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Short Communication

Adrenocortical Response to Competitive Athletics in Students from a Nigerian Tertiary institution

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ABSTRACT

Exercise is a voluntary stressor. It activates the sympathetic nervous system (SNS) as well as hypothalamic-pituitary-adrenal (HPA) axis, which results in an increase of cortisol secretion. Very little is known however about adrenocortical response at basal state, just before the onset of exercise (pre-exercise) and immediately after exercise (post-exercise) with relationship to gender especially in this environment. This study is therefore aimed at investigating the cortisol response during competitive athletics in male and female athletes during the basal state, just before the exercise commences, and after the exercise. Twenty male and female athletes (22.13 ± 3.37 years) participated in this study. They were divided into two groups based on gender. Each Group consisted of 10 athletes who participated in a 30-minute competitive sprint round the track. Blood samples were taken at basal states, pre-exercise and post-exercise states for the analysis of cortisol using an ELISA cortisol kit. From the results, the pre-exercise and post exercise cortisol levels were significantly higher than at the basal state in both male and female athletes. Also, there was no significant difference ($p>0.05$) in the cortisol level during basal and pre-exercise states between the male and female athletes. The female athletes had a significant ($p<0.05$) higher cortisol level in the post-exercise state compared to male athletes. conclusively, exercise increases cortisol levels during the anticipation state of exercise and after strenuous exercise in male and female athletes and the female athletes' hypothalamic pituitary adrenal axis maybe more responsive in the secretion of cortisol during strenuous exercise hence the greater increase seen.

Keywords: Adrenocortical response, Athletes, Competitive athletics, Nigerians

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INTRODUCTION

Adrenocortical hormones are polycyclic molecules produced by adrenal cortex in the outer region of the adrenal gland, and have a variety of roles that are crucial for the human body's response to stress, and additionally regulates other functions in the body. Stress is any situation that upsets an organism's homeostasis. Stress activates the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system (SNS). The result of HPA activation is an increase of cortisol. The activation of the SNS results in an increase in norepinephrine levels. Both the HPA axis and the SNS are attempts the body makes to return to homeostasis. Cortisol is a steroid hormone, in the glucocorticoid class of hormones, and is produced by the zona fasciculate of the adrenal cortex within the adrenal gland (Hill et al., 2008). Release is in response to stress and low blood glucose. It functions to increase blood sugar through gluconeogenesis, to suppress the immune system, and to aid in the metabolism of fat, protein, and carbohydrate (Hoehn and Marieb, 2010). Its primary role is to mobilize the body's nutritional resources in stressful situations. In short bursts, elevated cortisol is good because it elevates blood sugar levels to improve and to prepare the body for action (Taverniers et al., 2010). The secretion of cortisol is regulated by negative feedback, in which high circulating levels of cortisol itself send signals to the anterior pituitary gland to decrease adrenocortical hormone secretion (Hill et al., 2008). As is expected from other studies in this area, cortisol release from the adrenal gland increases during exercise; exercise acts as a stimulus to the HPA axis, resulting in significant increase in circulating cortisol levels (Hill et al., 2008).

Furthermore, very little is known concerning the physiological significance of the transient increase in cortisol levels during exercise. This lack of information is probably because many of cortisol's effects are delayed compared with the more fast-acting hormones. However, this does not negate its potential significance during exercise. Perhaps contrasting a prolonged bout of exercise under normal and low pre-exercise cortisol levels will provide insights about the metabolic effects of cortisol during exercise in humans and there is paucity of data in this environment.

MATERIALS AND METHODS

Subjects

Twenty (20) apparently healthy young male and female athletes between the ages of 18-25 years were selected by random sampling from athletic students in the University of Benin, Benin City. Their health status was assessed via questionnaires and physical examination. Subjects with any form of cardiovascular disease, metabolic or neurologic disorders were excluded from the study. Subjects used were also not on any form of medication in the last 6 months. Subjects were divided into two groups based on sex. Group A consisted of 10 male athletes and group B consisted of 10 female athletes. Subjects received information about the objectives and procedures of the study and a signed informed consent indicating agreement to participate in the study was obtained.

Procedure

The subjects were told to refrain from any form of exercise before commencement of the procedures. Their blood samples were taken at basal state, after which they were given 15 minutes interval to walk around and prepare for exercise (pre-exercise state). Their blood samples were then taken again just before the exercise. They were then subjected to strenuous exercise for 30 minutes done at their own choice of intensity, and their blood samples were collected again immediately after the exercise (post-exercise). 5mls of blood was collected into plain sample bottles each time blood was collected for the analysis of the hormone, cortisol using cortisol ELISA kits.

