



Original Research Article

A Comparative Study of Reaction Time to Exam Stress Based on Gender among First Year Medical Students

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ABSTRACT

Introduction: The study was planned to identify the possible gender difference in perceptions of academic stress and reaction to stressors among first year medical students. Exam stress is quite predominant among medical students and acts as an acute stressor which affects cognitive functions. Choice reaction time was used to evaluate the cognitive performance of students during stress free & stress (Exam) condition.

Materials and methods: The study was conducted on 60 healthy first MBBS students (30 boys & 30 girls) between the age group of 18 and 20 years. In this study choice reaction time was taken by digital reaction time apparatus. Randomly occurring visual and auditory choice reaction time tasks were presented to students. First set of readings were taken during stress free period, and the second & third sets were taken 20 minutes prior to first and second terminal practical examination respectively.

Results: The readings were analyzed by unpaired student "t" test. It was observed that there was statistically significant difference amongst boys & girls in visual and auditory reaction time in stress (exam) condition but no difference was found in stress free condition. It was also observed that exam stress prolongs both visual & auditory reaction time as compared to stress free condition in both boys & girls.

Conclusion: The observation shows that girls tend to perceive more stress than boys which might affect the cognitive functions more, as slower reaction time was observed in girls than boys when they are exposed to stress.

Key Words: Choice Reaction Time, Cognitive, exam, gender, stress.

INTRODUCTION

Stress indicates the consequence of the failure of an organism, human or animal to respond appropriately to emotional or physical threats whether are either actual or imagined. ^(1,2) Stress is a structured series of

physiological, neurohormonal and psychological efforts of adaptation towards any real and anticipated situations that threatens or disturbs homeostatic balance of the body and that require some kind of adjustments. ^(3,4)

Academic stress is an inevitable feature of students' life where periodic exams become an acute stressful experience for them. Academic stress is the product of a combination of academic-related demands that exceed the adaptive resources available to an individual".^(5,6) Exam stress is predominant among medical students which is proved by various studies conducted among medical students have reported prevalence of stress ranging from 27-73%.^(1,7) The student of first year MBBS faces major stress due to excessive academic workload, increased psychological pressure, sleep deprivation, helplessness, mental tension, inadequate support from allied health professionals. The first year MBBS students face a major challenge especially during practical examination, where they are exposed to viva for first time. The experience of stress among college students is considered normal, but if stress is severe and/or prolonged, it can reduce academic performance; interfere with a student's ability to participate in and contribute to campus life.⁽⁵⁾

The objective of the present study was to find out possible gender differences in stress reactivity in medical students when they are exposed to stressful events like exam. The choice reaction time was used to find out the performance of students during stress free & stress (exam) condition.

Reaction time is an index of sensory motor performance. Reaction time is the interval between the application of the stimulus and appearance of voluntary response. Choice reaction time (CRT) was taken in boys & girls in two separate conditions i.e. during stress free and when they were exposed to stress i.e. during exam period. CRT tests the cognitive domain as it involves recognition, discrimination, and analysis of stimulus and decision making for appropriate response selection.⁽⁸⁾

The perception of stress based on gender studies are inconsistent; as findings of studies conducted regarding stress with references to gender are somewhat conflicting. There are evidences which demonstrate that females report more distress to fear-producing and stressful experiences than males.^(9,10) Some of the human stress studies have largely indicated that physiological responses to acute stress do not differ in men and women.^(11,12) There are some evidences that show younger men have elevated adrenocorticotropin (ACTH) stress responses compared to younger women.^(10,11)

Due to conflicting evidence of sex differences in physiological reactivity to stress challenge studies, the present study tried to evaluate potential sex differences in response to exam stress in medical students.

MATERIALS & METHODS

Study Population: The study was conducted on 60 healthy first year medical students (30 boys & 30 girls) between the age group of 18 and 20 years who were randomly selected at Topiwala National Medical College, Mumbai. The subjects who had history of color blindness, hearing impairedness and sensory-motor disability were excluded from the study. Informed consent was taken from all the subjects. The study was approved by Institutional Ethics Committee of B.Y.L. Nair Charitable Hospital, Mumbai.

Material: Digital reaction time apparatus manufactured by Bio-Tech (INDIA), Mumbai, which has got maximum resolution time of 0.0001 seconds was used in this study.

Methods: Choice reaction time in the form of visual & auditory signals was used in present study. The examiner sits with master (primary) controls whereas student sits on other side with secondary controls. The examiner & student were separated with the

help of opaque partition so that student avoids seeing which switch the examiner presses.

