



## EFFECT OF STRESS AND ANXIETY ON FIRST YEAR MEDICAL STUDENTS

\*Sumitra Sudharkodhy<sup>1</sup>, Karthiyane Kuttly<sup>2</sup>, Vinutha Shankar M. S.<sup>2</sup>, Patil N. J.<sup>3</sup>,  
Balan K.<sup>4</sup>

<sup>1</sup>Department of Physiology, Karpaga Vinayaga Institute of Medical Sciences & Research Centre, Chinna Kolambakkam, Kanchipuram- 603308.

<sup>2</sup>Department of Physiology &, Sri Devaraj Urs Medical College, Tamaka, Kolar 563101.

<sup>3</sup>Department of Allied Health Sciences, Sri Devaraj Urs Academy of Higher Education and Research, Kolar- 563101.

<sup>4</sup>Department of Microbiology, Karpaga Vinayaga Institute of Medical Sciences & Research Centre, Chinna Kolambakkam, Kanchipuram- 603308.

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### \*Corresponding Author

**Dr. Sumitra Sudharkodhy**

Department of  
Physiology, Karpaga  
Vinayaga Institute of  
Medical Sciences &  
Research Centre, Chinna  
Kolambakkam,  
Kanchipuram- 603308.

### ABSTRACT

**Context:** Medical students are exposed to various stresses like demanding medical education and different teaching protocols.<sup>4,5</sup> Heart rate variability (HRV) is a simple and non-invasive indicator for the detection of cardiac autonomic dysfunction. This study was done to assess the effect of stress and anxiety on HRV. **Aims:**

- To assess the perceived stress, anxiety and heart rate variability in first year medical students.
- To correlate stress and anxiety to heart rate variability.

**Methods and Material:** The study included one hundred and ten, first year M.B.B.S students, excluding students with any infections, metabolic diseases, cardio respiratory diseases and medications which alter the autonomic functions. Anxiety and Stress were measured using

Spielberger state-trait anxiety inventory (STAI) and perceived stress scale (PSS) questionnaires respectively. Based on the scores students were assigned to stress & non-stress group and anxious & non-anxious group. The electrocardiogram (ECG) was recorded using a house built Analogue ECG Amplifier, which was further analysed using HRV analysis software. **Results:** STAI & PSS were analysed; those who have STAI score of above 40 come under anxious group and those with PSS score of 13 and above comes under stress

group. 62% students are both anxious as well as stressed. The parameters namely, mean heart rate, SDNN, RMSSD, LFnu and HFnu were correlated with stress and anxiety scores. During state-anxiety, there are significant increase in heart rate, RMSDD, LF domain, and LF/HF and during trait-anxiety there are significant increase in RMSDD and LF/HF ratio. In this study perceived stress is not significant with HRV. **Conclusions:** This study shows that during anxiety there is increased activity towards sympathetic, but no difference in parasympathetic activity and during perceived stress there is no significance with heart rate variability.

**KEYWORDS:** Anxiety; Stress, Spielberger state-trait anxiety inventory, perceived stress scale, Heart rate variability.

## INTRODUCTION

Stress, is defined as a mismatch between perceived demands and perceived capacities to meet those demands. It is a huge problem in the present scenario, which may lead to work related illness directly or indirectly.<sup>[1]</sup> It affects many physiological parameters in human body and causes imbalance in homeostasis mechanism.<sup>[2]</sup>

Medical training is highly stressful particularly for those who are beginning their medical education.<sup>[3]</sup> Medical students are exposed to various stresses in medical college like demanding medical education and different teaching protocols.<sup>[4,5]</sup>

Stress and anxiety is often associated with increased risk for cardiovascular disorders including ventricular arrhythmias, myocardial infarction, heart failure and sudden death<sup>6</sup>.

Heart rate variability (HRV) is a non-invasive electrocardiographic (ECG) index of the autonomic control of the heart, which has been extensively studied in anxiety and affective disorders. HRV reflects oscillations in the interval between consecutive heart beats. The analysis in the time domain of ECGs involves the identification of each cardiac cycle and the determination of mean intervals between successive R (R-R) or QT waves.

The aim of the present study is to test the impact of real life stressors among first year medical students on indices of resting cardiac autonomic regulation using spectral analysis of HRV and conventional autonomic tests.

**OBJECTIVE**

- To assess the perceived stress and anxiety levels and heart rate variability in first year medical students.
- To correlate stress and anxiety to heart rate variability.

**SUBJECTS AND METHODS**

One hundred ten healthy first year medical students of either gender from our tertiary care teaching hospital were included in our study. Informed oral consent was obtained from the study population that was approved by the institutional ethical committee.

**Inclusion criteria**

- First year medical students of age group 18 to 20 years.

**Exclusion criteria**

Students those were,

- Practicing any known stress relieving or relaxation technique.
- Not having any drugs or beverages in quantity which affect the autonomic nervous system like anticholinergic drugs.
- Not having any major illness which is known to affect the autonomic nervous system.

