MedCrave
Step into the World of Research

MOJ Proteomics & Bioinformatics

Research Article

Open Access

CrossMark

Continuous and interval training exercise programme: its relationship with biochemical parameters among some Nigerian undergraduates

Abstract

The importance of exercise and fitness in the management of diabetes has dominated the scientific research space in recentyears. This present study therefore emphasizes the advances and facts relating metabolic stress hormones, diabetes and exercise. Twenty apparently healthy Nigerian students whose mean age was 23.67±2.78years, mean heights 1.77±0.84m and average body weight 66.26±7.53kg participated in the study with internal training exercise programme for six weeks and continuous for the last two weeks. The testosterone, cortisol and Gamma Glutamyltransferase (GGT) levels were increased while the insulin level decreased although only cortisol and testosterone mean differences were significant after the exercise. From the result, it can be concluded that continuous and internal training exercise programmes are effective in managing stress-induced pathological (degenerative) diseases. Exercise is therefore recommended as a non-pharmacological adjunct in managing some metabolic syndrome such as non-insulin dependent diabetes and obesity among Nigerian students who are to an extent prone to stress.

Keywords: physical activity, insulin, cortisol, non-insulin dependent diabetes, obesity

Volume 4 Issue 6 - 2016

Uadia PO,[1] Ifie JE[1]

[1]Department of Biochemistry, University of Benin, Nigeria
[2]Department of Biochemistry, Kampala International University, Tanzania

Correspondence: Ifie JE, Department of Biochemistry, Kampala International University, Tanzania, Tel +2347064970409, Email esejossy@yahoo.com

Received: November 26, 2016 | **Published:** December 20, 2016

Introduction

There are several studies in the research space trying to reveal the relationship between exercise, age and their various metabolic modifications in blood profiles.[1] These facts on relationship among blood parameters and their variations are usually in relation to the stress level and relatively the type of exercise done by the individuals.[2] It was reported by Hussamettin & Evrim[3] that there is improved physiological and physical features of an organism during exercise training programmes performed for three weeks. The variations in physiological changes that result from exercise depend on the intensity and durations of the exercise training performance.[4] Students have been observed to be highly susceptible to stress and its relative pathological conditions due to the kind of foods they eat and the environment.[5] It has also been documented that the risk of type 2 diabetes is possibly due to increase in BMI and promoted by obesity especially resulting from sedentary lifestyles.[6] Diabetes is a heterogeneous group of syndrome characterized by the elevation of fasting blood glucose which can be as a result of relative or absolute deficiency of insulin as seen in type 1 or insulin resistance (insensitivity) as seen in type 2.[7]

Physical exercise is any bodily activity that enhances or maintains physical fitness and overall health and well-being.[8,9] This has been shown to be performed for various reasons including but not limited to increasing growth and development as well as for the prevention of ageing, strengthening of muscles and achieving positive effects on body metabolism.[10] Exercise can be interval training or continuous training with the interval training involving a combination of rounds of jogging and then resting maybe by way of walking within a timed interval.[11] The essence of which is to allow the body to have a maximum recovery periods which are specified in terms of duration, distance or both.[12] The continuous training exercise programme involves a low to moderate exercise intensity without resting intervals or recovery periods.[13] It is essentially used to prepare the body for sustained workouts and improve overall fitness and endurance.[14]

Cortisol is a hormone that have documented for its ability to help the human body respond to stress through its role in intermediary metabolism such as the stimulation of gluconeogenesis, lipid oxidation and protein metabolism in order to make fuel in the form of energy available to relieve the stress.[15] Testosterone has also been implicated in growth of muscle mass and strength notwithstanding its importance in the development of positive bone density.[16] The importance of insulin in the modification of the activities of various enzymes implicative of the carbohydrate, protein and lipid metabolism cannot be overemphasized.[17] Nevertheless, the insensitivity of cells to its presence is pathological[18] and has been shown to be positively correlated with increased accumulation of body fats and obesity.[6] Similarly, the type of lifestyle (active or sedentary) mediates the fitness and wellbeing of that individual.[19] Sedentary lifestyles tend to increase the likelihood of the development of insulin resistance due to weight gain whereas, physical activities tends to reduce this possibility.[19] Though various effects of some sort of physical activities on some hormones and glucose regulations have documented, there remains a gap and this study therefore sought to investigate the interdependence and correlation between certain stress hormones, blood glucose regulation and a feedback from exercise.

