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Effect of Exaggerated Studying Stress Between Medical Students on Central Somatosensory Conduction Time: An EMG Study.

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ABSTRACT

Studying stress is high among the medical students. This stress could develop several postural abnormalities. Forward head posture is commonly associated with these students. Forward head posture causes an increase in the tension on the spinal cord and increases the central somatosensory conduction time. The increase in the central somatosensory conduction time could affect the students' studying performance and learning abilities. This study was conducted to investigate the effect of the exaggerated studying stress among medical students on the central somatosensory conduction time. Seventy students with forward head posture were randomly selected. The central somatosensory conduction time was tested at the baseline and after 10 weeks. The central somatosensory conduction time was significantly increased between pre and posttests. The pre-test mean and standard deviation values of the central somatosensory conduction time for pre and posttest were 5.25±2.12 msec and 5.61±2.15 msec. Our study showed that the exaggerated studying stress among the medical students significantly increases the central somatosensory conduction time.

Keywords: Central Somatosensory Conduction Time, Exaggerated studying Stress, Medical Students,

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INTRODUCTION

Studying stress is showed to cause several postural abnormalities, including forward head posture, scoliosis, and kyphosis. Forward head posture is one of the commonly occurring postural abnormalities. Forward head posture is defined as 'the location of the external auditory meatus in front of the plumb line that passes across the shoulder joint [1]. It is a common happening postural disorder[1]. It has a high incidence and progression rate among the student, particularly medical students[2] because students have a high rate of psychologic distress and physical pressure[3]. Moreover, the usage of electronic devices recently become familiar during the lives of adolescents. They repeatedly use computers to carry out their leisure (internet, chatting, and playing games) and educational (studying, research) events [4,5]. Also, using the computers for playing various kinds of electronic games, which has a high level of attraction, will lead to increase the stay periods of adolescents on them[6].

Long persisted forward head posture causes musculoskeletal abnormal changes such as an upper crossed syndrome. Upper crossed syndrome is defined as a decrease in the lordosis of the lower cervical and an increase in kyphosis of the upper thoracic spine[7–9]. This abnormal position causes an upper and anterior movement of the center of the head. Consequently, changes in the status of the surrounding deep neck musculatures either shortening or lengthening result[10]. These changes exaggerate tension on the spinal cord by their attachments to the dura mater of the spinal cord[7,11]. Prolonged forward head posture can adversely affect the spinal cord. It is explained by Harrison et al[11] and Szeto et al[7] that forward head posture causes an upper and anterior movement of the center of the head. This anterior movement of the center of the head causes an increase in the weight of the head up to Seventy pounds due to the increase in the leverage on the cervical spine[12].

It is well known that our body uses the sensory data from the body and surrounding environment then uses this data to improve the motor planning, skills, and self-control[13,14]. Thus, the delay in receiving, interpreting, or using these data, will affect attention, emotional regulation, self-confidence, problem-solving, behavior regulation, skill development, and the ability to improve the interpersonal relationships[13,14]. Accordingly, the decline in these will interfere with the students' studying performance and learning abilities.

This significant affection on the students studying performance and learning abilities strived us to investigate how much severity this studying stress affects the central somatosensory conduction time and the spinal cord consequently. New studies have reported myodural connection bridge among deep extensor suboccipital muscles (rectus capitis posterior major, rectus capitis posterior minor, and obliquus capitis inferior) and the dura mater of the cervical spine[15,16]. Hallgren et al[17] showed that there is a connection between rectus capitis posterior muscles and the spinal dura matter. Subbarayalu[18] demonstrated that the prolonged forward head can alter the cervical musculature length-tension. This will lead to shortening of posterior cervical musculatures and weakening of anterior cervical musculature. Thus, the shortened of the posterior cervical muscles will increase tension on the dura matter which surrounds the spinal cord[19].

Due to the increase in tension on the dura matter, there will be an increase in tension on the spinal cord. Dolan[20] stated that the spinal cord could be stretched up to only 25% of its original length which can correspond to an elongation of 17.6 mm measured at the level of the cervical spine during neck flexion. Stretching above this level might result in a significant compression of the cord. Following this, cranio-cervical flexion will occur which results in a longitudinal transmission of traction force and rises the intramedullary pressure in the lower cervical spine. The fast incidence of low-grade mechanical traction on the neural tissues can lead to disturbance of the tissue and may result in transient or permanent neurological injury.

Dynamic forces induced by flexion and extension of the spinal column contribute to axial cord strain with potentially detrimental stretch-induced axonal injury[21]. Cadaveric studies have demonstrated that ongoing longitudinal strain, even within physiological limits, will eventually surpass its material tolerance thereby permitting neurological injury. Harrison et al[22] showed that the increased tension could raise the viscosity of fluid stream and may deliberate or harm neural transport system. The spinal cord is a viscoelastic material[23]. Thus, it deforms with the increase in stress placed on it. Harrison et al[22] stated that under even the minimum stress the spinal cord will undergo creep and stress relaxation. Furthermore, Smith[24] indicated that the cervical spine flexion only could deform the cord segments C2-T1 to about 10%, with a peak magnitude of 17.6% [25–27].