Anxiety and Stress were measured using Spielberger state-trait anxiety inventory (STAI) and perceived stress scale (PSS) questionnaires respectively. Based on the scores students were assigned to stress group /non-stress group and anxious group / non anxious group. The electrocardiogram (ECG) was recorded using a house built analogue ECG Amplifier.

Recording was done in the morning hours between 9:00a.m and 11:00a.m.

The subjects were given the following instructions.

- To avoid food two hours prior to testing
- To avoid coffee or alcohol 24 hours prior to testing
- To wear loose and comfortable clothing during the test.

**Recording**

The electrocardiogram (ECG) was recorded using in ECG Amplifier, with Audacity 1.3.13 license free software in the supine position for 5 minutes after 10 minutes of supine rest. Subjects were instructed to close the eyes and to avoid talking, moving of hands, legs and body, coughing and sleeping during the test.

ECG was recorded in dot wave form with 8000 samples/second (minimum required is 1000 samples/sec) the recorded wave was subjected to digital filtering to filter the noise and amplification to increase the size of ECG wave. Using beat finder every 'R' wave was recorded as beat and the real time was noted. The data was exported as labels to notepad and from there to Microsoft excel to find out 'R-R' interval, this was saved in notepad. Every subject's raw data, filtered data and R-R interval in millisecond in notepad is saved. The notepad file is opened in HRV Analysis software V1.1 license free software and the report sheet was saved in JPEG format.

The ECG was analyzed using HRV analysis software. The analysis from the HRV software provides information about time domain (SDNN, RMSSD) and frequency domain parameters (LF, HF, LF/HF ratio).

## RESULTS

STAI and PSS were analyzed, those who have STAI score of above 40 comes under anxious group and those with PSS score of 13 and above comes under stress group. 62% of students are both anxious as well as stressed. (Figure -1).

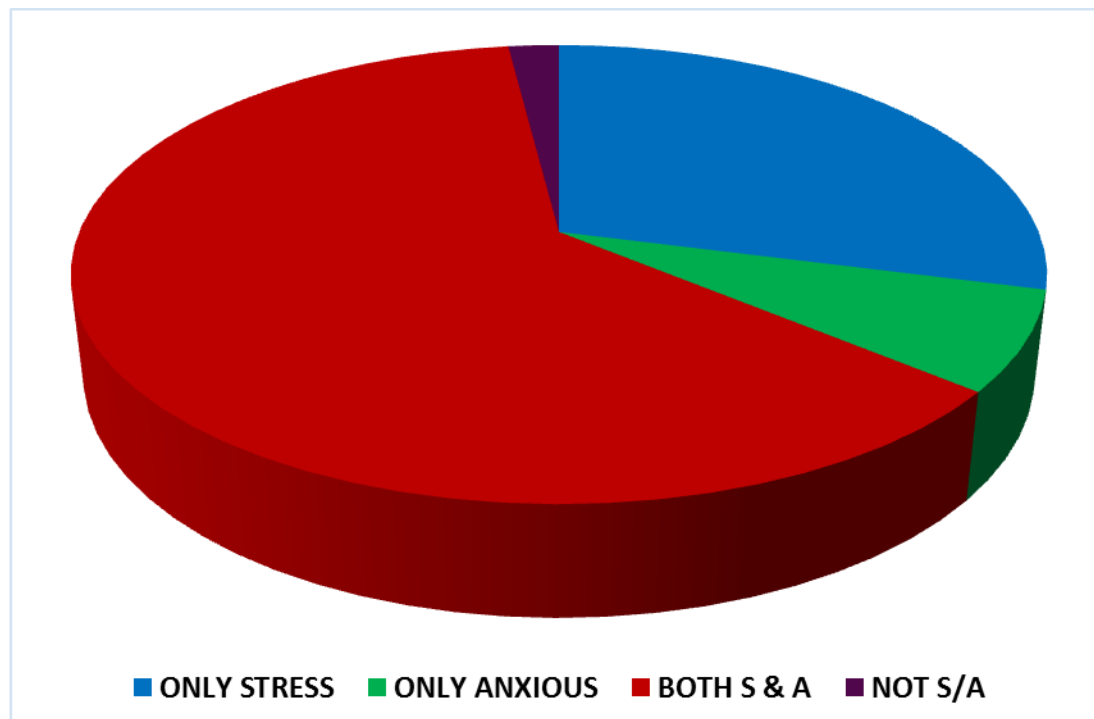


Figure 1: Shows stress and anxiety in first year medical students.

The parameters namely mean heart rate, SDNN, the root mean square of differences between successive rhythm-to-rhythm (RR) intervals (RMSSD), low-frequency LF nu and high-frequency HF nu were correlated with stress and anxiety scores (table-1,2,3).

During state-anxiety, there are significant increase in heart rate, LF domain, LF/HF and decrease in RMSSD (table 1) and during trait- anxiety there are significant decrease in RMSDD and increase in LF/HF ratio(table 2). In this study perceived stress is not significant with heart rate variability (table 3).

