Evaluation of Examination Stress and Its Effect on Cognitive Function among First Year Medical Students

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ABSTRACT

Background: Medical students experience stress at every phase of curriculum more so before examination. This stress may affect physiological, psychological and cognitive functions of the students.

Aim: The present study aimed to evaluate stress status among first year MBBS students by recording pulse rate (PR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and using stress questionnaire; its effect on cognitive function by recording auditory reaction time (ART) and visual reaction time (VRT).

Setting and Design: It is a cross-sectional study.

Materials and Methods: A total of 100 (49 males and 51 females) first year healthy MBBS students participated. Stress questionnaire was given and assessed. Cardiovascular parameters were also assessed. The ART and VRT were recorded before (pre examination setting) and after 3 month of examination (post-examination setting).

Statistical Analysis: The data were analysed by using SPSS 21.0 version.

Results: All parameters namely PR, SBP, DBP, ART, VRT and stress scores were increased in preexamination setting irrespective of gender. Increased PR was observed in female learners where as stress score and SBP were increased in males in pre-examination setting. ART and VRT were more in females as compared to males in both setting.

Conclusion: It is concluded that examination in the form of stressor hampers cognitive function of first year medical students. The cognitive functions of the female learners were more affected as compared to males. Therefore, proper counselling of the students should be initiated at the earliest to decrease their stress level.

INTRODUCTION

The medical students have to undergo a vast and complex medical curriculum during studentship. The journey itself is stressful. Studies have been reported regarding evaluation of the stress status among medical students by using various parameters like vital parameters [1], stress questionnaires [2,3], anxiety scale, cortisol level [4], before or at the time of examination. However, few literatures have evaluated stress (e.g., environmental) and gender difference by using reaction times [5,6]. Factors like age, gender, ethnicity and marital status may also influence student's severity of stress on academic performance [7]. Study reports that stress potentiates anxiety which may be mediated by glucocorticoid effect on corticotrophin releasing hormone in limbic system [8]. Stress can affect cognitive function via epinephrine and slowly via glucocorticoid [9]. Few models have been developed on the basis of how stress affects cognitive function, one such model is known as "distraction model" (attentional control theory) which explains under anxiety, the movements execution (e.g., about the location of a target) may become less accurate, more attempts or more time may be required to successfully perform a certain task [10,11]. However, "execution focus model" argues that limited attentional resources cannot explain the negative effects of anxiety upon performance [12]. 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 [13]. So far the investigators utilised reaction time to evaluate environmental stress, hostel-dwellers' stress and gender difference but there are very few studies which evaluated examination stress and effects of it on cognitive function among MBBS students. From earlier studies it is evident that reaction time is a reproducible index of sensory motor coordination. The present study was aimed to evaluate the stress status among first year MBBS students utilising cardiovascular parameters like pulse rate (PR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and its effects on cognitive function like auditory reaction time (ART) and visual reaction time (VRT) before and after the examination.

MATERIALS AND METHODS

The study was conducted in the Department of Physiology of a Teaching medical institute and hospital in Bangalore, India (May 2012 and August 2012). Ethical approval from the Institution Ethical Committee and written informed consent from the volunteers were obtained. A total of 100 (49 males, 51 females) first year MBBS healthy students of age group 18-21 yrs were selected on the basis of inclusion and exclusion criteria, who were appearing for Final Internal Assessment Examination.

Inclusion Criteria: healthy male and female first year medical students exclusion criteria: any 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.

The subjects were assessed for cardiovascular parameters, cognitive parameters and stress status at two time points. One before the final internal examination (pre-examination setting) and another reading after 3 month when there was no examination (post-examination setting).

