



Original Research Article

Comparison of cardiovascular, cognitive and stress parameters in presence and in absence of examination among medical students: An observational and prospective study

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ARTICLE INFO

Article history:

Received 04-10-2019

Accepted 14-12-2019

Available online 31-12-2019

Keywords:

Cardiovascular parameters

Cognitive parameters

Stress scores

Undergraduate medical students

ABSTRACT

Introduction: Medical student during undergraduate course of 4 ½ years including 1-year internship study hard, tirelessly for longer periods of day or night and often work beyond their mental threshold and physical strength resulting in stress. The present study was designed to evaluate and compare the stress status among first and second year MBBS students.

Materials and Methods: 160 (62 males and 98 females) first (n=90) and second (n=70) year healthy MBBS students were enrolled for this study. Cardiovascular parameters like pulse rate (PR), systolic blood pressure (SBP), diastolic blood pressure (DBP), Cognitive function tests like auditory reaction time (ART) and visual reaction time (VRT) and Stress score (by stress questionnaire) was evaluated and compared in presence of examination (pre-examination) and during absence examination (post-examination, 10-15 days after pre-examination). Data obtained from this study was analysed by Instat Graph Pad using paired t-test.

Results: All parameters studied in this study were increased in almost all students during pre-examination. In females compared to males all parameters were significantly less in pre-examination except PR (i.e. less SBP, DBP, less cognition function that means high ART & VRT and less stress score). During post-examination study comparison between males and females, difference of means of parameters were not significant except VRT (Visual reaction time was high in females). Cognition function was less in females as compared to males in both pre as well post examination.

Conclusion: Students were in stress with increased all cardiovascular parameters, cognitive parameters and stress score. This may affect the performance and can produce anxiety and/or depression subsequently. Students who are at risk of excessive stress should be identified and faculties should help them to deal the examination stress, anxiety or depression effectively and the earliest.

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1. Introduction

Medical curriculum is a vast and complex study course with training of four and half year with one year of internship. This long period of course includes heavy load of text books and study materials, different ward or clinical postings and numerous semester and university examinations. To achieve good grades student study hard, tirelessly for longer periods of day or night and often work beyond their mental

threshold and physical strength resulting in stress. Stress refers to conditions that arouse anxiety or fear. The transient rise in systolic blood pressure during stress is a common observation.¹⁻⁵

Several studies have shown correlation between chronic life stress and cardiovascular disease.⁶ Psychological stress is a risk factor for hypertension⁷ and coronary artery disease (CAD).⁶ Different physiological studies have proved that stress is linked with excessive sympathetic nervous system activation⁶ and thus influence the endocrine, haemopoietic

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and immune systems.⁸ Cytokines and cortisol seem to play an important role in the communication between these systems.⁹ The well documented changes that occur are increase in erythrocytes, neutrophils and platelets, whereas lymphocytes, eosinophils and monocytes decrease in number. Lymphocytes and monocytes express receptors for several stress hormones, including norepinephrine and epinephrine,¹⁰ thus stressful events could alter immune function.

It has also been observed that female students respond to examination situation with stronger anxiety and more intense stress related behavioural, metabolic and psychological changes. Menstrual cycles of females also seem to get affected during the pre-examination period owing to hormonal changes as observed in previous studies.¹¹

Cardiac parameters like pulse rate (PR), systolic blood pressure (SBP), diastolic blood pressure (DBP), Cognitive function tests like auditory reaction time (ART) and visual reaction time (VRT), Stress score (by stress questionnaire), anxiety scale and cortisol level were evaluated and compared before or at the time of examination among medical students in various studies.^{12–15}

Some studies have compared the difference of reaction time in male and females and thus evaluated stress (e.g., environmental).^{16,17}

Different factors may influence severity of stress on academic performance like age, gender, ethnicity and marital status.¹⁸

Anxiety may be potentiated by increase in glucocorticoid which directly effects on corticotrophin releasing hormone in limbic system.^{19,20}

Distraction model (attentional control theory) is one of the models, developed to show effect of stress on cognitive function. In this model performance of movement execution (e.g., about the location of a target) become less accurate and more attempts or more time may be required to successfully perform a certain task and this occurs when person is under anxiety.^{21,22} However, “execution focus model” argues that limited attentional resources cannot explain the negative effects of anxiety upon performance.²³

The alteration of reaction time occurs due to both physiological and pharmacological factors like stress, gender, and arousal. This alteration indicates the impairment of sensory-motor association.²⁴

In this study Cardiovascular parameters like pulse rate (PR), systolic blood pressure (SBP), diastolic blood pressure (DBP), Cognitive function tests like auditory reaction time (ART) and visual reaction time (VRT) and Stress Score through questionnaire was evaluated and compared in presence and during absence of examination among first and second year MBBS students.