Studying the exaggerated studying stress on the spinal cord and the central somatosensory conduction time is important to know how much this stress could affect the spinal cord and central somatosensory conduction time among medical students. Understanding the degree of this relation could provide a new direction to provide a forward head postural exercise to these medical students to avoid the adverse effects of the stress. Thus, this study is conducted to investigate the effect of exaggerated studying stress between medical students on the central somatosensory conduction time.

MATERIAL AND METHODS

Design

The purpose of the study was to study the effect of the exaggerated studying stress between medical students on the central somatosensory conduction time. A randomized observational study was performed in outpatient clinics of Physical Therapy Faculty, Beni Suef University, Beni Suef, Egypt. The participants were selected from the students of this faculty. They were randomly chosen to participate in this study using the roll of dice. They recruited in the study after signing an informed consent prior to data collection. The local faculty's ethics committee approved this study. Participants were recruited from January 2016 to June 2016.

Subjects recruitment

Seventy-five participants were initially examined. The inclusion criterion involved that the participants had a craniovertebral angle equal or less than 50° (Yip et al., 2008). The exclusion criteria included any existence of signs or symptoms of medical "red flags" (eg, tumor, fracture, rheumatoid arthritis, osteoporosis, and prolonged steroid use), signs of any upper motor neuron disease, vestibulobasilar insufficiency, previous cervical or thoracic spine surgery, and upper limbs radicular symptoms [28]. There were 4 subjects of the initially examined subjects didn't participate in this study. The excluded participants were either didn't encounter the selection criteria (3) or contributed only to the baseline assessment and didn't continue the study (2). Seventy participants only met this inclusion criterion. They were twenty males and ten females. The participants' ages ranged from 18 to 21 years old. They were tested both at the baseline and after 10 weeks. A diagram of subjects' flow throughout the study is shown in Figure 1.

Evaluative procedures

The central somatosensory conduction time

The central somatosensory conduction time was reported in the literature to be a reliable and valid method for the investigating spinal cord function [29]. The device used in the measurement of the central somatosensory conduction time was Nihon Kohden Neuropack System (M1 MEB-9200 EMG/EP/IOM, Nihon Inc., Tokyo, Japan). Participants were asked to sit in a comfortable position on a chair with a back support. Nu-prep gel (Weaver and company Inc., Aurora, CO, USA) was used to reduce the skin resistance. The stimulating electrode was placed over the right median nerve at the wrist, and the cathode positioned about 3 cm proximal to the anode. The recording electrodes were positioned on the seventh cervical vertebrae (N13) and the scalp (N 20) [30]. The stimulus was square-shaped pulse and pulse period of 0.3 msec, It was transported at 5.5 sec with a frequency of 25-3000 Hz, a pulse duration of 40-80 msec, sweep length and a sampling interval of 80-160 µsec. The central somatosensory conduction time was calculated as the variance in peak latency between N20 from the scalp and N13 from the neck [30].

Data analysis

The main outcome measure was the central somatosensory conduction time. To reduce any bias, before any central somatosensory conduction time analysis, the files of participants were coded by one of the faculty administrators who was not involved in the study [31]. The central somatosensory conduction time data were collected at the baseline and after 10 weeks. In this study, The mean, standard deviation were calculated for the central somatosensory conduction time. The percentage of decrease for the central somatosensory conduction time in each group was calculated by [(pretest group means- posttest group mean)/ pretest group mean] ×100 [32]. The paired t-test was used to evaluate the central somatosensory conduction. The outcome variable was continuous, and data were normally distributed by using Shapiro-Wilk's test[33]. For all statistical analysis, we used a level of significance at P<0.05. The SPSS (ver. 24, IBM Inc., Armonk, NY, USA) was utilized for the statistical calculations in our study.

RESULTS

The demographic and general characteristics of the participants at the baseline were presented in Table 1. These included age, height, weight, sex, and history of neck pain.

Statistical analysis.

The paired t-test, after 10 weeks, showed that there was a significant increase in the central somatosensory conduction time (P<0.05), the central somatosensory conduction time pretest and posttest means were 5.25±2.12 msec and 5.61±2.15 msec, respectively and the percentage of increase was 5.73% (Figure 2, Table 2).

Table 1: The demographic and clinical characteristics of the subjects

Items	Control Group
	X ±SD
Age (yrs.)	20.06 ±0.35
Weight (Kg)	80.00 ±11.73
Height (cm)	177.45 ±10.58
Gender (%) Male Female	 65% 35%
Previous history of neck pain (%) Present Absent	 30% 60%
Lifestyle (%) Athletic Non-athletic	43% 57%

X: Mean, SD: Standard deviation,

Table 2: Within group analysis of the pretest and posttest for the central somatosensory conduction time.

