

# Level of Academic Stress and Its Effect on Sympathetic Parameters in First Year Medical Students

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**Abstract:** *Background and objectives:* Stress is the reaction of body with a change that requires a physical, mental or emotional tolerance or experience by way of an adjustment or response. Many studies on stress in medical education focus on the documentation of stress and information on the correlation of stress. [1] (2011). Most of the autonomic functions tests are based on evaluation of cardiovascular reflexes triggered by performing specific provocative maneuvers. Stimuli which increase Blood pressure such as Isometric Hand Grip Test (IHGT) activates mainly sympathetic outflow. While the Blood pressure response to orthostatic tests like blood pressure on standing or lying to standing (LST) reflects the sympathetic activity. [2] (2010). The purpose of this study was to examine the stress level by medical education on first year students in medical college using autonomic function tests like LST and IHGT. *Methods:* The study group consisted of 52 first year medical students (26 males and 26 females) of BLDEA's Shri B.M.Patil Medical College Bijapur, Karnataka. The data of parameters of autonomic functions tests (LST and IHGT) was taken 2 month prior to academic examination (viva voce) as prestress (PS) reading and during examination as During stress (DS) reading. Data were analyzed using Wilcoxon Rank signed 2 tailed test. And for subgroup separate male and female data analysis Paired t test was used. *Result:* Participants of age group 17-20 years had mean wt kgs, ht cms and BMI kgs/m<sup>2</sup> were recorded. the basal physiological parameters like Systolic, Diastolic blood pressure, Pulse Rate, Respiratory Rates were recorded 2 months prior to examination. Statistics analysis revealed that there was a significant increase in parametric readings of Autonomic function Tests of LST and IHGT during the stress i.e. viva voce examination. Among the students females had significant stress even before the examination. Mean LST in PS was 8.42 increased to 14.5 in DS. Mean IHGT was 18.04 which decreased to 12.69 in DS both the test were statistically significant with p value < 0.0001. By LST 78.85% had borderline stress and none severe stress / distress. While with IHGT 51.92 % had borderline stress and 26.92% had severe stress during stress. Sex wise distribution by LST 34.62% males had borderline stress and 61.54% had severe stress during academic stress and 11.54% females had borderline stress and 7.69% severe stress or distress in prestress. While 38.46% females had borderline stress and 34.62% severe stress or distress during academic stress.

**Keywords:** Stress, Autonomic Function Test, Distress, Lying down to standing blood pressure, Isometric Hand Grip Test

## 1. Introduction

Medical students encounter multiple anxieties during transformation from insecure students to young knowledgeable and responsible members of society. There is a growing concern about stress in medical training field. Studies have observed that medical students experience a high incidence of distress during Undergraduate course. The majority of the studies on stress in medical education focus on the documentation of stress and information on the correlation of stress [3] (2004), [4] (2006), [5] (1993), [6] (2005). Academic stress can be considered a good model of a natural stress in human being. During academic stress there is increase activity of sympathetic nervous system.

A minimum amount of stress is necessary to give a spark in a healthy competitive spirit while too much of the same can be counterproductive. Its physiological mechanism involves the Autonomous nervous system (ANS). ANS together with endocrine and immunological systems determines the status of the internal environment of the organism and adjust it to its current needs, thus enabling adaption of the internal environment to changes in the external environment. This internal adjustment is called homeostasis [2] (2010).

Most of the Autonomic function tests (AFTs) are based on evaluation of the cardiovascular reflexes triggered by performing specific provocative manoeuvres. Stimuli that raises Blood pressure, such as isometric exercise, cold pressor test or mental arithmetic activates mainly sympathetic outflow. While BP response to orthostatic

testing like BP on standing and Valsalva manoeuvre are in large a part of reflection of sympathetic activity [2] (2010).

The term stress was first employed by endocrinologist Hans Selye in 1930s. It is caused by an existing stress causing factors, which may be different at different situation and different persons, called stressors. These stressors like academic examinations and viva voce cannot be evaded but have to be faced with [51] (1956).