Materials and methods

Subject

Twenty apparently healthy Nigerian students whose mean age was 23.67±2.78years, mean heights 1.77±0.84m and average body weight 66.26±7.53kg from the Department of Biochemistry University of

Benin, Nigeria participated in the study. Subjects were randomly selected and consented to participating in the exercise programme. Subjects who were known to be actively involved in any known structural regular exercise protocols or training programmes were excluded.

Exercise protocol

These training programmes were performed in the early hours (5:30am-7:00am) of the day for 3days in a week. The subjects were made to perform muscle flexibility exercise as a build up to the track field jogging with recovery periods (interval exercise programme) during the first six weeks and continuous exercise programme for the next two weeks.

Biochemical analysis

Blood was collected from each consenting student the first day before the commencement of the exercise programme (control) and at the end of the programme (subjects) at the Biochemistry laboratory Department, University of Benin Teaching Hospital. Blood samples were centrifuged at 1200Xg for 5mins at room temperature (29-31°C) and the supernatants were stored frozen for biochemical analysis. The methodology described by HO et al.,[20] was used to determine the blood level of cortisol using ELISA (EIA-1887). The insulin concentration was determined using the method described by Reaven.[21] Gamma GlutamylTransferase was assayed using method described by Cabrera-Abreu & Green.[22] Testosterone assay was carried out in a solid phase by enzyme linked immunosorbent assay (ELISA) as described by Eric et al.[23]

Statistical analysis

Paired students T-test and Pearson's coefficient of correlation were used to analyze the data obtained with the levels of significance set at α=0.05(P=5%).

Result

Results obtained for this study are presented in Tables 1 & 2.

Table 1 Shows the effect of exercise on biochemical parameter. Values are expressed as mean±$\overline{SD}$ for "n" subjects.

Biochemical parameters	Pre-exercise (Control) n=20	Post-exercise (Test) n=20
Cortisol (nmol/l)	365.17±198.72	371.80±184.16*
Testosterone(mg/ml)	4.06±1.97	4.20±2.08*
Insulin (u/ml)	5.88±2.58†	3.40±2.20
GGT(u/l)	36.92±16.35	56.30±4.11

*Significantly different when compared to control subjects

†Mean higher values when compared to test subjects.

All mean values were higher in post-exercise subjects with the exception of insulin (insulin: 5.88±2.58 and 3.40±2.20 for control and test respectively) with Cortisol and testosterone statistically significant (Cortisol: t_{cal}=2.546, testosterone: t_{cal}=2.735, insulin: t_{cal}=1.240, GGT: t_{cal}=1.657 and $t_{crit(0.05,2,20)}$=2.021).

Table 2 Correlation of Cortisol and insulin concentration of subjects before and after exercise programme

Hormones	Pre-exercise control n=20	Post exercise test n=20
Insulin(u/ml)	5.88±2.58†	3.40±2.20
Cortisol(nmol/l)	365.17±198.72	371.80±184.16
r-values	-0.15	-0.8662
p-values	p≥0.05	P<0.05

Values are expressed as mean±SD for "n" subjects.

*Statistical significant correlation when compared to Cortisol in post exercise subjects. †Mean higher values when compared to test subjects.

Insulin and Cortisol showed a negative correlation when compared pre-exercise and post exercise although only post-exercise showed a statistical significance (pre-exercise: r_{cal}=-0.015, $r_{crit(0.05,2,20)}$=0.362 and post-exercise: r_{cal}= -0.8662, $r_{crit(0.05,2,20)}$=0.362).

Discussion

Result of this study showed that significant difference was observed in testosterone and Cortisol levels ($p \leq 0.05$) in test group when compared to control while only insulin showed a mean higher value for control (pre-exercise) groups compared to the post exercise groups (Table 1). A negative correlation was also observed between cortisol and insulin levels among post-exercising samples (Table 2) and this result aligns with report by Mohammed et al.,[24] and Hakonsen et al.[25] The effects of exercise and various training programmes on various neuro-endocrine secretion as well as glucose regulation at different times of the day have been investigated and documented.[26] Cortisol level increases as exercise workload increases and exercise induce decrease in plasma glucose at about 50% while cortisol levels were minimal. The insulin insensitivity was observed to decrease after rigorous exercise which is in concordance with the report given by Henriksson[27] and Tamura et al.[19]