2. Materials and Methods

2.1. Study site/place

This study was conducted in the Department of Physiology and Pharmacology of Katihar Medical College, Katihar.

2.2. Study duration

January to July 2018 (Seven months)

2.3. Study design

An observational and prospective study

2.4. Inclusion criteria

- 1) First and second year MBBS students
- 2) ≥ 17 years of age and all the gender
- 3) Healthy students

2.5. Exclusion criteria

Students have history of neurological or psychiatric disorders, taking of medicines affecting emotional status and endocrinological disorder, any visual and auditory disorder, addiction to tobacco or alcohol

160 students were selected from first and second year MBBS batch before internal assessment theory examination considering after inclusion and exclusion criteria. 80 students were from first year and 70 students were from second year MBBS batch. Following tests were done.

2.5.1. Cardiovascular parameters

Tests like PR (Pulse Rate - beats/min) and BP (Blood Pressure- mm of Hg) were recorded in supine position by palpating radial artery and sphygmomanometer respectively.

2.5.2. Cognitive parameters

Test like ART (Auditory Reaction Time, in milliseconds) and VRT (Visual Reaction Time, in milliseconds) were recorded by using Audio Visual Reaction Time Machine, in a well illuminated and quiet surrounding in Physiology research laboratory. This instrument had two modes one for Auditory and another for Visual reaction time. It had three frequencies i.e. 250Hz, 500Hz and 750Hz which were randomly used for auditory stimulus. Red, Yellow and Green flashing lights were used randomly for visual stimulus. Students were directed to press the response switch by the index finger of the dominant hand as soon as the response would be perceived. The reaction time was displayed on the Reaction Time Machine and was recorded.

2.5.3. Stress status

Stress status was assessed by a questionnaire. Which contained 20 questions with 0-4 points given to each

(i.e. no stress (Score=0) to extremely stressful (Score=4). Questionnaire was given to the students and collected after 10min to assess stress score. The total score obtained from this questionnaire was analysed.^{14,25,26} According to scores given by student, stress status was interpreted like

- a. Score between 0-20: - Good control over stress,
- b. Score between 21- 40: - Low level of stress,
- c. Score between 41- 60: - Medium level of stress,
- d. Score between 60-80: - High level of stress.

On following areas of stress producing scenario, questions were framed like

1. Academic demands,
2. Peer pressure,
3. Lack of time for personal needs,
4. Interpersonal relationships including those with teaching and administrative staff.
5. Inability to sleep well,
6. Worrying,
7. Feeling tense and
8. Unhappy.

Anthropometric measurements like weight in kilograms and height in centimetres were assessed using standardised weighing machine and height measurement scale.

Studies were done for twice in following manner in all enrolled students.

2.6. Pre-examination study

All enrolled students were instructed to appear in Physiology Research Laboratory 1.15 hours prior starting the final internal examination without consuming any kind of caffeinated drinks like coffee or tea. Before starting the experimental session, students were given rest of 15 minutes. Experimental sessions were completed 10 mins before starting the theory examination.

2.7. Post-examination study

10 to 15 days after completion of final internal assessment theory examination i.e. when students were practically free of examinations, once again all students were instructed to appear in Physiology Research Laboratory on different day. They were strictly instructed to appear without consuming any kind of caffeinated drinks like coffee or tea. Before starting the experimental session, students were given rest of 15 minutes.

In 1st year students, pre-examination study was performed on 30 students each on 1st, 2nd and 3rd day (According to the three-subject examination in first year). In 2nd year students, pre-examination study was performed on 14 students each on 1st, 2nd, 3rd, 4th and 5th day (According to the five-subject examination in second year)

2.8. Statistical analysis

Data obtained from this study was analysed by InStat Graph Pad. The pre and post -examination data was analysed using paired t-test. Results were tabulated and presented as Mean+SD.