Academic stress increases sympathetic discharge and is characterized by a change in a set point of Hypothalamopituitary axis activity. This leads to immediate effect on Heart rate, Blood pressure and cardiovascular system which can be recorded as change in blood pressure on standing or lying to standing (LST) and Isometric Handgrip strength test (IHGT). A combination of the autonomic function tests is usually required ascertain ones are sensitive to sympathetic dysfunction and other to parasympathetic. This sympathetic over activity for longer time is known to be associated with hypertension and increase in cardiovascular morbidity and mortality at younger age [7] (2011). Medical students of first year face a numerous education challenge in the process of adjusting to this professional course and often stressful academic setting, including increased pressure to success at unfamiliar task, greater academic competition, new curriculum and new environment [8] (2003).

## 2. Material and Methods

An observational descriptive cross sectional study was conducted among 52 (26 male and 26 female) apparently healthy first year medical students of BLDEA's Shri B.M.Patil medical college of Bijapur, Karnataka. Each student filled a questionnaire recording his or her personal, family and health details.

### 2.1 Inclusion Criteria

The apparently healthy students of age group of 17-20 years were selected for this study.

### 2.2 Exclusion Criteria

- The students with history of hypertension, diabetes, obesity or any systemic diseases.
- Students with history of smoking, tobacco chewing alcoholism or on medical treatment were excluded.
- Students with family history of hypertension or diabetes were also excluded by detailed personal, family and past history and clinical examination.

A thorough general physical and systemic examination was done before the start of data collection. Two months prior to academic examination anthropometric parameters like wt, ht, BMI and physiological parameters like SBP, DBP, PR and RR were recorded as basal readings and Autonomic function test parameters like LST (lying to standing) and IHGT (Isometric Hand Grip Test) were recorded. Sympathetic test parameters were recorded twice as Prestress (PS) and during stress (DS) during academic viva voce examination. The parameters were recorded between 9AM to 12 noon to avoid the diurnal variation. The parameters were taken in a quiet room in physiology department in order to alleviate the emotional and psychological stresses. The results of these above parameters of the autonomic functions before and after examination were compared and analysed statistically.

### 2.3 Methods

Weight (kgs) nearest to 0.5kg and height (cms) nearest to 0.1cm were recorded. BMI was computed by formula  $Wt(kgs)/Ht(mt)^2$ .

Before recording the physiological and sympathetic test parameters students were explained about the procedures and were allowed to take 10 minutes rest in a quiet room. Blood pressures were recorded by Auscultatory method by DIAMOND BP Apparatus.

#### 2.3.1 BP on standing (Lying to standing, LST)

Sudden change in posture from lying down to standing initiates some momentary changes in Blood pressure (BP) which is normally rectified immediately by Baroreceptors reflexes, hence no changes are observed. Immediately on standing there occurs pooling of blood in dependent parts leading to decrease in peripheral resistance and cardiac output and momentary decrease in systolic blood pressure. This decrease in Systolic Blood Pressure (SBP) immediately decreases Baroreceptors discharge via vasomotor centre leading to increase in Diastolic Blood Pressure (DBP). Thus

after standing from lying down posture increase in DBP can be recorded for about 30-60 seconds. Normally difference of Standing to lying DBP should be  $\leq 10$  mmHg [52] (2009). Difference in the change of DBP from lying down to standing was recorded with 30-60 seconds during PreStress and during stress. [2] (2010), [9] (1997).

#### 2.3.2 Isometric Hand grip strength test (IHGT)

A rise in DBP is determined during isometric pressing of handgrip dynamometer at approximate  $1/3^{rd}$  of maximum contraction strength for 3-5 minutes. BP measurements are recorded at the other arm at 1 minute interval. Increase in DBP is due to the Heart rate acceleration without an increase in peripheral resistance. The result is presented as the difference between the highest DBP during the isometric contraction and the average DBP at rest [2] (2010), [9] (1997). In Sustained hand grip there is sustained muscle contraction which causes a rise in systolic and diastolic BP. The stimulus derives from exercising muscle and central command [2] (2010). Efferent fibers travel to the muscle and heart, resulting in increased cardiac output, BP, and HR. This autonomic manoeuvre has been adapted as a clinical test of sympathetic autonomic function. BP is measured using a sphygmomanometer cuff. The test is of limited sensitivity and specificity. Confounding variables are not well known [10] (1964), [11] (1989), [12] (1974).

