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Original article

Effect of short term exercise on serum cortisol and lipid profile in young male of college of health sciences Nnamdi Azikiwe University, Nnewi Campus

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Abstract

Background: Exercise is one of the activities to achieve fitness and when performed accurately gives maximum beneficial effect to health. It can be in the form of endurance, resistance or concurrent exercise. The side effect of it could arise due to excessive increase in blood cortisol.

Objectives: The objective of this study was to determine the effect of short-term endurance, resistance and concurrent exercise on serum cortisol and lipid profile.

Methods: 48 less physically active males between the ages of 18-25 years were included in this study. Subjects were randomly assigned to various forms of exercise as follows. Endurance (n=16, jogged round a 400metre field for 15minutes), resistance (n=16, jump squat and bench press exercise for 15mintes), concurrent (n=16, jump squat and bench press for 7minutes and jogged for 8minutes). Blood samples were collected before exercise and 3 minutes after exercise. Serum cortisol was analyzed by ELISA method and lipid profile (Cholesterol, Triglycerides, HDL-C, LDL-C) by colorimetric method.

Results: There was no significant difference in serum Cholesterol, Triglycerides, LDL-C after all forms of exercise ($p>0.05$). There was significant difference in HDL-C in endurance and concurrent training, (1.49±0.37 to 1.81±0.58) and (1.45±0.29 to 1.53±0.24) before and after each exercise respectively ($P<0.05$). Cortisol showed a significant increase in endurance and concurrent training, (9.94±4.22 to 11.67±5.37) and (11.70±3.73 to 14.64±6.72) before and after each exercise respectively. ($p <0.05$).

Conclusion: Longer duration of exercise is needed to elicit a significant decrease in total cholesterol, triglyceride and LDL-C levels.

Key words: Exercise, Cortisol, Lipid-profile.

Introduction

Physical activity/exercise is any bodily movement produced by skeletal muscles that require energy expenditure. Physical exercise are bodily activities that maintains physical fitness, overall wellness and general body health, these exercises could be aerobic and anaerobic. It is performed for general muscle strengthening and when done frequently can prevent some diseases e.g. type 2 diabetes, obesity, and cardiovascular disease.[13] World Health Organization (WHO) states that lack of physical activity contributes approximately 17% of heart disease and diabetes. WHO also

identified that physical inactivity is the 4th leading risk factor for global mortality. Regular exercise has significant health benefits. It reduces the risk of cardiovascular disease, diabetes, and help control weight. [2] As much as exercise is good for the body, prolonged high intensity exercise without proper rest at intervals is harmful. Exercise causes significant changes in plasma concentration of biochemical hormones. This study has a special interest in the hormone cortisol.

Cortisol is a 21-carbon steroid hormone synthesized from cholesterol and produced by the zona fasticulata (middle layer) of the adrenal cortex. Adrenocorticotropin hormone stimulates the synthesis of steroid hormones by activating desmolase so that the availability of pregnelone is increased.[20] Approximately 70% is bound to cortisol binding globulin, 20% is bound to albumin and the rest is free. The free cortisol is the biologically active form with a half life of 30-90minutes. Secretion of cortisol is controlled by the hypothalamus and the pituitary gland, parts of the brain that are important in regulating hormones and many other body functions.[3] Physical activity brings the body out of homeostasis temporarily and causes the release of cortisol.[14] Cortisol is released sparing available glucose for the brain, generating new energy from stored reserves, and diverting energy from low-priority activities (such as the immune system) in order to survive immediate threats. Cortisol contributes to hepatic gluconeogenesis, and plays an important role in glycogenolysis.[17] More so, cortisol and steroid hormones contain cholesterol. Cholesterol is a lipid and is an important component of all the steroid hormones including cortisol.

Lipids are insoluble in water but soluble in organic solvents. They function as storage form of energy (triglycerides), vital component of cell membranes and a precursor of all steroid hormones (cholesterol). Lipids are insoluble in plasma and are transported bound to carrier proteins called lipoproteins. They are high density lipoprotein (HDL), low density lipoprotein (LDL), very low density lipoprotein (VLDL).[19] LDL is the main lipoprotein transporting cholesterol from liver to tissues. Increased plasma LDL is associated with atherosclerosis, myocardial infarction. LDL levels are increased in obesity.[1] HDL serves to remove cholesterol from the peripheral cells to the liver, where cholesterol is converted to bile acids and excreted. Some epidemiological studies has demonstrated inverse relationship between HDL levels and the incidence of coronary heart disease. [10]

Moreover, risk of cardiovascular disease is lowered by raising serum HDL levels, lowering TG, lowering LDL. In exercise, HDL levels are increased while the levels of TG, LDL, cholesterol are reduced, subsequently lowering the risk of obesity and cardiovascular accidents.[19] Physical activity is known to be essentially good for human life, but little is known about the effect of short term exercise on these parameters especially in our environment. Hence, the need to investigate the effect of different forms of short term exercises on serum concentrations of Cortisol and Lipid profile.