3. Results

All parameters like PR, SBP, DBP, VRT and Stress score were increased (extremely significant) in pre-examination as compared to post- examination study.

Mean PR in female students was significantly more than male students. Mean SBP and DBP in females were significantly less than males but the mean difference SBP was significant and DBP was not significant. Mean ART and VRT, both were significantly high (reaction time high) in females as compared to males. Mean stress score was also significantly less in females compared to males.

During post-examination study, mean difference of PR, SBP, DBP and stress score was not significant in males and females. Compared to males, mean ART (difference not significant) and VRT (very significant) were more in females.

Delta PR (calculated by subtracting pre and post-examination study value) was increased in females as compared to males irrespective of the study setting and the difference was extremely significant. Mean difference of delta SBP, DBP, ART, VRT and Stress score were not significant between males and females.

4. Discussion

In pre-examination compared to post-examination study period irrespective of gender all parameters like PR, SBP, DBP, ART, VRT and stress scores were increased significantly. Most common cause may be due to increase in sympathetic stimulation that increases PR and BP (both systolic and diastolic blood pressure). ART and VRT may be increased due to release of epinephrine and glucocorticoid.^{26,27} Under stressful conditions, the cognitive system becomes overloaded thus reduces a person's attentional resources.²⁸

Due to increased sympathetic nervous system and brain-pituitary-adrenocortical axis during stress acting either directly or indirectly can alter decision making and attention. In this study pre-examination compared to post-examination, stress score was increased significantly. This has similar result from previous study in which stress was common among first year medical students due to academic demands.^{2,3,29}

In this study PR, ART and VRT were increased in females as compared to males in pre-examination, but difference in PR was more significant. These findings were similar with other study.^{12,30}

Table 1: Comparison of cardiovascular parameters, cognitive parameters and stress score in pre-examination and post-examination study

Parameters	Pre-examination (n=160) (mean±SD)	Post-examination (n=160) (mean±SD)	p-value
PR (beats/min)	88.21±12.26	78.17±12.47	0.0001***
SBP (mmHg)	129.20±11.35	122.70±10.55	0.0001***
DBP (mmHg)	86.70±7.36	80.86±5.26	0.0001***
ART (ms)	180.89±27.69	167.74±29.60	0.0001***
VRT (ms)	211.49±25.67	190.56±31.08	0.0001***
Stress score	28.34±9.28	21.38±5.64	0.0001***

*p<0.05-Significant; *p<0.01-Significant, **p<0.001-Very Significant, ***p<0.0001- Extremely Significant, p>0.05- Not Significant (NS)

Table 2: Comparison of cardiovascular parameters, cognitive parameters and stress score in pre-examination study on the basis of gender

Parameters	Male (n=62) (mean±SD)	Female (n =98) (mean±SD)	p-value
PR (beats/min)	84.09±10.28	92.38±13.16	0.0001***
SBP (mmHg)	130.48±10.56	125.56±12.88	0.013*
DBP (mmHg)	85.62±7.06	84.5 6±6.8 8	0.349, NS
ART (ms)	174.8 9±24.72	185.96±29.27	0.015*
VRT (ms)	205.9 2±19.58	217.66±29.49	0.006*
Stress score	30.1 5±8.84	26.7 9±9.25	0.024*

Table 3: Comparisons of cardiovascular parameters, cognitive parameters and stress scores in post- examination study on the basis of gender

Parameters	Male (n =62) (mean±SD)	Female(n=98) (mean±SD)	p-value
PR (beats/min)	82.26±13.98	78.5 2± 9.86	0.98, NS
SBP (mmHg)	120.36±10.76	120.20±10.35	0.93, NS
DBP (mmHg)	77.42±5.63	77.94±6.08	0.59, NS
ART (ms)	163.2 5±28.76	171.68±29.55	0.08, NS
VRT (ms)	183.96±27.86	199.52±32.60	0.002**
Stress score	21.56±5.57	20.62±5.72	0.31, NS

Table 4: Changes of cardiovascular parameters, cognitive parameters and stress scores based on gender

