A Study of Impact of Examination Stress on Musculoskeletal Strength and Fatigue using Mosso's Ergo Graph in first year Medical Students.

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Abstract

Background: Stress produces physiological and mental reactions in the body. Stressful life is most common experiences in human life. Mild stress is beneficial in performance but constant high stress may lead to anxiety and depression. Examination stress act as stressor and decreases the performance of student. A stressor is a change in the personal event or an environment that can cause stress.

AIM: Present study was done to evaluate the muscle strength variations and fatigue under examination stress among medical students.

Material and Method: Study involved 100 healthy boys and girls between 18-21 years of age. Who have no history of tobacco or alcohol consumption. Each students muscle strength was assessed by calculating work done using hand grip dynamometer and Mosso's ergo graph, once during routine schedule in relaxed state (with no examination) and again during stressed state (during mid- term examination).

Result: The amount of work done and handgrip strength was significantly higher on relaxed state compared to during examination.

Conclusion: This study suggests that as examinations act as unavoidable stressors, which lead to the variation in the performance of the students. The medical teachers as well as students should be made aware of the negative consequences of stress faced during medical training. Effective relaxation program and psychological counselling services should be provided to students so that they cope better with examination stress.

Keywords: Musculoskeletal Strength, Fatigue, Stress, Mosso's Ergo graph, Work Done Handgrip Dynamometer

Introduction

Stress is the overwhelmed or incapable to cope with physical or psychological stimulus that can produce physiological and mental reactions which may lead to illness. It produces a psychophysiological state during prolonged cognitive activity like examinations. Stress responses are mediated by stress release hormone known as cortisol in body. There are substantial individual differences in response to stress[1,2]. Some individual show little or no response while others show large cortisol increases in responses to stress[3]. Hypothalamic- adrenal-pituitary axis (HPA axis) response to physical exercise does not differ between women and men. Several studies revealed that there are no significant sex differences or higher cortisol responses in young men than in young women after exposure to psychological stress (academic exams)[4]. The huge course burden, long hours of study, staying away from families, family expectations accompanied by the transition phase from being carefree individual to a qualified person who has to work in a advancing medical field adds stress to life. Besides these daily worries one deals with, examinations form the hardest part of a student life where they are going to be tested and judged. It is associated with pressure to do well, working for long hours, sleepless nights, and all together, a feeling so as though their life is centred on exam results. Stress reactions are always followed by recovery processes, which may be compromised when stressors are severe, prolonged, or unaccustomed[5,6]. The adaptive capacity to deal with stress is one's fitness, which

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when exceeded may place the individual at greater risk for disease[7].

Many studies have proved that medical profession causes high incidence of psychological distress among students. Medical students in their life go through several academic stresses. Mild stress could be beneficial in cognitive performance whereas persistent high stress can lead to anxiety and/or depression[8]. Stress can cause physical effects as palpitations, breathlessness, abdominal pain, muscle weakness, headaches, and emotional effects such as apprehension, reduced concentration, short temperedness, nightmares, and insomnia. It can cause cognitive symptoms such as confusion, difficulty in thought organization, compromised judgment, going blank[9]. There is evidence that adapting to stress consumes regulatory strength, self-regulation break down when people under stressful situation[10]. Major academic stressors include examinations, time demands, competition and peer pressure[11]. Examinations have a negative effect on the mental health of students in terms of stress, anxiety, and depression[12,13]. Previous studies have mainly focused on the stress level in students and identification of various stressors[2,8,9,13,14]. Not many studies are done to assess the effect of exam stress on musculoskeletal performance or physical activity, so the present study under taken to explore the effect of examination stress on musculoskeletal strength and rate of fatigue in medical students.