## 3. Statistic Analysis

Data were entered into computer database and analysed using Stastical software stat 2009. Wilcoxon signed Ranked 2 tails test was used to compare the Prestress (PS) and During stress (DS) values. p values  $< 0.05$ ,  $< 0.01$  and  $< 0.001$  were considered as significant, highly significant and very highly significant respctly.

Student's t test for parried sample was used to compare the mean values of the study variables in relation to stress as prestress and during stress in male and female separate. Statistical analysis revealed that there was a significant increase in parameters of the autonomic functions like IHGT and LST during examination stress (DS) in both male and female medical students. Female medical students had significant stress even before the examination (Prestress PS).

## 4. Results

**Table 1:** Sex-wise distribution of Anthropometric parameters: Mean and Standard deviation Weight, Height and BMI of 17-20 years medical students.

	Weight(kgs) Mean SD	Height(cms) Mean SD	BMI(kgs/mt <sup>2</sup> ) Mean SD
Male (n= 26 )	67.15± 11.498	170.0±7.57	23.29±4.170
Female (n= 26 )	60.42±8.29	158.92±3.63	23.96±3.457

**Table 2:** Showing the Baseline physiological parameters: Mean and Standard Deviations recorded 2 months prior to academic stress.

Autonomic Function	Male		Female		
	PreStress	During Stress	PreStress	During Stress	
	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	
LST	8.077±1.547	16.554±3.33	9.615±2.7	13.88±3.88	
IHGT	21.69±3.896	14.27±3.09	15.92±2.296	11.88±2.96	
Physiological parameters		Male (26)		Female (26)	
		Mean	SD	Mean	SD
Mean Systolic Blood pressure (mmHg)		116.3	±6.0	112.6	±7.4
Mean Diastolic Blood pressure (mmHg)		76.2	±5.9	75.2	±7.2
Mean Pulse Rate (/min)		79.2	±5.7	82.3	±7.7
Mean Respiratory Rate (/min)		16.9	±2.7	18.9	±2.2

**Table 3:** Showing the analysis of the LST and IHGT of (n=52) First year medical students: By Wilcoxon signed Rank 2 tailed tests;

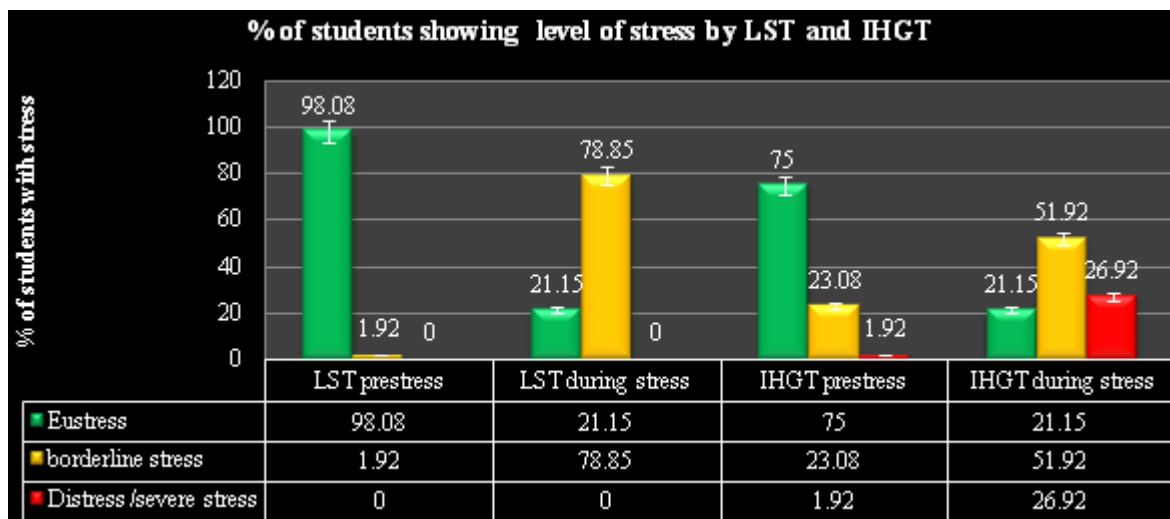
parameter	No.	PS Mean SD	DS Mean SD	Mean diff	Z valve	df	P value
LST	52	8.42	14.5	-1.58	-6.28	102	≤0.0001
IHGT	52	18.04	12.69	-5.35	-6.27	96	≤0.0001