Parameters	Male (n =62) (mean±SD)	Female (n =98) (mean±SD)	p-value
Delta PR (beats/min)	-1.83±16.97	-13.86±17.46	0.0001***
Delta SBP (mmHg)	-10.1 2±1 4.88	-5.36±15.09	0.052, NS
Delta DBP (mmHg)	-8.2±14.98	-6.62±9.01	0.406, NS
Delta ART (ms)	-11.6 4±3 7.56	-14.28±41.33	0.684, NS
Delta VRT (ms)	-21.96±34.78	-18.14±44.05	0.564, NS
Delta Stress score	-8.59±8.37	-6.17±8.16	0.072, NS

Similar to a previous study, Stress score through stress questionnaire was also significantly more in females compared to males.³¹ But in pre-examination of this study, stress scores were significantly increased in males also. Difference of stress levels between males and females were not significant reported by a study.³² PR, SBP, DBP and stress scores in males and females in post-examination study was not significantly different.

Cognitive function was decreased (i.e. both audio and visual reaction time were increased) in females as compared to males in both pre and post-examination. Increase in VRT in females may be explained by change in steroid hormone during menstrual cycle. Cognitive function of female brain is under control of ovarian steroid and this ovarian steroid

has widespread effects throughout the brain regions.^{33,34}

Difference of studied parameters were not significantly different between both the genders except delta PR, which was significantly higher in females. Hypothalamic-pituitary-axis and autonomic nervous system activity may be increased in females due to examination stress. This could be the reason behind the increase in PR. In this study females were more distressed compared to male and this result was supported by other studies too.³⁵

Limitations of this study was that we measured stress by questionnaire and not studied psychological factors that may influence the stress response, stress scores were obtained at only one point of time, other sources of stress such as familial or interpersonal pproblems were not examined

and internal assessment scores of the students were not correlated in this study with pre-examination stress level.

5. Conclusion

Cardiovascular parameters, cognitive parameters and stress scores were increased in almost all of the students irrespective of gender in pre-examination study. This may negatively affect the performance of students and can produce anxiety and/or depression subsequently. Students who are at risk of excessive stress should be identified and faculties should help them to deal the examination stress, anxiety or depression effectively and the earliest.

6. Source of funding

None.

7. Conflict of interest

None.