The result of this study may not be unconnected to the stimulation of certain stressor hormones during aerobic exercise. During this period of exercise, the fast moving muscles demand for more oxygen which acts as the final electron acceptor in the oxidative phosphorylation pathway occurring in the mitochondria, more glucose is required for breakdown to supply the extra ATP needed by the fast moving muscles. The exercise generates a stress signal transmitted to the brain to stimulate certain neuro-endocrines known as "stress hormones" which are capable of helping the body during the period of stress.[17] This explains the increase in Cortisol and testosterone level in the post exercise subjects plasma samples as these hormones function in response to stress ,acting to increase blood glucose level

for oxidation by the rapidly metabolizing fast moving muscles. When the continuous training sets in, the exercise becomes more vigorous and so the oxidation tends to be anaerobic as the NADH (electron acceptor in oxidative phosphorylation) gets depleted, the TCA cycle is slowed down. To regenerate NADH, NAD+ is used up in anaerobic pathway(lactic acid),and in this case glycogen store gets depleted and glucose level in the blood is expected to drop by ten-fold due to the shift as observed by Louis Pasteur. The drop in the blood glucose level causes the B-cells of the islet of Langerhans to be desensitized and there will be a corresponding drop in the insulin production.[28] This explains the decrease in plasma insulin level after the 6-week training programme and the negative correlation between Cortisol hormone and insulin after the training period. The increase in Cortisol level is to regulate the protein synthesis[29] of certain enzymes (such as hormone sensitive lipase) which are actively involved in the breakdown of adipose fat, protein and lipids to yield amino acids and fatty acids that are oxidized for energy.[15,30] GGT is synthesized in response to stress and the increased plasma level of GGT is based on the stimulating effect of Cortisol on its synthesis to regulate the stress effect.[31–33] Since secretion of Cortisol and other hormones such as epinephrine and glucagon exerts an opposing effect to insulin, a negative correlation is therefore expected and this was observed after the exercise (Table 2).

Conclusion

The present study though involves subjects that were apparently healthy with regards to BMI and body weight, the post-exercise measurements signify the importance of exercise even among individuals who are apparently healthy. Thus, reducing their risk of degenerative diseases whose promoter is basically free radicals. It can therefore be concluded that continuous and interval training exercise programmes are effective non- pharmacological appendage in the management and risk reduction of metabolic disorders such as obesity and non-insulin dependent diabetes mellitus among Nigerian students.

Acknowledgements

Biochemistry Laboratory Department, University of Benin Teaching Hospital, Benin city, Nigeria. All students who participated in this study.

Conflict of interest

The author declares no conflict of interest.