**Table 1: Comparison of STAI-S & HRV with Non Anxious and Anxious group**

STAI-S	NON ANXIOUS GROUP (n=35 )	ANXIOUS GROUP (n=76 )	P VALUE
STRESS SCORE	34.56 ± 4.19	50.51 ± 6.45	0.000
MEAN HEART RATE	80.97 ± 9.31	86.97 ± 16.04	0.123
RMSSD	52.64 ± 30.74	38.71 ± 25.48	0.045
LF	30.77 ± 17.71	40.05 ± 21.09	0.038
HF	67.13 ± 20.41	59.94 ± 21.11	0.033
LF/HF	0.56 ± 0.49	1.07 ± 1.37	0.068

**Table 2: Comparison of STAI-T & HRV with Non Anxious and Anxious group**

STAI-T	NON ANXIOUS GROUP (n=29 )	ANXIOUS GROUP (n=82 )	P VALUE
STRESS SCORE	33.93 ± 4.33	49.74 ± 6.44	0.000
MEAN HEART RATE	81.96 ± 8.51	86.18 ± 15.98	0.238
RMSSD	56.92 ± 34.21	38.26 ± 23.69	0.005
LF	32.66 ± 17.82	38.71 ± 21.20	0.386
HF	64.79 ± 20.79	61.29 ± 21.21	0.728
LF/HF	0.61 ± 0.53	1.02 ± 1.34	0.303

**Table 3: Comparison of PSS & HRV with Non Stress and Stress group**

PSS	NO STRESS GROUP(n=11)	STRESS GROUP (n=100)	P VALUE
STRESS SCORE	10.60 ± 1.71	20.39 ± 4.63	0.000
MEAN HEART RATE	84.53 ± 9.80	85.15 ± 14.94	0.472
RMSSD	40.98 ± 23.40	43.26 ± 28.35	0.428
LF	42.71 ± 14.33	36.59 ± 20.97	0.564
HF	57.29 ± 14.33	62.68 ± 21.62	0.564
LF/HF	0.86 ± 0.50	0.92 ± 1.25	0.519

## DISCUSSION

Anxiety results in psychological problems resulting in deterioration of academic performance. This further affects autonomic balance resulting in cardiac dysfunction. In the present study HR, SDNN, LF and LF/HF ratio increased and RMSSD, HF decreased were

compared to a study done by Andrei *et al* in 2009 shows that high Trait anxiety is associated with sympathetic dominance. In comparison to mental stress, autogenic training have parasympathetic dominance. No significant effects of TA or the psychophysiological conditions on LF power, or LF/HF ratio.<sup>[7]</sup> Some other studies have also revealed high prevalence of depression and anxiety among medical students, with levels of overall psychological distress consistently higher than in the general population.<sup>[13,14,15,16,17]</sup>

Later in one Indian study by Srinivas *et al* shows that LF nu and LF/HF ratio of heart rate variability in supine posture was significantly higher in the “stress” group compared to the “no stress” group.<sup>[8]</sup> In this study self-rated scale was used instead of STAI and PSS.

One international study by Reetta Orsila *et al* showed that HRV parameters describing mental stress, i.e., RMSSD, TINN and HF were lowest in the morning. These low morning values suggest the subjects’ perceived stress was high in the morning. On the other hand, these values were highest at night, which suggests the subjects’ relaxation and low mental stress. The values of LF and LF/HF, which were the highest in the morning and the lowest at night, are also indicative of high mental stress in the morning and low at night.<sup>[9]</sup>

Another study done by Paolo Melillo *et al* showed that almost all HRV features measuring heart rate complexity were significantly decreased in the stress session. The features SD2, D2, En(0.2), En(rchon), a1, lmax were significantly reduced during university examination as compared with rest session, while lmean, REC and ShEn increased significantly during stress.<sup>[10]</sup>

According to the study done by Sato T (2006) showed that heart rate and LF/HR ratio declined during the massage, but these affects almost subsided after massage.<sup>[11]</sup>

Perceived stress score (PSS) is an index of an individual’s perception to events in one’s life that is perceived as stressful. In our study, there were no significant decrease in PSS in contrary to an Indian study that showed significant decreased in health care students.<sup>[18]</sup>

## LIMITATIONS

1) There are some limitations to the present study. We did not measure respiration, because in many HRV studies respiratory sinus arrhythmia was ignored.<sup>[12]</sup> However, the effect of breathing pattern on HRV is a debated question. Some studies showed that different breathing conditions may have an impact on the reproducibility of HRV.

2) the results should be interpreted with caution due to the small sample size and the recording of only a single day.

3) Variation of resting HR was not considered while interpreting the HRV results.

Despite some limitations, there are considerable strengths in this study. The data for this study were gathered using multiple measurements in combination with new variables to quantify HR.

## CONCLUSION

This study shows that during anxiety there is increased activity towards sympathetic, but no difference in parasympathetic activity and during perceived stress there is no significance with heart rate.

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## Conflicting Interest

Nil.

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