Material and Methods:

The present prospective study was conducted in department of physiology SSPM Medical College and Lifetime Hospital, Padve. 100 students which included 54 boys and 46 girls aged between 18-21 years were selected for the study. Subjects with a history of tobacco, alcohol and caffeine consumption or with history of chronic illness like tuberculosis, hypertension and diabetes were excluded from the study. All the participants who were healthy and fulfilling the inclusion criteria were invited to enroll in the study. They were explained well about the procedure of the study and informed and written consent was obtained. The base line heartrate and blood pressure (digital omron) were recorded and anthropometric parameters like weight (kg) and height (metres) and body mass index was calculated. The height was as measured by Commercial stadiometer to the nearest 0.5 cm. The participant was made to stand erect with bare foot on the floor board of the stadiometer with his or her back to the vertical backboard of the stadiometer. Weight was recorded by Digital scale with an accuracy of +100gm, subjects were asked to come in light clothes and bare foot. In this study the muscular fatigue was recorded for calculating the amount of work done by the exercising muscle by using Mosso's Ergography and Hand grip dynamometer

BMI: The WHO Criteria for Body Mass Index was taken into consideration

Body Mass Index	Range
Underweight =30	<18.5
Normal	18.5-24.9
Overweight	25-29.9
Obese	>=3

Assessment of stress parameters:[15]

Subjects were given a questionnaire of 42 items for scoring Depression, Anxiety and Stress (DAS) Scale, which has 14 questions each for assessing depression, anxiety and Stress levels. Scoring was done as normal, mild, moderate, severe and extremely severe.

Assessment of muscle strength:

To test the muscle strength, Mosso's Ergography and Handgrip dynamometer was chosen as the testing tool. The usage of instruments and procedure of the tests was well explained to the subjects before the start of the test.

Procedure: Insert the index and the ring finger of the subject into the fixed-tube holders, leaving the middle finger to pull the load. Set the metronome to oscillate once in two seconds. Connect the sling to the middle finger. Ask the subject to lift the load by maximal contraction of the flexors of the middle finger and repeat lifting the load every two seconds along with the metronome oscillations. The metronome was set at one beat per two seconds i.e. to a frequency of 30/min. The subjects were asked to make a series of maximal contractions without moving the shoulder at regular intervals following the beat of the metronome. Ask the subject to continue (lifting the load) till the load can no longer be lifted. Outcome of the procedure was noted in terms of work done Three trials of recording were done each time and best of it was taken for analysis once during relaxed state (with no examination stress) and another during stressed state (during examination). The subjects were verbally encouraged with the drive to keep their motivation level high during the procedure. The subjects were instructed not to consume any kind of energy drink including caffeine, as well as not to perform any sort of physical activity one day before or on the day of the tests.

Work done calculations:

1. Average height of contraction = Area of triangle + Area of Rectangle

Length of the base line

2. Work done in gm.Cm. = Weight in gm x average height of contraction in cms x number of contractions

Handgrip dynamometer procedure: First, the participant was allowed to study the instrument for a short time, and then asked the participant to hold the dynamometer in the hand, with the arm at right angles and the elbow by the side of the body. The handle of the dynamometer is adjusted if required - the base should rest on the first metacarpal (heel of palm), while the handle should rest on middle of the four fingers. When ready the subject is asked to squeeze the dynamometer with maximum isometric effort, which is maintained for about 5 seconds. The tension developed was measured. The whole procedure was repeated for 3 times and best reading was taken. It is measured in kilogram. The subject should be strongly encouraged to give a maximum effort. Scoring: The best result from several trials is recorded, with at least 30 seconds recovery between each effort[16].

Performance: The marks obtained in the viva voce of preliminary physiology examination, was taken as performance. The performance was not significantly different in the two groups (Percentile marks in males and females are 75.6±12.1 and 75.26±10.1 respectively).

Statistical analysis: All the data were expressed as mean ± SD. Statistical comparisons were performed by dependent 't' test. Correlation analysis was performed using Pearson correlation coefficient. A probability value less than 0.05 (P<0.05) was considered significant for all statistical tests applied.

Result:

Of the 100 students enrolled in the study, 54 were males and 46 females with mean age of 20.4 ± 1.59 years, height 1.70±8.66 m and weight 60.75±9.69 kg. Stress, anxiety, and depression levels determined during relaxed state were compared to the levels observed during stressed state. Although the changes in the baseline parameters was not significant in stressed and relaxed state, the levels of mood parameters were significantly raised during examination stress and were statistically (Table 1).

Table 1: Comparison of stress parameters during relaxed state and stressed state.