Experimental Design – it is a cross-sectional study: All the students were asked to visit research laboratory at 8.45 am prior to internal assessment examination without having any kind of caffeinated drinks like coffee or tea and were asked to rest for

Parameters	Pre-examination n=100	Post-examination n=100	p-value
PR (beats/min)	87.17±12.03	79.21±12.26	0.001**
SBP (mmHg)	127.10±11.16	119.60±10.25	0.001**
DBP (mmHg)	84.59±7.263	76.11±5.66	0.001**
ART (ms)	181.43±27.31	168.41±29.49	.002*
VRT (ms)	213.51±25.62	192.54±30.93	0.001**
Stress score	27.38±9.15	20.01±5.44	0.001**

Data is mean±SD. Considered significant is *p<0.05; **p<0.01

[Table/Fig-1]: Comparison of cardiovascular parameters, cognitive parameters and stress score in pre-examination and post-examination setting

Parameters	Pre-examination Male=49	Pre-examination Female=51	p-value
PR (beats/min)	83.16±9.78	91.02±12.80	.001**
SBP (mmHg)	129.51±10.36	124.78±11.52	.033*
DBP (mmHg)	85.14±7.746	84.06±6.80	.460
ART (ms)	175.90±24.52	186.75±29.01	.046
VRT (ms)	207.82±19.88	218.98±29.29	.028*
Stress score	29.35±8.92	25.49±9.05	.034*

Data is mean±SD. Considered significant is *p<0.05; **p<0.01

[Table/Fig-2]: The influence of gender on cardiovascular parameters, cognitive parameters and stress score in preexamination setting

Parameters	Pre-examination Male=49	Pre-examination Female=51	p-value
PR (beats/min)	81.31±14.88	77.20±8.76	.098
SBP (mmHg)	119.31±10.50	119.88±10.11	.781
DBP (mmHg)	76.10±5.43	76.12±5.92	.989
ART (ms)	164.65±28.92	172.02±29.87	.213
VRT (ms)	184.78±27.66	200.00±32.30	.013*
Stress score	20.47±5.37	19.57±5.52	.411

Data is mean±SD. Level of significance is *p<0.05; **p<0.01

[Table/Fig-3]: Comparisons of cardiovascular parameters, cognitive parameters and stress scores in postexamination with the influence of gender

Parameters	Male=49	Female=51	p-value
Delta PR (beats/min)	-1.857±17.833	-13.823±16.199	.001**
Delta SBP (mmHg)	-10.204±15.530	-4.902±15.170	.087
Delta DBP (mmHg)	-.061±15.909	-1.235±9.251	.570
Delta ART (ms)	-11.244±38.618	-14.725±42.837	.671
Delta VRT (ms)	-23.040±34.287	-18.980±43.776	.608
Delta Stress score	-8.877±8.197	-5.921±7.883	.069

Data is mean±SD. Considered significant is *p<0.05; **p<0.01

[Table/Fig-4]: Influence of gender on changes of cardiovascular parameters, cognitive parameters and stress scores

15min. In the experimental sessions, tests were performed on 33 students each on 1st and 2nd day, 34 students on 3rd day and completed 10min prior to the examination. The students' Stress Questionnaire (Ministry of Social Security, National Solidarity and Reform Institutions, www.gov.mu/portal/sites/suicideprevention/file/student), having 20 questions, was given to the students and was collected after 10min to assess their stress score. The scores were interpreted as, 0-20: Good control over stress, 21-40: Low level of stress, 41-60: Medium level of stress, 60-80: High level of stress. Anthropometric measurements like weight in kilograms and height in centimetres were assessed using standardised weighing machine and height measurement scale. The cardiovascular parameters like pulse rate (beats/min) and BP (mmHg) were recorded in supine position by palpating radial artery and sphygmomanometer respectively. Cognitive test like the ART and VRT were recorded by using an in house built PC 1000 device with a 1000 Hertz square

wave oscillator, in quiet surroundings in research laboratory. Blue light (flash-type) was used for signal marker for VRT and sound for ART with one tapping key and they were in turn connected to computer. The ART and VRT were reported in milliseconds and same was repeated after 3 month when there was no examination.

