Original Research Article

Effect of examination stress on cognitive performance and EEG of medical students

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Abstract

Medical students undergo examination stress during university exam. Stress is associated with the cognitive performance and memory development. A total 336 male and female MBBS students were divided into non examination and examination groups. Both groups were analyzed with memory scale and EEG. Results showed in males students there was a significant increase in remote memory, immediate recall, visual retention, recognition and decrease in delta frequency. In females increase in remote memory, recognition, theta frequency and decreased in visual retention and alpha frequency was observed. There was a positive correlation between alpha, beta frequency and memory of female examination going groups. Positive correlation was between theta frequency and memory of non-examination going male and female students. Positive correlation was recorded between non examination going male and female students.

Key words

Stress, Examination, Cognitive performance, EEG, Medical students.

Introduction

Stress is outcome observed among medical students. Examination stress induces the MBBS students the difference between which he has to do and what he has done [1]. Hans Selye introduced the term ‘stress’ for medical studies. [2]. The stress response can be measured with cognitive task and questionnaire [3].

Homeostatic imbalance induces stress among medical professionals [4].

Studies on EEG show relatively greater right side cortex activity is relation with negative reactions to emotional stimuli [5] while relatively greater right frontal activity shows with a number of negative mood states or behaviors example depression, fear and withdrawal. One who perceived negative emotion or mood state that has received less attention and concentration due to stress [6].

EEG shows a good correlation with the mental stress in terms of suppression of alpha waves add improvement of theta waves [7]. These results suggest that theta wave repeat one after other may play an important role to organize the information network provided by working memory, and this network operates as an integrated unit by means of synchronization in the theta band which was consistent with earlier studies [10]. Earlier findings suggest that alpha, associated with theta, in transit phase reflect the transition of information from manipulation to maintenance state of working memory tasks [7]. Alpha frequency at 8-13Hz occurring during wakefulness over the occipital areas in the posterior regions of the head. Alpha wave with higher voltage recorded with eyes closed and under condition of relaxation and no relative mental inactivity [9]. Increased alpha activity was shown to be an indication of brain inactivity, while decreased in alpha activity was an indication of greater brain activity [7]. EEG shows how one person feel stress when sensory stimuli received and other person may not feel stress when received same stimuli [8].

Power spectrum analysis showed an increase of –4.0 Hz in all experimental manipulations, whereas the 4.25–8.0 Hz increase recorded only in the situation of forced wakefulness plus stress [10]. This problem solving and picture recognition task reduces the alpha wave than a person at rest as high power alpha wave is being observed [10].

Materials and methods

The present study was a cross-sectional study with sample size of 336, Prevalence = 30%, Z=1.96 for 95% confidence interval. The study was conducted Department of Physiology, Santosh Medical College, Ghaziabad in collaboration with Department of Physiology, Govt. Medical College, Kannauj upon young male and female first year students of age 20.03±2.70. The subjects were divided into 84 male non examination going, 84 female non examination going, 84 male examination going, 84 female examination going groups. The ethical clearance was taken from both institutional ethical committee. The PGI memory scale was used to assess the effect of examination stress on memory and Neurocompact of Medicaid system was used for EEG. The parameters of exam going group was taken one month before the university examination and compared with non examination group. The following inclusion and exclusion criteria were followed throughout the study period.

Inclusion criteria: I year medical students of either sex with good general, physical and mental health, aged between 18 to 25 years.

Exclusion criteria: Subjects with anxiety or depression, alcoholics, tobacco chewers, caffeine intakers, any family history related disease.

Methodology

In the present study questionnaire and the task present in the PGI memory scale was used. EEG was assessed by Neurocompact 3200 and EEG electrode placement was done by 10-20 medicaid system. The two tailed unpaired t-test was performed between non examination and examination going male and female groups and 0.05 value was considered statistically significant to draw any conclusion. Pearson's correlation value 0.05 was considered significant between memory of every group with EEG frequencies.

Table – 1: Memory performance and EEG frequency (Hz) of male and female non exam going and exam going.