**Table 4:** Showing the Sex wise descriptive analysis of LST and IHGT: Before Stress (PS) and During Stress (DS).

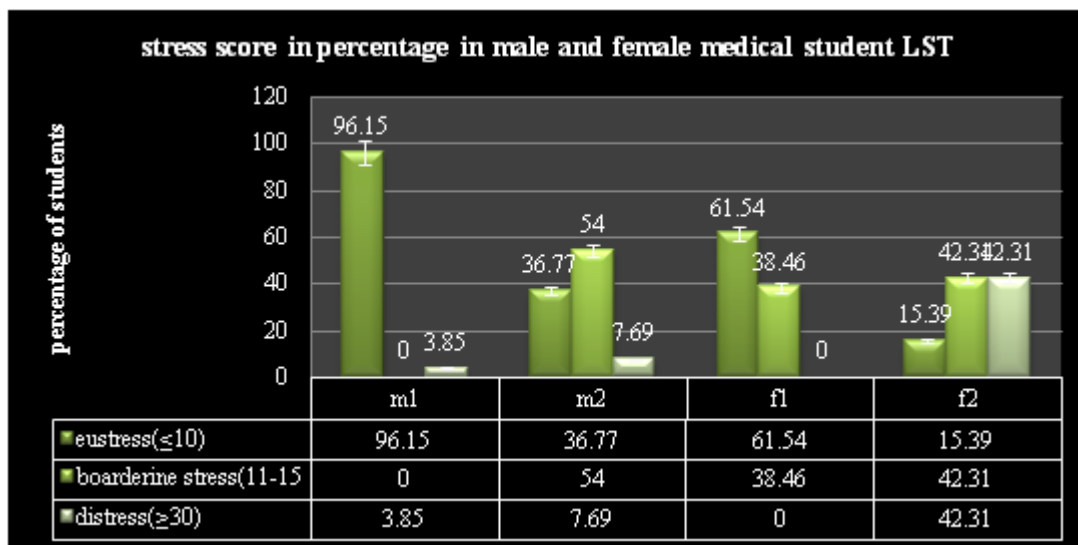
Autonomic Function	Male		Female	
	PreStress	During Stress	PreStress	During Stress
	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD
LST	8.077±1.547	16.554±3.33	9.615±2.7	13.88±3.88
IHGT	21.69±3.896	14.27±3.09	15.92±2.296	11.88±2.96

**Table 5:** Showing the Sex wise descriptive analysis and Paired t tests of LST and IHGT: Before Stress (PS) and During Stress (DS)

