

Original Article

Exercise leads to physical stress, A cross sectional study of Karachi – Pakistan

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Abstract

Exercise has many health benefits but also exercise is a stress situation for which the body must find a new dynamic equilibrium. If workout is performed beyond the limitations than it may disturb normal body homeostasis and results in stress. The basic objective behind this study was to evaluate the relation between Physical activities & Physical Stress. A cross sectional study was conducted to evaluate physical stress during exertion. All the subjects were randomly selected from Arts, Science, Commerce, Engineering & Pharmacy faculty of Karachi University. Serum cortisol, a potential biomarker evaluating stressed condition and finding a correlation with stress scores noted by using sadaf stress scale showed high intensity of stress while other results showed that around 41 percent participants were severely affected with physical stress during performance.

Keywords

Serum cortisol, Physical activity

Introduction

Physical activity is any body movement that works your muscles and requires more energy than resting. Walking, running, dancing, swimming, cycling, yoga, and gardening are a few examples of physical activity. We all know that exercise has many health benefits and that can condition our bodies to perform at a higher efficiency over time. (Anderson, 2014) exercise is also a stress situation for which the body must find a new dynamic equilibrium. This dynamic process requires, among other things, adaptive responses of the hormonal system (Chrosousos, 1992).

If workout is performed beyond the limitations than it may disturb normal body homeostasis and results in stress. This stress is underlined as “physical stress” (Tsigos et al., 2002). Physical stress results in elevated cortisol level and catecholamines in blood plasma by the activation of HPA axis and autonomic nervous system (Mastorakos et al., 2005). Individuals starting exercise initially may release higher cortisol in blood than the trained one because the body has adapted the stressor and become comfortable with it. But some time when it becomes unbearable to adapt the stress by the body, it results in high cortisol levels (David rynecki, 2013). Different type of exercises release different levels of cortisol in blood for example aerobic workout release higher levels of cortisol than weight lifting. Also the intensity of exercise determines the levels of cortisol (Kindermann et al., 1982). Chest pain, Shortness of breath, Tachycardia, Shakiness, Body itches, Nausea, Crunchy knees, Insomnia, Fatigue, fat gain, dizziness, disorientation, dehydration, skipped or disrupted menstrual cycle, easily agitated, lethargy are the signs and symptoms that appear during performance of exercise (Chelsea, 2010) and the marker representor of Physical stress (Sadaf, 2013).

Methodology

A cross sectional study was conducted on a sample size of 100 healthy subjects including both genders with age range of 20 – 30 years. The individuals were categorized to evaluate physical stress during exertion according to the BMI i.e. Overweight, obese and normal. Sampling was done in University of Karachi. The subjects who do exercise on regular basis or those who were suffering from chronic illness were excluded. Subjects were interviewed under a predesigned questionnaire based on 20 components. Out of 100 those who scored for physical stress were considered for further analysis whereas Pre questionnaire includes following:

- Demographic data (name, age, height, weight, occupation etc).
- Life style (active or sedentary).
- Days of performing exercise.
- Type of exercise
- Any medical problem
- Changes in heart rate or breathing patterns during physical exertion.
- Types of instrument used for performing exercise.
- Boosters/supplement intake
- Drugs prescribed by the doctor.
- Meals
- Dietary intake
- Activity preference

Subjects were instructed to come with two hours of fasting. Consent was also taken from all participants.

BMI was calculated by using formula: $\frac{\text{weight in kg}}{\text{height}(m^2)}$

Estimated BMI showed normal, obese, overweight and highly obese individuals. After their BMI

measurement, BP and pulse rate was measured using OMRON BP monitoring device (R2).

All the subjects were asked to perform brisk walking on treadmill until they were exhausted. Maximum time limit was 15 minutes.

When individuals were exhausted, they were allowed to stop walking. After performing exercise

protocol BP and pulse rate were again monitored. There random glucose levels were also measured using BP monitoring system (check: uc-1001).

Subjects were then asked to fill the Sadaf Stress Scale (SSS) for the evaluation of physical stress while the scale includes 19 signs and symptoms that appear during physical stress. After exercise 3ml blood were drawn through sterile syringe in afternoon.