			X ±SD(msec)	x̄	(95% CI)	Paired t-test		(%)
						t value	P value	
Central somatosensory conduction time		Pretest	5.25 ±2.12	-0.36	- 0.30 to -0.15	-5.5	0.01*	-5.73
		Posttest	5.61 ±2.13					

X: Mean, SD: Standard deviation, P: Probability. x̄: Mean difference, *: Significant difference (P < 0.05), CI: Confidence level and %: Percentage of improvement.

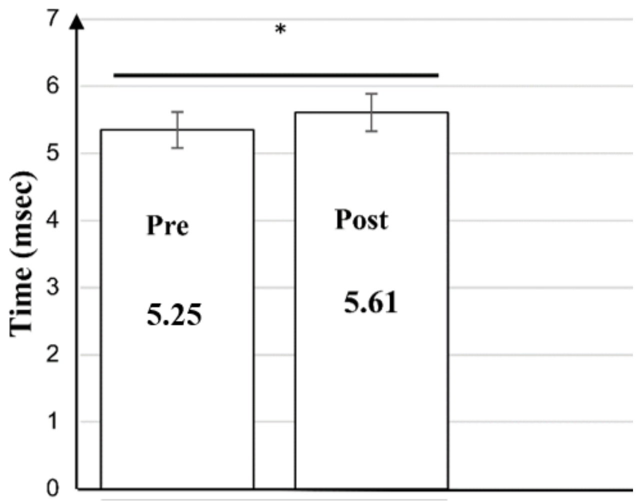

Figure 1: Within group mean differences between pretest and posttests for the central somatosensory conduction time in both control and exercise groups. There was a significant decrease between pretest and posttests for the central somatosensory conduction time. *: Significance (P< .05).

DISCUSSION

Our study is unique because it is the first study investigated the effect of postural abnormalities on the spinal cord function. Our study's results showed that the central somatosensory conduction time was significantly increased as a response to a prolonged exaggerated tension usually presented in medical students. The increase in the central somatosensory conduction time after 10 weeks could be due to that; the unproperly posture is common for students [2], specifically the medical school students [37]. It is showed that the rate of the physical pressure and psychologic distress is high in medical students. This is due to the heavily prolonged studying periods they spend to complete all their heavy daily study duties. Thus, the decline in the spinal curve will be rapid[3]. Besides, recently the usage of electronic devices become used with a high rate thru the ordinal lives of students who continually use computers, mobile phones or tablets to carry out their leisure (internet, chatting, and playing games) and educational (studying, research) events [4].

All these factors including high stress, extended periods in the studying whether by writing or using computers using bad postural habits leads to a quick decline in the forward head posture. Bilston and Thibault[23] reported that the spinal cord is a viscoelastic material. The rate at which the stress is applied is considered important in any viscoelastic material[38]. Thus, the postural loads continued for an extended time could result in higher neural changes in the spinal cord. Harrison et al[22] stated that under extreme strain but minimum stress the spinal cord undergoes the creep and stress relaxation. This could illustrate the effect of deformation happened in the spinal cord which decreases its increased somatosensory conduction time.

Our study outcomes are consistent with the outcomes of several animal studies[39–41], because studies inspected the consequence of increased tension on the human spinal cord is little. These animal studies demonstrated that the central somatosensory conduction time increases by any rise in the tension located on the spinal cord. Fiford and Bilston[41] conducted a study to examine the effect of uniaxial low to moderate traction rates on the mechanical proprieties of the spinal cord in mice. They reported that the spinal cord of mice experiences a nonlinear viscoelastic properties. Jarzem et al [39] studied the result of placing a traction on the dog's spinal cord. They found that the central somatosensory conduction time was significantly reduced a 30 min afterward this traction and this reduction continued till this traction removed. Eriksen [40] performed a study to scrutinize the effect of traction on the physiologic continuousness of the spinal cord in hams. They reported that extended periods of traction of the spinal cord significantly diminishes the somatosensory evoked potential and this diminish remains till this traction removed.

This study was limited by several factors, such as short period, age range and small sample size. This study was conducted mainly to investigate the effect of the exaggerated studying stress among the medical students on the spinal cord. Furthermore, no follow-up data were attainable because the study aim was to investigate the immediate effect of this exaggerated studying stress over a period of 10 weeks. Future studies are highly needed to perform randomized control trials to investigate the needed exercise types to correct this increase in the central somatosensory conduction time and how much time is needed to restore this.

Perspective

The current literature is rare and unclear about how much stress can affect the spinal cord conduction speed. To improve our knowledge about how much the spinal cord could be affected by the stress among the medical students who undergo high stresses during their study. Research is needed to detect the affection in the spinal cord conduction speed that could affect the sensory motor processing and concequently their studying performance and learning abilities. central somatosensory conduction time is considered a good measure for the spinal cord function and health. This study can give a standard to dtermine the sutiable studying time for students to prevent the development of these adverse effects on the spinal cord.

CONCLUSION

Our study showed that the studying stress among the medical students significantly increases the central somatosensory conduction time. The decrease in the central somatosensory conduction time could be an indicator of increasing the tension on the spinal cord.

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