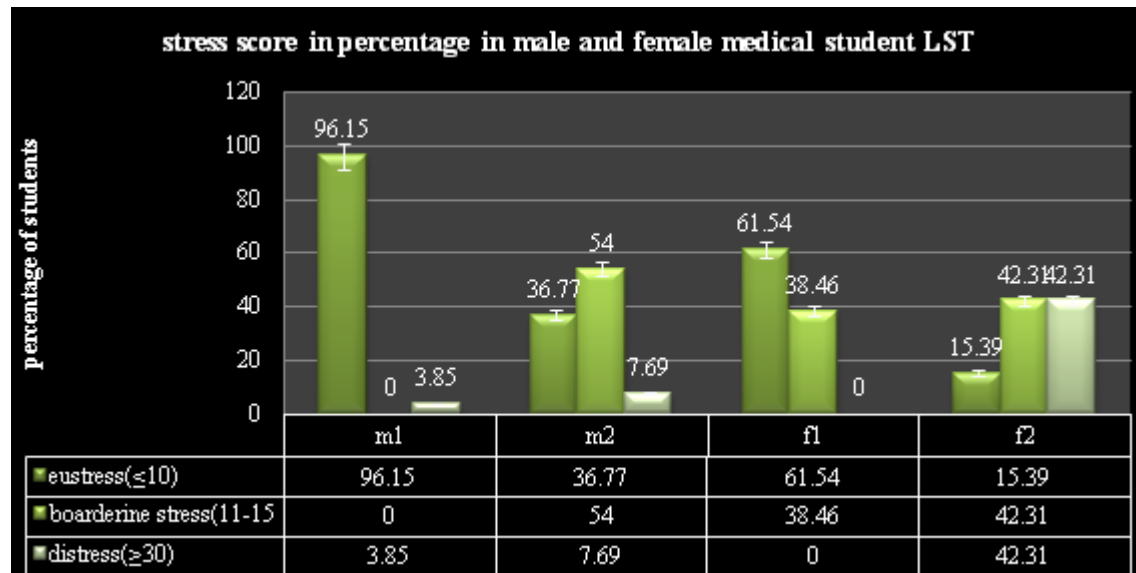
No. of students	Tests	PS	DS	Mean diff	t-value	df	P value
Male (No.=26)	LST	8.08	16.54	-3.92	-11.76	50	≤0.0001
	IHGT	21.6	14.3	10	-7.83	52	≤0.0001
Female (No.=26)	LST	9.62	13.88	-0.38	-4.60	50	≤0.0001
	IHGT	15.62	11.27	7.62	6.56	50	≤0.0001



**Graph 1:** showing the % of students (n=52) in Eustress, borderline stress and distress/severe stress level by IHGT and LST



**Graph 2:** showing the % of students in male and females in Eustress, borderline stress and distress/severe stress level by LST



**Graph3:** showing the % of students in male and females in Eustress, borderline stress and distress/severe stress level by IHGT:

Majority of First year medical students perceived stress. Stress was found to be significantly more during academic examination (viva voce). Academic examination as stress factor was greater perceived cause of stress in first year medical students.

The present study was conducted among 52 first year medical students of BLDEA's Shri B.M.Patil Medical College Bijapur. By the LST 98.08% were Eustress in PS which declined to 21.14% in DS. While 1.92% had Borderline stress in PS which increased to 78.85% in DS. None of them showed severe stress by this stress. By IHGT during stress (DS) out of 52 students percentage of Eustress declined from 75% to 21.15%, while Borderline stress increased from 23.08% in prestress (PS) to 51.92% in DS and severe stress in (PS) 1.92% to 26.92% in DS. By LST % of females with borderline stress increased from 11.54% (PS) to 38.46% (DS), and 7.69% to 34.62% with severe stress. In males 34.62% borderline and 61.54% severe stress in DS with 100% Eustress in PS.

By IHGT, taking into consideration sex, in PS 42.31% of females were Borderline stress and none severe stress while only 3.85% of males had distress (Severe stress). During Stress 42.31% and 50% of females showed borderline and severe stress compared to the values obtained for males were 65.4% borderline and 7.69% severe stressor distress.

## 5. Discussion

The aim of the study was to test the following research questions. To what extent do the first year medical students experience stress. How male and female students are affected by the academic stress. This study examined the impact of academic (examination) stress in the autonomic functions tests like LST and IHGT on the Autonomic system of the first year medical students before examination (prestress (PS) and stress during examination (DS)). The LST and IHGT in both male and female medical students were significantly high with p value  $< 0.00001$ .

The findings show relatively high mean level of distress is experienced by both male and female first year medical student's. It was also found that there was borderline stress in the female in PS. Many studies have been conducted in the past on the stress in medical students whose stress scoring was based on General Health Questionnaire (GHQ) basis. Very few studies have shown the correlation between stresses and autonomic functions tests [13] (2006), [14] (1971), [15] (1994), [16] (1984).