Signs and symptoms of Physical Stress

Breathlessness	Churning stomach	Diarrhea/constipation
Dizziness	Dry mouth	Excess sweating
Headache	Increased cold/flu	Increased heart rate
Indigestion	Nausea feeling	Feeling of palpitation
Rapid/shallow breathing	Sleeping problems	Fatigue
Tremors in hands/legs	Tingling in hands/legs	Weight loss/gain
Feeling of heart rate		

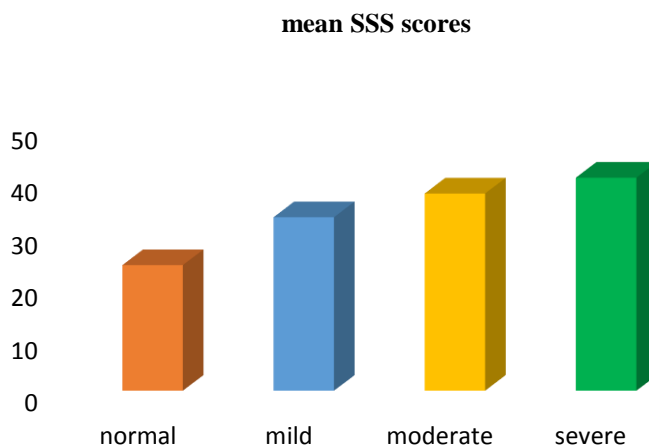
Normally, cortisol levels rise during the early morning hours and are highest about 7 a.m. They drop very low in the evening and during the early phase of sleep. The timing of the cortisol test is very important because of the way cortisol levels vary throughout a day. The reference ranges for serum cortisol are as follows:

Morning - 7-28 µg/dL Afternoon - 2-18 µg/dL Stimulated* - ≥ 18 µg/dl Suppressed** - < 2 µg/dl
*Low-dose ACTH stimulation test: before or after (anytime, but usually one hour) ACTH 250 µg (one ampoule) intravenous injection.

**Overnight low-dose dexamethasone suppression test: 8 AM serum cortisol after oral dexamethasone 1 mg taken in late evening (11 PM). ARCHITECT Cortisol is a delayed one-step chemiluminescent micro particle immunoassay (CMIA) used for the quantitative determination of cortisol in human serum, plasma or urine with a flexible assay protocol, named

as Chemiflex. In which, sample and anti-cortisol coated paramagnetic micro particles are combined to create a reaction mixture. Cortisol present in the sample then binds to anti-cortisol coated micro-particles. After incubation, cortisol acridinium-labeled conjugate is added to the reaction mixture. The cortisol acridinium-labeled conjugate competes for the available binding sites on the anti-cortisol coated micro particles. Followed by a second incubation, the micro-particles are washed, pre-trigger (1.32% hydrogen peroxide) and trigger (0.35 N sodiumhydroxide) solutions are added to the reaction mixture. The resulting chemiluminescent reaction normally measured as relative light units (RLUs). There is an inverse relationship exists between the amount of cortisol in the sample and the RLUs detected by the ARCHITECT i System optics, Abbot Laboratories, USA.

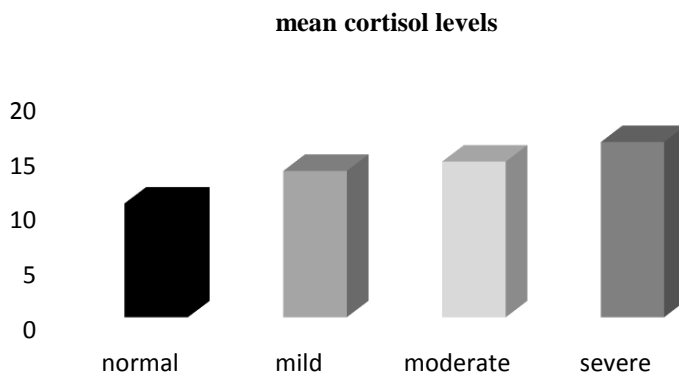
Results



Graph 1: Sadaf scores stress of physical stress:

This graph shows the scoring of SSS evaluated for determining physical stress among participants during exercise. Scores showed that around 41 percent participants were severely affected with physical stress during performance. While about 38 percent participants were moderately affected. Only few participants were appeared normal because they were physically active.

