervention programme [32].

Psycho-education along with biofeedback training that involved relaxation exercises were the corner stone in this intervention model and proved to be effective. This format of psycho-educating the clients about the benefit of consistently following the intervention is also beneficial as proved in earlier studies [33]. It also helps in understanding how participants perceive the situation and gauge their reactions towards it which will contribute towards improving their condition [34]. Relaxation training also calms the system and makes students more efficient in managing academic stress [26].

It becomes imperative to also understand that participants need to practice the relaxation exercises after the completion of the training to ensure the changes have a more long-lasting effect [35].

### Limitation

The study was based on a pre-test post-test experimental design and showed significant difference in stress reduction between the two time periods however, greater clarity of the effects of the stressors could be deduced if a control group was added as part of the study. Future research should focus on comparing a control group and the experimental group after the biofeedback training session. Additionally, the size of the intervention sample is effective to understand significant differences, but should be increased to essentially draw up a module to reduce academic stress. Other variables such as personality factors, past history, etc. can also be considered while devising an effective intervention module for students. As academic stress continues to be an alarming concern, it may also extend to post-graduate students as well as the faculty and administration to get insight towards a holistic understanding of the problem.

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