Memory performance of	**Male (non-exam going n=84, exam going n=84)**			**Female (non-exam going n=84, exam going n=84)**		
	mean	**±std**	**p-value**	**mean**	**±std**	**p-value**
remote memory non exam going	5.01	1.38		5.23	1.64	
remote memory exam going	5.38	0.93	**<0.05***	5.62	0.79	**<0.05***
recent memory non exam going	4.75	0.88		4.53	0.72	
recent memory exam going	4.15	0.90	p>0.05	4.38	0.77	p>0.05
mental balance non exam going	2.44	0.50		2.34	0.48	
mental balance exam going	2.14	0.35	p>0.05	2.36	0.48	p>0.05
attention &concentration non exam going	3.77	1.11		4.63	1.22	
Attention &concentration exam going	4.75	1.34	p>0.05	3.82	1.54	p>0.05
delayed recall non exam going	4.99	0.98		5.29	0.95	
delayed recall exam going	5.83	0.99	p>0.05	5.22	0.88	p>0.05
immediate recall non exam going	3.27	1.08		2.92	0.89	
immediate recall exam going	3.58	1.47	**<0.05***	3.00	1.24	p>0.05
retention for similar pair non exam going	3.74	0.56		3.77	0.88	
retention for similar pair exam going	2.88	0.88	p>0.05	2.98	0.86	p>0.05
retention for dissimilar pair non exam going	4.58	0.54		4.70	0.57	
retention for dissimilar pair exam going	5.77	1.83	p>0.05	4.68	1.76	p>0.05
visual retention non exam going	8.71	0.45		8.87	0.33	
visual retention exam going	8.96	0.73	**<0.01****	8.66	0.99	**<0.05***
recognition non exam going	8.95	1.41		8.56	0.71	
recognition exam going	9.28	0.77	**<0.001*****	8.93	0.87	**<0.01****
EEG wave	**Male**			**Female**		
	mean	**±std**	**p-value**	**mean**	**±std**	**p-value**
alpha wave hz non exam going	9.82	1.18		9.8	1.18	
alpha wave hz exam going	9.5	1.26	p>0.05	9.54	1.30	**<0.01****
beta wave hz non exam going	24.47	2.56		24.2	2.46	
beta wave hz exam going	25.43	3.48	p>0.05	24.55	3.37	p>0.05
theta wave hz non exam going	3.82	0.71		3.81	1.19	
theta wave hz exam going	4.29	1.2	p>0.05	4.26	1.22	**<0.001*****
delta wave hz non exam going	1.36	0.48		1.39	0.49	
delta wave hz exam going	1.30	0.46	**<0.05***	1.93	0.46	

Table – 2: Correlation of combined memory performance scores with combined EEG of male and female students.

Variables	**Alpha(r)**	**beta(r)**	**theta(r)**	**delta(r)**	**p-value**
memory of male non exam going	-0.11	-0.207	0.004	0.061	>0.05
memory of female non exam going	0.007	0.011	0.113	0.000	>0.05
memory of male exam going	-0.048	-0.004	-0.091	-0.027	>0.05
memory of female exam going female	0.032	0.026	-0.031	-0.046	>0.05

Figure – 1: Memory scores between the groups.