The overall percentage of stress in first year medical students in this study was observed to be 53.9% (Borderline stress BS) and severe stress (SS) in DS by IHGT. And by LST 78.9% had BL stress and none had SS. In agreement with previous reports, majority of the researchers have reported that academic examination as a significant source of stress in students.

Result of the present study showed a significant increase in IHGT and decrease in LST during the stress. Increased sympathetic activity induced by isometric contraction in IHGT causes noradrenalin release and hence elevation of blood pressure. Increased blood pressure might also be contributed by release of endothelin, prostaglandins and Angiotensin II. [17] (2012), [18] (1997).

It is important to remember that stress is a natural part of life. A minimum amount of stress is necessary to spark in a healthy competitive spirit while too much of the same can be counterproductive.

## 6. Mechanism

During academic stress the sympathetic nervous system (SNS) activity is increased. Acute and short term stress improves the performance by increasing the sympathetic discharge for a short time. But chronic stress increases sympathetic discharge for longer time. It is characterized by a change in the set point by hypothalamo pituitary axis activity leading to immediate effect on heart rate and blood pressures and autonomic parameters [7] (2011). As it can be



seen in the graph chronic stress may lead to distress with decrease in the performance of the students due to fatigue, exhaustion and failure .In 1985 [19] (1999). It is suggested that changes in posture might provide a most delicate test of the condition of vasomotor mechanism. It is well recognized that there is transient fall in blood pressure on standing, with stimulation of the carotid Baroreceptors and consequent reflex tachycardia and peripheral vasoconstriction that leads to fall in diastolic blood pressure.



**Graph 4:** showing the relation of performance and level of stress

Several studies from West and from Asia have reported that medical training is highly stressful particularly for those who are the beginner [14](1971), [20](2014), [13](2006).

Ratana Saipanish assessed stress among Thai medical students (64%) at Thai medical school [21] (2003). Guthrie et al reported higher percentage of 36.8% at a university in the North of England who had mental health problems as measured by the GHQ as compared to the present study with 26.92% by IHGT[22] (1995).

The young students populations have always been vulnerable to stressful life conditions especially in pursuit of higher professional education (medical) in a highly competitive environment [23] (2003), [24] (1993),[21] (2003). In the present study academic achievements and academic tests / exams were significantly related to stress level .The findings of the present study are consonance with study conducted by Reda Abouserie .He concluded that female students are more stress than males .He correlated between the locus of control and academic stress which suggest that students with external beliefs had more stress [25] (1994).

The highly competitive atmosphere in medical schools may be the result of stress, getting poor marks can increase stress. Human body responds to stress by alterations in Autonomic Nervous System (ANS). A study from Agha Khan University Pakistan has reported that more than 90% of students felt stressed at one time or the other during their course [26] (2004).The findings of the present study were consistent with those of other studies from Pakistan, India other Asian countries. In one of the study conducted in India 73% of first year medical students have reported to have higher level of stressed [27] (1998).

Everly, G. S. and Rosenfeld, R observed that stress is a psycho-physiologic arousal occurring in the body as a result of a stimulus which becomes a stressor by virtue of the cognitive interpretation of the individual [28] (1991). Emotional factors were found to be significantly more in first year medical students as compared to 2<sup>nd</sup> or 3<sup>rd</sup> year students. This may be due to entry into a large professional college which makes students feel insecure in the initial period [27] (1998).

The amount and severity of stress experienced by medical students may vary according to the settings of the medical schools, the curricula, evaluation (exam) system etc., Previous studies from medical school in different countries have reported varying level of stress[29] (2005), [30] (1991) ,[31] (1991, [32] (1992), [33] (1999) ,[34] (2010).