Variables	Relaxed state (n=100)	Stressed state (n=100)	'P' value
Heart rate (beats/min)	76±12	78±6.9	0.707
Systolic BP (mmHg)	116±7.2	118±8.5	0.078
Diastolic BP (mmHg)	77±5.2	80±9.6	0.220
Stress	12.08±5.5	15.30±4.9	0.0001**
Anxiety	9.6±4.4	12.7 ±3.8	0.001**
Depression	7.4 ± 4.5 9.	05 ± 4.55	0.0001**

In our study, we also evaluated changes seen in the musculoskeletal performance of work done in correlation to anxiety, stress, depression, and body mass index among medical students during the examination (Table 2).

Table 2: Comparison of musculoskeletal performance during relaxed state and during stressed state with work done, weight, height, BMI scores by dependent t test

Variables	Relaxed state (n=100)	Stressed state (n=100)	'P' value
Work done (g cm)	96.05±52.81	87.00± 44.96	0.0001*
Weight(Kg)	65.07±9.69	60. 75± 10.60	0.0001*
Height(m)	1.70±8.66	1.70±8.63	0.0944
BMI(kg/m2)	19.11±5.5	17.8.6±4.9	0.0001*

Worked done during the relaxed state was better than the stressed state and was statistically significant, the weight during the stressed state was also reduced and accordingly the changes were seen in BMI and these factors also affected the amount of work done during relaxed and stressed state. Results showed performance was negatively correlated with examination stress and anxiety. The results of handgrip dynamometer showed better performance in relaxed state compared to stressed state and was statistically significant (Table 3).

Table 3: Comparison of performance by Handgrip dynamometer during relaxed state and stressed state

Variables	Relaxed state (n=100)	Stressed state (n=100)	'P' value
Hand grip strength(kg)	37.23 ±7.12	33.93±11.69	0.0007*

Discussion

Stress is highly personalized as people have different stressors and even different responses to same stressors. Some amount of stress can be healthy as it keeps us on toes and refine our skills but additional stress may be harmful to one's health both physically or mentally. In the Behavioural Risk Factor Surveillance System (BRFSS) database, the number of unhealthy days reported by 175,850 adults was inversely associated with physical activity[17]. Various studies have reported that medical curriculum has various levels of stress amongst medical students and health care professionals[10,11,12]. Some prospective studies had employed designs to compare a period of objective stress (i.e., final examinations) with a less stressful period[18,19,20,21], to compare a stressed and non-stressed population over time[22,23], or to manipulate a laboratory stressor compared to a control condition[24]. Among these, six studies discovered a statistically significant effect of stress on exercise and/or physical activity. In studies done by Oaten and Cheng[21] and Steptoe et al.[19] they assessed students during a baseline period near the beginning of a semester and also during final examinations, and control groups were assessed at the end of the semester but not during examinations. Both studies found declines in duration of exercise/ physical activity compared to controls, but Oaten and Cheng[21] also found declines in exercise frequency and the perceived ease of exercise. In another study done by, Griffin et al.[20] they found that exercising ability decreased for those college students experiencing increased demands during examination stress; however, the changes were not significant. However, there was a significant correlation between stress and exercise at baseline. In the present study also the work performance was reduced in the stressed state compared to the relaxed state being consistent with the previous studies

In a review article titled "The Effects of Stress on Physical Activity and Exercise "states that the majority of studies identified by the literature review supported the hypothesis that stress has an impact, whether negative or positive, on physical activity behaviours (n =134,79.8 %). However, the literature was not entirely in agreement with regards to the valence of the association. Majority of the studies (n = 123, 72.8 %) gave evidence that psychological stress predicts lesser physical activity or exercise. However, correlations of stress and exercise in studies supporting the association typically found no relationship greater than -0.28 to -0.42[20, 21, 24-30]. Contrarily, (n=29, 17.2 %) studies provide evidence of an increase in physical activity with stress.

Conclusion

Therefore it can be said that, some papers reported evidence indicating an association in both a positive and negative direction; and some indicators of stress and physical activity were not associated, but others were in either a positive or inverse direction.

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