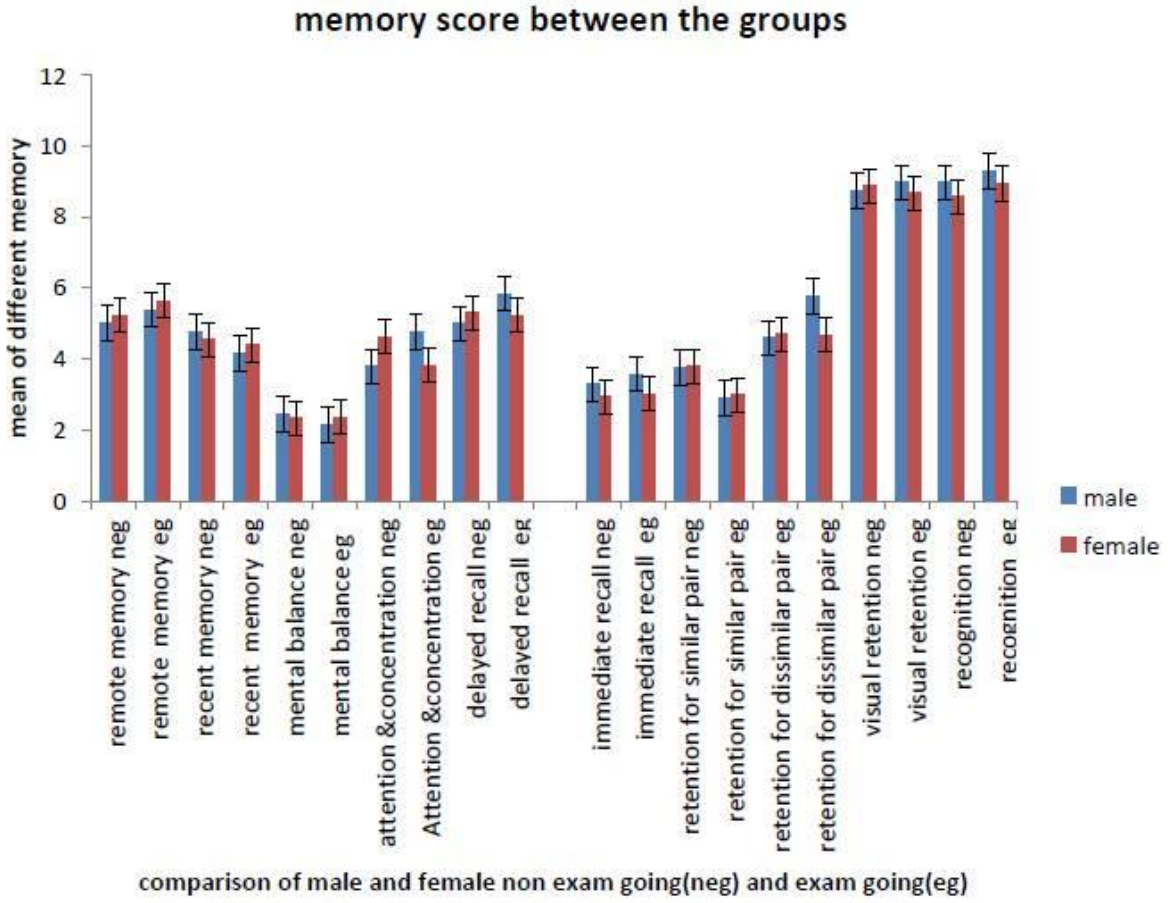
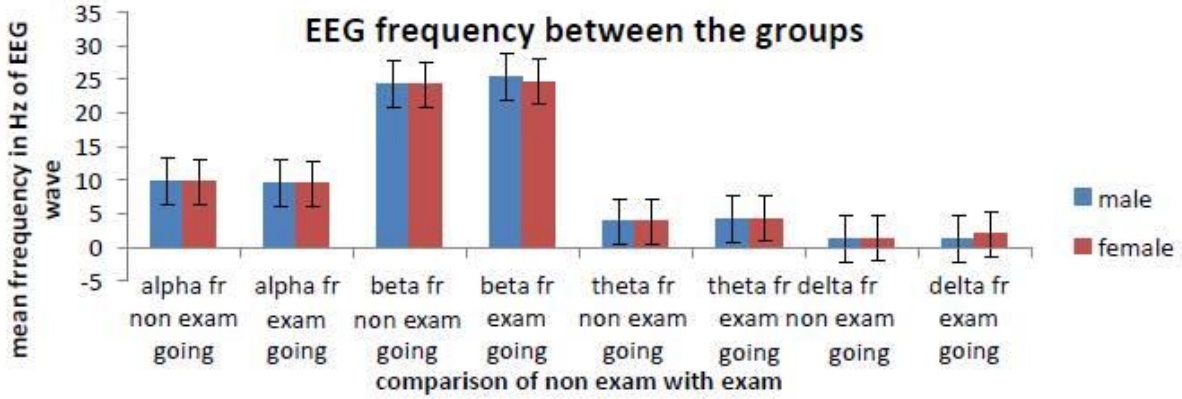


Figure – 2: EEG frequency (Hz) between the groups.



Results

There was a significant increase in remote memory, immediate recall, visual retention, recognition whereas a significant decrease in delta frequency of male was observed in examination going group (**Table – 1, 2**).

In female students there was a significant increase in remote memory, recognition, theta frequency and a significant decrease in visual retention, alpha frequency. in examination going group **Figure – 1 and 2**. After finding the results memory of every group was correlated with EEG frequency. A positive correlation was observed between alpha frequency and female non exam

going (0.007) and exam going (0.032) group. Positive correlation between beta frequency and female non exam going (0.011) and exam going (0.026) group. Positive correlation between theta frequency and memory of male non exam going (0.004) and female non exam going (0.113). Positive correlation between delta frequency and memory of male non exam going (0.061).

Discussion

Cognitive psychology identifies fundamental components of the mental life of human beings as immediate recall increased in male students. Problem- solving and decision making capacity caused visual retention increased in male students support [1]. Endogenous and exogenous homeostasis are separated for cognitive mood recognition and followers should alert and accept cognitive changes as recognition increased in both male and female student support [4]. Human performance in all situations can be correlated with arousal, increasing arousal and decrease arousal. But if a person's arousal level is high then performance may be hampered and it is also true that a simple task can be done at the high aroused level and it is also true that the high level of mental task can be performed in low arousal level Positive correlation between beta frequency and female non exam going and exam going group. support [6]. Stress makes an individual focus on here time pressure and dual-task load increases more error rates to an individual. Mathematical problem solving can increase anxiety which hampered working memory as alpha frequency decreased in female student support [9] .Alpha and theta frequency can be observed in memory performances. If the alpha frequency is increased and theta frequency is decreased. In different individual alpha, the wave is different. High-frequency alpha wave is observed in the subjects whose reaction time i.e. tendency towards doing the task is more than those subjects whose reaction time is less. A positive correlation was observed between alpha frequency and female non exam going and exam going group; Positive correlation between theta frequency and memory of male non exam going and female non exam going group support [10].

Conclusion

The outcome of the study specifies that during exam period environmental cues, mood cues, training, facilitated emotions which increase left prefrontal cortex activity which can develop different type of memory to overcome examination stress. There may be still lacunae in the study and future study will be conducted with a large sample size.

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