Faiyaz Qureshi et al concluded that academic examinations in medical students are stressful enough to produce changes in Blood pressure and blood cells parameters [35] (2002).Shruti JS and Hitendra MP concluded that there was increase in sympathetic activity in first year medical students by obtaining the highly significant in Pulse Rate, Arterial blood pressure, body temperature and significant reduction in galvanic skin resistance during pre exam period (5-7 days before exam ) [36] (2014). ElizabethTharion et al also concluded that during exam there was significant decrease in cardiac R-R interval hence increase in Heart Rate and increase in Blood pressure [37] (2009).

From both IHGT and LST in the present study it was revealed that female medical students had borderline stress more that male medical students before academic examination .Similar findings were observed by Mohsin et al. However Cohen has reported that there was no significant difference in stress [38] (1998). Among academic stressors according to Mohsin et al tests or examinations were the chief sources of stress [34] (2010).

Those students who perceive test/examination as a burden may experience stressful situation while others consider examination as useful in their learning and experience less stress. Previous studies have also reported that academic /examination are common sources of stress among medical students .The present study is consistent with the study by Reda Abouserie who found the significant negative correlation between self esteem and both academic and life stress emerged, indicating that students with high esteem are less stressed that those with low[25] (1994).

In similar studies by SNB Inam et al 75% of male and 61% of female total of 65% of first year medical students had stress. It was significantly higher in first year comparatively .Western data suggest that females experience higher levels of stress as compared to males ,the same is true with the present study report. Similarly studies [39](2008),[25](1994),[40](2010) reported that female students' mean anxiety and stress scores were significantly higher compared to the male students .The same results were obtained from the study by Sherine M et al [41](2004).The present study is consistent with study conducted by Mustafa et al found in their study that female had higher level of stress (23.8%) compared to the male (17.1%) [42](2008).

Khadija Qamar et al showed that 41.7% of medical students had stress. Among them female showed significant higher level of stress [43] (2014). Similarly A study in Jizan university Saudi Arabia showed that 77.2% of first year medical students had stress .The prevalence of stress was higher in female(76.9%) as compared to male (63.7) [44] (2012).Hamza el also conducted similar study in Saudi Arabia showed stress in 74.2% in first year medical students [1] (2011).Similar findings by [40] (2010), [45] (2011) showed that mean perceived stress was significantly higher among females students , in contrast report by Supe AN showed that there was no such significant difference on the basis of sex[46](1998).

Simic and Mannica showed that cardiac R-R interval parameters were the same in the prestress and post stress examination periods. The same parameters declined in stress level during the exam situations indicating habituation to exam stress [47] (2012).

Zeller assessed the effect of real life mental stress situation on Blood pressure and Heart Rate in students [48] (2004). They also found that increase in Heart Rate at the beginning of exam followed by its decline during the rest of the exam similar to finding by Simic and Mannica.

## 7. Conclusion

It could be concluded from the present that academic activity like examination or viva voce in the medical students affect the autonomic nervous system by increasing the sympathetic activity. Even before academic examination the students were stressed more so in females. PreStress stress in first year medical students may be due to change in study environment, curriculum etc.In first year medical students academic performance and fear of failing are stressor that are of concern to the students' level of stress.

## 8. Recommendation

Several studies indicated a need for programs in colleges that students can cope up with .Physical activities like sports, and socialization are indispensable for individual growth and to foster personal development [49] (2003) Sports music, mediation or yoga be a made as part of curriculum.

Different stress management techniques such meditation, yoga support groups games etc help in better adaption of coping skills improved knowledge of stress and enhanced ability to resolve conflicts[50](2000). The students may be advised to take the advantages of meditation or yoga classes. Stress reduction workshops or stress relief seminars. Finally Earlier in the career one finds and masters the stress management techniques that works for oneself the sooner one will be ready to tackle the task of learning the full complement of skill necessary to become successful and able doctors in the society.

## 9. Future Scope of Study / Limitation of Study

This present study was non invasive and safe convenient and comfortable for the students .But the data did not estimate the blood cortisol level which is the marker of the stress condition and It did not analysis the hematological parameters. Since the General Health Questionnaire or anxiety scale was not used to estimate the level of stress in the students .The mental status of the students could not be evaluated .The family background with financial status, social status was also not included in the study which affect the performance and stress level in the student.

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