The examiner randomly presents either with visual (red or green signals) or auditory signals (high or low frequency sounds) to the subject. The subject immediately responds by pressing the corresponding switch on his/her side. The time duration between the application of stimulus by examiner and the response from the student is taken as reaction time. This was recorded on reaction time apparatus in seconds. In the beginning two to three practice sessions were given to the students. After that four such test recordings were taken and the averages of these recordings were taken as final record for each subject. One set of recordings was taken in 'stress free' condition and the second & third set of recordings was taken 20 minutes before the first and second terminal practical examination respectively. Statistical analysis was done with the help of unpaired "t" test.

P<0.05 was taken as statistically significant.

RESULTS

Table no 1, 2, 3 shows visual (Red & green) (VRT) and auditory (high & low frequency sound) (ART) reaction time in boys and girls in stress free period, during first and second terminal practical exam (Stress) respectively.

Table No 1 shows that there was statistically no significant difference in either visual or auditory reaction time amongst boys & girls in stress free condition. Whereas in first terminal exam (Table No 2) there is statistically significant difference amongst boys & girls in visual and auditory reaction time in stress condition.

While during second terminal exam (Table No3) it was also observed that there is statistically significant difference amongst boys & girls in visual and auditory reaction time in stress condition except in visual reaction time in green signal.

TABLE-1 REACTION TIME IN BOYS & GIRLS IN STRESS FREE PERIOD

PARAMETERS	BOYS	GIRLS	T TEST
VRT RED SIGNAL	0.2632 ± 0.062	0.2781 ± 0.046	NS
VRT GREEN SIGNAL	0.2493 ± 0.059	0.2617 ± 0.052	NS
ART HIGH FREQUENCY SOUND	0.3695 ± 0.066	0.4048 ± 0.088	NS
ART LOW FREQUENCY SOUND	0.3708 ± 0.074	0.4194 ± 0.086	NS

VALUES ARE GIVEN WITH ± STANDARD DEVIATION (SD)

NS-Not Significant

VRT: Visual reaction time; ART: Auditory reaction time. Reaction time given in table is in seconds.

TABLE-2 REACTION TIME IN BOYS & GIRLS IN FIRST TERMINAL EXAM PERIOD

PARAMETERS	BOYS	GIRLS	T TEST
VRT RED SIGNAL	0.3321 ± 0.098	0.4026 ± 0.119	**
VRT GREEN SIGNAL	0.3118 ± 0.113	0.3862 ± 0.123	**
ART HIGH FREQUENCY SOUND	0.4712 ± 0.102	0.5620 ± 0.169	**
ART LOW FREQUENCY SOUND	0.5206 ± 0.109	0.6256 ± 0.209	**

VALUES ARE GIVEN WITH ± STANDARD DEVIATION (SD)

P<0.05 - ** Significant

VRT: Visual reaction time; ART: Auditory reaction time. Reaction time given in table is in seconds.

TABLE-3 REACTION TIME IN BOYS & GIRLS IN SECOND TERMINAL EXAM PERIOD

PARAMETERS	BOYS	GIRLS	T TEST
VRT RED SIGNAL	0.3226 ± 0.077	0.3992 ± 0.168	**
VRT GREEN SIGNAL	0.3121 ± 0.086	0.3638 ± 0.164	NS
ART HIGH FREQUENCY SOUND	0.4343 ± 0.095	0.5459 ± 0.218	***
ART LOW FREQUENCY SOUND	0.5115 ± 0.149	0.6134 ± 0.252	**

VALUES ARE GIVEN WITH ± STANDARD DEVIATION (SD)

P<0.05 - ** Significant *** highly significant NS-Not Significant

VRT: Visual reaction time; ART: Auditory reaction time. Reaction time given in table is in seconds.

DISCUSSION

The purpose of this study was to examine possible gender differences on reaction time during exam stress in medical students. It was observed that girls were affected more than boys when they were exposed to stress condition in the form of exam as compared to stress free condition. It was also observed that exam stress prolongs both visual & auditory reaction time as compared to stress free condition in both boys & girls.

The present study was conducted on first year medical students, who are known to have significant amount of stress. The young students have always been vulnerable to stressful conditions especially in pursuit of higher professional education in a highly competitive environment. (13,14) During the first year of medical college, students are faced with numerous educational challenges in the process of adjusting to stressful academic setting, increased pressure to succeed at unfamiliar tasks, greater academic competition, more frequent failure experiences, and important career decisions. (15,16,17) Thus there are various stressors which may impair judgment, reduce concentration, loss of self-esteem, increased anxiety and depression and thus may affect the performance of students especially during exams. (18) Stress is any factor that threatens the health of an individual or has an adverse effect on the functioning of the body. As such, stress is a normal, desirable,

and beneficial part of our lives that can help one learn and grow, but prolonged, uninterrupted, unexpected and unmanageable stress is damaging. (19)

Reaction time is defined as an interval of time between presentation of stimulus and appearance of appropriate voluntary response in a subject. (20) In choice reaction tasks the subject are presented with several stimuli and has to discriminate between various stimuli to make a choice amongst appropriate response. (21) Thus, choice reaction time is a cognitive process which involves recognition, discrimination, and analysis of stimulus and decision making for appropriate response selection. (21)

In the present study, choice reaction time was taken during exam (stress) and stress free condition to find the cognitive performance in medical students. It was observed that the exam stress affects the cognitive functions as reaction time (auditory & visual) prolonged during exam period in both boys and girls.