STATISTICAL ANALYSIS

Done by SPSS 21.0 version. The pre and post data were analysed using paired t-test. Correlation analysis was performed using pearson's correlation coefficient. Results on continuous measurements are presented on Mean±SD and results on categorical measurements are presented in Number (%).

RESULTS

[Table/Fig-1] shows that all the parameters like PR, SBP, DBP, VRT and stress scores (p≤0.01) and ART (p≤0.05) were significantly increased in preexamination setting as compared to postexamination setting irrespective of gender. [Table/Fig-2] shows PR (p≤0.01) was significantly increased in females as compared to males whereas stress scores and SBP (p≤0.05) were observed to be increased significantly in males as compared to females in preexamination setting. [Table/Fig-2,3] show both ART and VRT were more in females as compared to males irrespective of setting. However, VRT (p≤0.05) was significantly increased in females as compared to males in both setting. [Table/Fig-4] shows the delta PR [as calculated by subtracting pre- and post-examination setting value) (p≤0.01) was significantly increased in females as compared to males irrespective of the setting.

DISCUSSION

The present study showed that PR, SBP, DBP ART, VRT and stress scores increased significantly in pre-examination compared to post-examination setting. Increased PR and BP (both systolic and diastolic blood pressure) are due to more sympathetic stimulation [14,15]. Increased ART and VRT can be because of enhanced release of epinephrine and glucocorticoid. These findings are in contradiction with other authors who have reported decreased ART prior to examination [16]. Our findings slightly related to integrated model which is strongly based on distraction model [17]. Study also reported that under stressful conditions, the cognitive system is overloaded thereby it reduces a person's attentional resources [18]. Stress acting through sympathetic nervous system and brain-pituitary-adrenocortical axis can affect decision making and attention. This sympathetic nervous system and brain-pituitary-adrenocortical axis can be acting either directly or indirectly. It was also observed in the present study that stress score was increased in pre-examination significantly compared to post-examination. These findings in agreement with previous authors that stress is common among first year medical students due to academic demands [19-21].

Current study shows that PR, ART and VRT are increased in females as compared to males in pre-examination set-up, but difference in PR is more significant. This finding is consistent with other reports as well [1,22]. Increase in ART and VRT can be due to enhanced release of epinephrine [23-25]. A previous study reported that stress level as found by stress questionnaire is more in females [26]. On the other hand another study reported that the stress levels were not significantly different between males and females [27]. The present study shows that stress scores are also significantly increased in males as compared to females in pre-examination setting. This result warrants further validation of stress questionnaire. Furthermore, in the present study the internal assessment scores of the students were not correlated with pre-examination stress level of the learners. It will be of interest to undertake such a study in the future to get comprehensive idea regarding the pre-examination stress level of the students. There is no significant difference of PR, SBP, DBP and stress scores in males and females in postexamination setting. ART

and VRT values are increasing in females as compared to males in both setting. However, VRT was significantly higher in females which could be due to fluctuation of steroid hormone during menstrual cycle. It is known that ovarian steroid have widespread effects throughout the brain regions including cognitive function [28,29]. The delta PR was significantly higher in females as compared to males. However, other parameters like delta SBP, delta DBP, delta ART, delta VRT and delta stress scores did not show any significant difference. Increase in PR in females could be due to hypothalamic-pituitary-axis and autonomic nervous system activity in response to examination stress. In concordance with other studies the present study concludes that women are more distressed with the task compared to male [30].

CONCLUSION

Our study has put preliminary effort to observe effects of stress on cognitive function and revealed that excessive stress affects cognitive functions and may negatively affect their performance in the examinations. It is further observed that female learners were more affected by stress which impaired their cardiovascular parameter like PR and cognitive parameters prior to examination. Identification of students who are at risk of excessive stress will help the educator to deal effectively with such students at the earliest.

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