Graph 2: Serum cortisol test results.

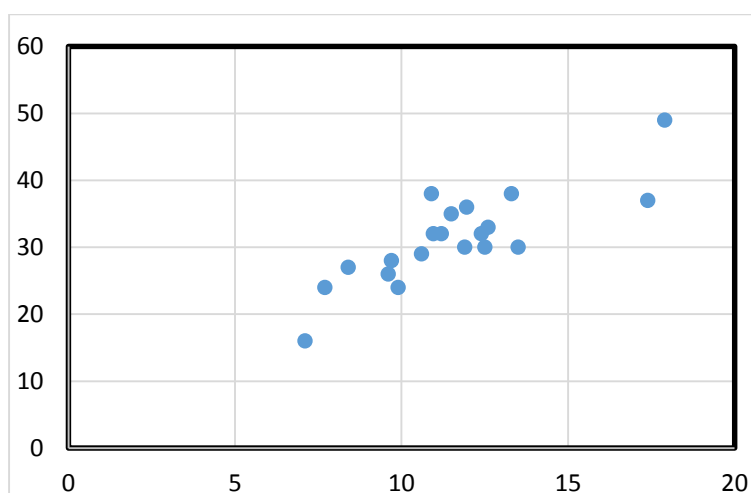


This graph shows the serum cortisol levels determining the stress level among participants. Around 16 percent had severe stress during performance because of higher cortisol value than normal while remaining reported mild and moderate stress. Only 10 percent were normal because of their normal cortisol values.

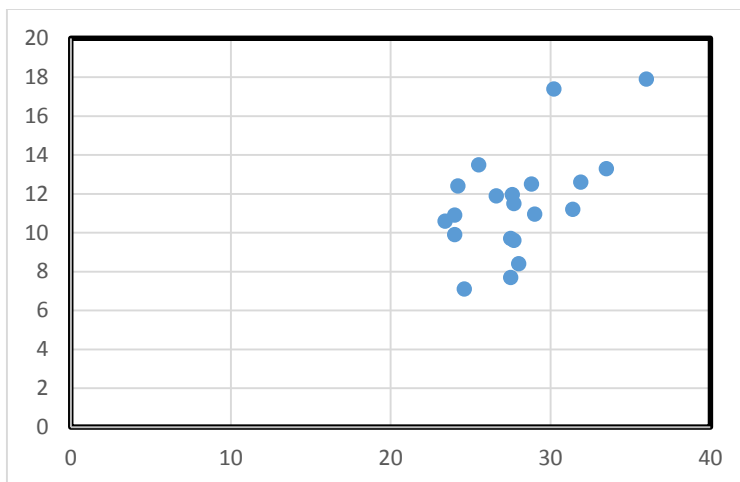
Table 1: Correlation between SSS and serum cortisol test:

Correlations			
Cortisol	Pearson Correlation	cortisol	SSS
	Sig. (2-tailed)	1	.830**
	N	20	.000
SSS	Pearson Correlation	.830**	1
	Sig. (2-tailed)	.000	
	N	20	20

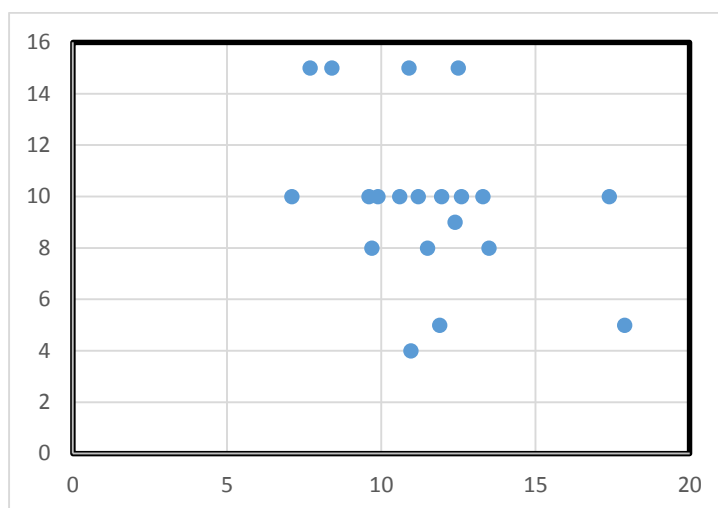
****.** Correlation is significant at the 0.01 level (2-tailed).