The exam stress is a known acute stressor. (8) The main mediators of the stress response are sympathetic nervous system and the hypothalamic-pituitary-adrenal axis (HPA). (22) The basic neuroendocrine core of stress responses triggers release of hypothalamic release of corticotrophin releasing hormone (CRH) which stimulate the release of adrenocorticotropin hormone (ACTH) from the anterior pituitary, which,

in turn, stimulates the adrenal cortex to release corticosteroids, especially cortisol or corticosterone. ⁽²³⁾ CRH serves as a neurotransmitter that mediates sympathetic arousal, and provide link between the adrenocortical and autonomic branches of the stress response.

Cortisol exerts a profound influence over prefrontal cortex (PFC) structure and functioning in response to stress. Stress mainly affects the cognitive functions of students by profound influence over PFC by impairment in PFC signaling & can modify cognitive functions in humans. ^(8, 24) It was observed in our study that girls tend to perceive more stress than boys as there was statistically significant difference amongst boys & girls in visual and auditory reaction time in stress (exam) condition.

Previous research studies had demonstrated that females tend to perceive more stress than male and those females are more likely to become depressed in response to these stressors than men. ^(25, 26) This supports the idea that women may be perceiving similar life events as more negative as compared to men, and contributing to their tendency to report higher trait anxiety & depressive symptoms. ⁽²⁶⁾ Studies have consistently demonstrated that female students report greater levels of stress ^(17, 27, 28) and they report more distress to fear-producing and stressful experiences than men. ^(9,10) According to Misra and Mckean (2000) “individuals who scored high on trait anxiety experienced higher stressors and reactions to stressors. Females exhibited higher anxiety than males. ⁽²⁹⁾ While Sulaiman et al. (2009) found that male students experienced less stress compared to the female students. ⁽³⁰⁾ These various studies were consistent with the observations that the females were the more affected gender when it comes to academic stress. ^(5, 29, 30, 31)

The result of some of the neuroimaging studies shows that there is gender specific neural activation model underlying central stress response. ⁽³²⁾ The model suggests asymmetric prefrontal activity in males and primarily limbic activation in females. Stress responses in men is primarily characterized as ‘fight-or-flight’ while, in female it causes limbic activation might indicate an intrinsic neurobiological mechanism to activate the reward system under stress, thereby down-regulating the ‘fight-or-flight’ response. Thus, study showed relatively blunt acute stress response in stress tasks in female subjects. ⁽³²⁾ Thus study agrees with greater acute HPA and autonomic responses in males as compared to females using performance stress paradigms. ⁽³³⁾

It has been hypothesized that gender differences in cortisol reactivity to stress may be associated by hormonal variation occurring during the menstrual cycle. ⁽³⁴⁾ However, in the present study we did not focus our investigation on differences in acute stress reactivity due to the phase of menstrual cycle. However, it does not rule out influence of gonadal hormones on affect and cognition in response to stress. ^(26, 35, 36)

Our study is consistent with the above findings that girls have tendency to perceive events as more stressful than boys’ counterparts. Our study reported significant difference amongst boys & girls in visual and auditory reaction time in stress (exam) condition but no difference was found in stress free condition. This confirms that as girls perceive more stress than boys, the cognitive functions may be getting more affected as they show significantly slower reaction time than boys when they are exposed to stress.

CONCLUSION

The results of present study demonstrate that, stress affects the cognitive

performance of both boys & girls, but girls are affected more than boys to report higher levels of stress. The findings are consistent with most previous studies and further support the notion that, on average, girls tend to perceive stressful life events as more stressful than men. These basic sex differences in the perception and response to stress could constitute a vulnerability to the subsequent development of depression and anxiety in females.

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ABBREVIATIONS

ACTH- Adrenocorticotropin hormone
 ART- Auditory reaction time
 CRH- Corticotrophin releasing hormone
 CRT- Choice Reaction Time
 HPA- Hypothalamic-pituitary-adrenal axis
 PFC- Prefrontal cortex
 VRT- Visual reaction time

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