Statistical Analysis

All results were presented as means $\pm$ standard error of the mean (SEM). All statistical calculations were carried out using Graph Pad Prism 5.0. Differences between the groups were analyzed using the one-way analysis of variance (ANOVA). A simple linear graph was drawn for possible association in the different groups. Results were considered to be statistically significant at $p < 0.05$.

RESULTS

Ages of the respondents ranged from 18-24 years with a mean age of 22.1 ± 1.1years for males and 20.3 ± 0.3years in females. These and other details are presented in Table 1, showing anthropometric Data of both male and female athletes. N = 10, means ± SEM. A significant difference was observed in weight and height (P<0.001) and no significant difference observed in Age, Blood Pressure and Skin temperature.

The cortisol levels of male athletes in basal state, and pre-exercise was observed to be higher when compared to female athletes but not statistically significant (p> 0.05), while the cortisol levels in female athletes' post-exercise was observed to be significantly (p< 0.05) higher when compared to male athletes (Table 2). Results also show higher cortisol levels at basal states and before exercise in male athletes when compared to female athletes but the differences were not statistically significant (p> 0.05). While post- exercise serum cortisol levels was significantly higher (P< 0.05) in female athletes than their male counterparts. Also, pre-exercise and post exercise cortisol level was significantly higher (p> 0.05) than the basal state in both male and female athletes

Table 1:
Anthropometric Data of both male and female athletes

	Male athletes (n = 10)	Female athletes (n = 10)	P Value	Summary
Age (years)	22.1 ± 1.1	20.3 ± 0.3	p>0.005	ns
Weight (kg)	68.1 ± 2.2	61.6 ± 0.6	p<0.001	***
Height (cm)	167.5 ± 2.0	153.6 ± 1.1	p<0.001	***
Blood pressure (mmHg)	118.3 ± 1.3	121.2 ± 0.7	p>0.005	ns
Skin temperature (^{o}c)	36.7 ± 0.2	36.9 ± 0.3	p>0.005	ns

*** signifies (p< 0.001) ns (not significant)

Table 2:
Serum Cortisol Levels at Basal, Before and After Exercise in Male and Female Athletes

Groups	Cortisol Levels (ng/ml)		
	Basal	**Pre-exercise**	**Post-exercise**
Group 1 (Males)	85.79 ± 6.16	104.52 ±10.214*	^{a}144.06 ±15.142**
Group 2 (Females)	65.92 ±4.96	85.61 ±8.09*	^{b}173.38 ±32.87**

* signifies (p< 0.05) and **(p< 0.01) while a and b signifies difference between male and female post-exercise cortisol levels (p<0.05).

DISCUSSION

This study was designed to find out if there are differences in cortisol level in male and female competitive athletes at basal states, pre-exercise and post-exercise. The cortisol level in the basal state and pre-exercise state was higher in male athletes than female athletes, although it was not significant. Thatcher *et al*. (2004) showed a lack of gender differences in pre-competition cortisol. The cortisol level in male athletes at post-exercise was significantly higher than the basal and pre-exercise state. Also for the female athletes, cortisol level was highest in the post exercise state compared to basal and pre-exercise state. Deuster *et al*. (1989) reported an increase in cortisol level in both fit and unfit individuals when exercising due to exhaustion and that the level of increase was similar in proportion in both fit the unfit subjects. The magnitude of rise in cortisol declined as training continued and as subjects improved their fitness (Voigt *et al.* 1990). Our findings are in agreement with previous studies i.e VanBruggen *et al.* (2011) who reported a higher cortisol concentration after high intensity exercise in aerobically trained males and females. Sperlich *et al.* (2012) also reported a higher cortisol concentration after a qualifying heat in elite male downhill racers. It has been suggested convincingly that exercise activates the hypothalamic-pituitary-adrenal (HPA) axis by demonstrating that exercise induces an increase in plasma immunoreactive β-endorphin/β-lipotropin in normal volunteers (Kelso *et al*., 1984). Adult male volunteers of similar physical fitness and body composition tested under three exercises – thermoregulatory stress conditions, showed a gradual increase in cortisol level before and after exercise (Roberg and Roberts, 1997).

Also, the cortisol level in female athletes at post exercise state was significantly higher than that of male athletes. This maybe as a result of females being more susceptible to psychological stress and stress is a major factor that increases cortisol levels (Obminski, 2008).

In conclusion, cortisol level is increased during exercise and the even higher post exercise increase seen in female athletes may be as result of the differences in their HPA responses and susceptibility to stress.

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