Methods

Subjects

Fourty eight apparently healthy young men participated in this study having been considered eligible by the inclusion and exclusion criteria, signed the informed consent and filled the questionnaire appropriately.

Exercise Protocol

The study involved three kinds of exercise the endurance training (low-intensity jogging), resistance training (jump squat and bench press), concurrent training (a combination of both endurance and resistance training).

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Subjects were grouped into three(3) groups of sixteen(16) each.

Group 1 was made up of 16 subjects who performed the endurance training which consisted jogging round a 400metre field for 15minutes.

Group 2 was made up of 16 subjects who performed the resistance training which consisted performing a jump squat and bench press for 15minutes.

Group 3 was made up of 16 subjects who performed the concurrent training which consisted performing a jump squat and bench press for about 7minutes and a low-intensity jogging for about 8minutes.

The subjects arrived at the study/training area at about 6:30am on a Saturday morning after an overnight fast. Subjects were randomly put into groups. The exercise was monitored by a physiotherapist.

Specimen Collection

Body weights of subjects were measured using a weighing balance and height using a standiometre. Subjects were seated for about 10-15 minutes after which Five milliliter (5ml) of whole blood was collected from the subjects using the standard venepuncture technique into properly labeled plain container. This was the basal sample and served as the control specimen. Subjects were then subjected to exercise according to their groups. After the exercise, the subjects were seated and a second blood sample was collected within 3minutes post exercise. This served as the test sample. The blood samples were allowed to clot and Serum was collected after centrifugation at 4000rpm for 10minutes. Serum was stored at -20°C and assayed for the estimation of serum cortisol and serum lipid profile within three weeks post collection.

Results

Endurance exercise

Table 1 shows that there was significant increase in the mean serum level of HDL, Cortisol after endurance exercise ($p<0.05$) compared to before exercise, while there was no significant difference in Cholesterol, Triglyceride and LDL ($p>0.05$).

Resistance exercise

There was no significant ($p>0.05$) difference in the mean serum level of Cholesterol, Triglyceride, HDL, LDL, Cortisol before and after resistance exercise as seen in Table 2.

Concurrent exercise

Table 3 shows that there was significant increase in the mean serum level of HDL, Cortisol after concurrent exercise ($p<0.05$) compared to before exercise, while there was no significant difference in Cholesterol, Triglyceride and LDL ($p>0.05$).

Discussion

Different forms of exercise cause significant changes in the chemical constitution of the plasma. Such changes can affect cortisol and lipid profile levels too. Cortisol levels is linearly related to the intensity and duration of exercise.[18,7] This showed that the mean cortisol levels of the different forms of exercise had a significant increase in the levels of the hormone in the blood after endurance and concurrent training while there was no significant difference in the cortisol levels of resistance training exercise. This findings agrees with the study of[15] in which an increase in cortisol levels was observed in horses after a 1000km race, and[11] which indicated an increase in salivary cortisol levels after a

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run of a 1000m path, [22,5] in which there was no significant difference in pre and post cortisol concentration in resistance exercise. On the contrary,[9] observed no significant difference in cortisol response after concurrent training. However, in his work aerobic exercise was performed before resistance exercise. The significant increase seen in cortisol levels after the aerobic and concurrent training could be attributed to the body's mechanism in combating stress by an increase in cortisol secretion through the activation of the hypothalamic-pituitary axis.[3] The no significant difference observed after resistance exercise can be attributed to the training protocol of low intensity and short duration used which was not able to generate the necessary stress to increase plasma cortisol secretion. Low intensity exercise does not result in significant increase in cortisol levels but actually results in a reduction in cortisol level.[8]From the present study there was no significant difference in total cholesterol, triglycerides and LDL-C levels after exercise, which is in contrast to the works of[16,23,6] which showed a significant decrease in total cholesterol, triglyceride and LDL-C levels after exercise programs of 8-l2weeks. HDL-C had a significant increase after endurance and concurrent exercise, this is similar to the findings of[4,12] which registered an increase in HDL-C levels after exercise. The increase after resistance exercise which was not significant contrary to the work of[21] which registered an increase in HDL-C levels after a 6weeks exercise program suggests longer duration resistance exercise is needed to elicit an increase in serum HDL-C levels, total cholesterol, triglyceride and LDL-C levels. It was also observed from the present study that there was no significant correlation between cortisol and lipid profile levels.

Conclusion

Short term endurance and concurrent training had significant increases in HDL-C and cortisol levels. On the contrary, short term resistance training did not show difference in serum HDL-C and cortisol levels while serum total cholesterol, triglycerides and LDL-C levels were also not affected in short term endurance, resistance and concurrent exercise. Hence, it was observed in this study that short duration endurance and concurrent exercise increase HDL C and cortisol levels.

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