Graph 3 This graph shows the strong correlation between the Sadaf stress scores and serum cortisol values.



Graph 4 The correlation between BMI and cortisol is significant. Individuals with higher BMI while performing exercise had higher cortisol levels than the lean ones.



Graph 5 This graph shows no direct correlation between exercise and Cortisol.

Discussion

Physical stress was much more in most of the exercised individual. According to Sadaf stress scale (Physical Stress) only very few were scored as normal (Graph1). They were found physically stressed and most of them reported all the nineteen symptoms that occur during exercising condition. Individuals reported symptoms like anxiety moodiness, agitation that are the major indicators of stress condition. These symptoms were appeared due to the release of cortisol, adrenaline and non-adrenaline thus connecting the stress reaction (Borer, 2003). Hence physical activity can act as one of the physical stressor (Sadaf Ahmad, 2013) but again its type intensity and duration determines the level of stress (Doherty, 2000; Hawley, 2002) The finding of the study suggests physical stress is directly proportional to increased cortisol levels and thus supports strong correlation of SSS with serum cortisol levels (Graph 3). The blood samples of

exercised participants were tested for the presence of cortisol, which is an indicator of physical stress. Most of the samples showed positive cortisol test while some showed negative cortisol test because those participants were might be involved in regular exercises or they have better exercise endurance thus reduced physical stress developed in the body (Graph 2). Our immune system and hormonal system has direct influence on our body during exercise. Most importantly interleukin 1b has direct effects on our endocrine system. It acts on hypothalamus to release CRH This CRH acts on anterior pituitary to release ACTH. This ACTH finally acts on adrenal gland to release cortisol (Besedovsky et al., 2004). Cytokine i.e. interleukin 1b is released during and after physical exertion for example exercise (Haahr et al., 1991). This cytokine is released within the body due to the micro muscular damage as a result of exercise (Hoffman et al., 1994). Cortisol level increases in both

moderate and high intensity type of workout and decreases within few hours as the workout ceases. Hence its presence is reported in healthy and unhealthy individuals (much more in physically inactive individuals) when working out till exhaustion (Voigt et al., 1990). Cortisol also had shown catabolic potentials (Kraemer et al., 2003), substrate mobilization and recovery potentials after workout (McKeever et al., 2004). Hence HPA axis is overly activated along with parasympathetic activation to balance the changes ongoing within the body during stressed condition to avoid disequilibrium within the body (Vicennati et al. 2009). This produces stress symptom like increased heart rate, dizziness, nausea, sweating, shakiness, fatigue, tingling and tremors in hands and feet. The increased BMI along with physical exertion may act as a physical stress for the participants. We observed that individuals with BMI more than normal range were exhausted earlier than normal participants. This may be because of increased body fat percentage thus individual has to exert much more force in order to perform workout resulting in physical stress which is much more in individuals suffering with high body weight. This stress thereby also increases cortisol and parasympathetic activity (Vicennati et al. 2009). Obese individuals have poorer performance of workout because of extra load (increased body fat) acting as a barrier (Astrand O Rodahl, 1997).

Conclusion

Present study suggested that physical activities do cause physical stress. The level of physical stress would be more in those individuals who are living a sedentary life style because of less endurance capabilities. This may also lead to other physical strains like obesity and cardiovascular risks. The tested serum cortisol, a potential biomarker evaluating stressed condition and finding a correlation with stress scores noted by using sadaf stress scale showed high intensity of stress and a linear correlation with serum cortisol that is yet another potential evidence of evaluating stress. Physically active individuals upon exertion have no or less occurrence of stress because of buildup stamina, endurance and new equilibrium against the stressor. However individuals who are engaged in high intensity workout for prolonged period of time may also lead towards HPA fatigue. The physiological fatigue developed either in sedentary individuals or individuals with over training or work out have direct effect on blood pressure, pulse rate due to the activation of parasympathetic system by the overload of cortisol.

Conflict of Interest

We have read and understood IJEHSR policy on declaration of interests and declare that we have no conflict of interests.

Acknowledgment

This research was supported by psychophysiology research lab, university of Karachi.

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