References

- Rosenberg PP. Students perceptions and concerns during their first year in medical school. *J Med Educ.* 1971;46:211–218.
- Miller P, McC The first year at medical school: some findings and student perceptions. *Med Educ J.* 1994;28:5–7.
- Vitaliano PP, Russo J, Carr JE, Heerwagen JH. Medical school pressures and their relationship to anxiety. *J Nerv Ment Dis.* 1984;172(12):730–736.
- Stewart SM, Betson C, Marshall I, Wong CM, Lee PWH, Lam TH. Stress and vulnerability in medical students. *Med Educ.* 1995;29:119–127.
- Qureshi F, Alam J, Khan MA, Sheraz G. Effects of examination stress on blood cell parameters of students in a Pakistan medical college. *J Ayub Med Coll Abbottabad.* 2002;14(1):20–22.
- Rozanski A, Blumenthal JA, Kaplan J. Impact of psychological factors on the pathogenesis of cardiovascular disease and implications for therapy. *Circ.* 1999;99:2192–2217.
- Lucini D, Norbiato G, Clerici M, Pagani M. Hemodynamic and autonomic adjustments to real life stress conditions in humans. *Hypertens.* 2002;39:184–188.
- Dorshkind K, Horseman NS. Anterior pituitary hormones, stress, and immune system homeostasis. *Bioessays.* 2001;23:288–294.
- Gurrero JM, Reiter RJ. A Brief Survey of Pineal Gland- Immune System Interrelationships. *Endocr Res.* 1992;18(2):91–113.
- Marshall GD, Aqarwall SK. Stress, immune regulation, and immunity: applications for asthma. *Allergy Asthma Proc.* 2000;21(4):241–246.
- Loucks AB, Redman LM. The effect of stress on menstrual function. *Trends Endocrinol Metab.* 2004;15(10):466–471.
- Sharma B, Wavare R, Deshpande A, Nigam R, Chandorkar R. A study of academic stress and its effect on vital parameters in final year medical students at SAIMS Medical College. *Biomed Res.* 2011;22(3):361–365.
- Rizvi AH, Awaiz M, Ghanghro Z, Jafferi MA, Aziz S. Preexamination stress in second year medical students in a government college. *J Ayub Med Coll Abbottabad.* 2010;22(2):152–155.
- Srinivasan K, Vaz M, Sucharita S. A study of stress and autonomic nervous function in first year undergraduate medical students Indian. *J Physiol Pharmacol.* 2006;50(3):257–264.
- Singh R, Goyal M, Tiwari S, Ghildiyal A, Nattu SM, Shobha SD. Effect of examination stress on mood, performance and cortisol levels in medical students. *Indian J Physiol Pharmacol.* 2012;56(1):48–65.
- Karia RM, Ghuntla TP, Mehta HB, Gokhale PA, Shah CJ. Effect of Gender Difference on Visual Reaction Time: A Study On Medical Students Of Bhavnagar Region. *IOSR J Pharm.* 2012;2(3):4524–454.
- Shenvi D, Balasubramanian P. A comparative study of visual and auditory reaction time in males and females. *Ind J Physiol Pharmacol.* 1994;38(3):229–231.
- Hammer LG, Grigsby TL, Woods S, the conflicting demands of work, family and school among students of an urban university. *J Psychol.* 1998;132(2):220–227.
- Grillon C, Duncko R, Covington MF, Kopperman L, Kling MA. Acute stress potentiates anxiety in humans. *Biol Psychiatry.* 2007;62(10):1183–1186.
- Ruprai RK, Kamble P, Kurwale M. Environmental stress and changes in a Anxiety Score and Reaction time: A comparative study among day scholars and hostilities in first year MBBS students. *GJISS* 2012;1(2):1–3.
- Eysenck MW, Derakshan N, Santos R, Calvo MG. Anxiety and cognitive performance: Attentional control theory. *Emotion.* 2007;7(2):336–353.
- Behan M, Wilson MR. State anxiety and visual attention. The role of the quiet eye period in aiming to a far target. *J Sport Sci.* 2008;26(2):207–215.
- Beilock SL, Carr TH. On the fragility of skilled performance: what governs choking under pressure? *J Exp Psychol Gen.* 2001;130(4):701–725.
- Misra N, Mahajan KK, Maini BK. Comparative study of visual and auditory reaction time of hands and feet in males and females. *Indian J Physiol Pharmacol.* 1985;29(4):213–218.
- Vitaliano PP, Maiuro RD, Mitchell ES, Russo J. Perceived stress in medical school: resistors, persistors, adaptors and maladaptors. *Soc Sci Med.* 1989;28:1321–1329.
- Firth J. Levels and sources of stress in medical students. *BMJ.* 1986;292:1177–1180.
- Mcewen BS, Sapolsky RM. Stress and cognitive function. *Curr Opin Neurobiol.* 1995;5(2):205–216.
- Chajut R, Algom D. Selective attention improves under stress: Implications for theories of social cognition. *J Pers Soc Psychol.* 2003;85(2):231–248.
- Jain P, Mahajan A, Jain P, Babbar R. Effect of partial sleep deprivation on auditory event related potential and reaction time in medical students. *J K Sci.* 2010;12(1):19–22.
- Zeller A, Handschin D, Gyr N, Martina B, Battegay E. Blood pressure and heart rate of students undergoing a medical licensing examination. *Blood Press.* 2004;13(1):20–24.
- Shah M, Hasan S, Malik S, Reddy CTS. Perceived Stress, Sources and Severity of Stress among medical undergraduates in a Pakistani Medical School. *BMC Med Educ.* 2010;10(2):1–10.
- Supe AN. A Study of Stress in Medical Students at Seth G S Medical College. *J Postgrad Med.* 1998;44(1):1–6.
- Asso D. The relationship between menstrual cycle changes in nervous system activity and psychological behaviour and physical variables. *Biol Psychol.* 1986;23(1):53–64.
- Asso D, Braier JR. Changes with menstrual cycle in psychophysiological and self report measures of activation. *Biol Psychol.* 1982;15(1-2):95–107.
- Kelly MM, Tyrka AR, Anderson GM, Price LH, Carpenter LL. Sex differences in emotional and physiological response to the Trier Social Stress Test. *J Behav Ther Exp Psychiatric.* 2007;39(1):87–98.

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Cite this article: Kumari N, Kumar A, Kumar M. Comparison of cardiovascular, cognitive and stress parameters in presence and in absence of examination among medical students: An observational and prospective study. *Indian J Clin Anat Physiol* 2019;6(4):462-467.