References

1. Bobeuf F, Labonté M, Khalil A, et al. Effects of resistance training on haematological blood markers in older men and women: A pilot study. *Curr Gerontol Geriatr Res*. 2009:156820.
2. Wardyn GG, Rennard SI, Brusnahan SK, et al. Effects of exercise on haematological parameters, circulating side population cells and cytokines. *Exp Hematol*. 2008;36(2):216–223.
3. Hussamettin N, Evrim C. The effects of 8 weeks aerobic exercises in the blood lipid and body composition of the overweight and obese females. *Physical education and Sport science movement and Health*. 2010;2(2):314–320.
4. Natale VM, Brenner IK, Moldoveanu AI, et al. Effects of three different types of exercise on blood leukocyte count during and following exercise. *Sao Paulo Med J*. 2003;121(1):9–14.
5. Ifie E J, Onyesom I, Oweh OT, et al. Correlation between body mass index and blood glucose levels among Nigerian undergraduates. *Hoaj Biology*. 2013;2(1):1–4.
6. Barbara BK and Jeffrey SF. Obesity and insulin resistance. *J Clin Invest*. 2000;106(4):473–481.
7. Kitabchi AE, Umpierrez GE, Miles JM, et al. Hyperglycemic crises in adult patients with diabetes. *Diabetes Care*. 2009;32(7):1335–1343.
8. Wilmore J and Knuttgen H. Aerobic exercise and endurance: improving fitness for health benefits. *Phys Sportsmed*. 2003;31(5):45–51.
9. El–Sayed MS1, Sale C, Jones PG, et al. Blood haemostasis in exercise and training. *Med Sci Sports Exerc*. 2000;32(5):918–925.
10. Stampfer MJ, Frank BH, JoAnn EM, et al. Primary prevention of Coronary Heart Disease in women through diet and lifestyle. *N Engl J Med*. 2000;343(1):16–22.
11. Gibala MJ, Gillen JB, Percival ME. Physiological and health–related adaptions to low–volume interval training: influences of nutrition and sex. *Sports Med*. 2014;44(2):127–137.
12. De Vos N, Singh N, Ross D, et al. Optimal Load for Increasing Muscle Power During Explosive Resistance Training in Older Adults. *J Gerontol A Biol Sci Med Sci*. 2005;60A (5):638–647.
13. Hensen D, Dendale P, Jonkers RAM, et al. Continuous low to moderate intensity exercise training is as effective as moderate to high intensityexercise training at lowering blood Hbac1c in obese type 2 diabetes patients. *Diabetologia*. 2000;52(9):1789–1797.
14. Dincer S, Altan M, Terzioglu D, et al. Effects of a regular exercise program on biochemical parameters of type 2 diabetes mellitus patients. *J Sports Med Phys Fitness*. 2015;56(11):1384–1391.
15. Djurhuus CB, Gravholt CH, Nielsen S, et al. Effects of cortisol on lipolysis and regional interstitial glycerol levels in humans. *Am J Physiol Endocrinol Metab*. 2002;283(1):E172–E177.
16. Tuck SP, Francis RM. Testosterone, bone and osteoporosis. *Front Horm Res*. 2009;37:123–132.
17. Nelson DL, Cox MM. *Lehninger Principle of Biochemistry*. 5th ed. USA: W.H. Freeman and Company; 2008. p. 902–904.
18. Milner KL, Van Der Poorten D, Trenell M, et al. Chronic hepatitis C is associated with peripheral rather than hepatic insulin resistance. *Gastroenterology*. 2010;138(3):932.e3–941.e3.
19. Tamura Y, Tanaka Y, Sato F, et al. Effects of diet and exercise on muscle and liver intracellular lipid contents and insulin sensitivity in type 2 diabetic patients. *J Clin Endocrinol Metab*. 2005;90(6):3191–3196.
20. Ho JT, Al–Musalhi H, Chapman MJ, et al. Septic shock and sepsis: a comparison of total and free plasma cortisol levels. *J Clin Endocrinol Metab*. 2006;91(1):105–114.
21. Reaven G. Wanted! a standardized measurement of plasma insulin concentration. *Artrioscler Thromb Vasc Biol*. 2011;31(5):954–955.
22. Cabrera–Abreu JC, Green A. Gamma glutamyltransferase: value of its measurement in paediatrics. *Ann Clin Biochem*. 2002;39(1):22–25.
23. Eric LD, Yiqing S, Vasanti SM, et al. Sex differences of endogenous sex hormones and risk of types 2 diabetes: A systematic review and Meta–analysis. *J Ame Med Asso*. 2006;295(11):1288–1299.
24. Mendes FA, Gonçalves RC, Nunes MP, et al. Effects of aerobic training on clinical symptoms and biochemical parameters in women with polycystic ovarian syndrome. *Int J Adv Sci Res Rev*. 2011;1(4):1–5.
25. Hankosen LB, Thulstrup AM, Aggerholm AS, et al. Does weight loss improve semen and reproductive hormones? Results from a cohort of severely obese men. *Reprod Health*. 2011;8:24.
26. Lovallo WR, Farag NH, Vincent AS, et al. Cortisol responses to mental stress, exercise and meals following caffeine intake in men and women. *Pharmacol Biochem Behav*. 2006;83(3):441–447.
27. Henriksson J. Influence of exercise on insulin sensitivity. *J Cardiovasc Risk*. 1995;2:303–309.

28. Edgerton DS, Ramnanan CJ, Grueter CA, et al. Effects of Insulin on the Metabolic Control of Hepatic Gluconeogenesis *In Vivo*. *Diabetes*. 2009;58(12):2766–2775.

29. Danilla IC, Emerson S, Renata VP, et al. Influence of chronic exercise on serum cortisol levels in older adults. *Eur Rev Aging and Physical Activity*. 2013;11:126–128.

30. Hill EE, Zack E, Battaglini C, et al. Exercise and circulating cortisol levels: the intensity threshold effect. *J Endocrinol Invest*. 2008;31(7):587–591.

31. Ascaso JF, Pardo S, Real JT, et al. Diagnosing insulin resistance by simple quantitative methods in subjects with normal glucose metabolism. *Diabetes Care*. 2003;26(12):3320–3325.

32. Ivy JL. Role of exercise training in the prevention and treatment of insulin resistance and non–insulin–dependent diabetes mellitus. *Sports Med*. 1997;24(5):321–336.

33. Mayer–Davis EJ, d'Agostino R, Karter AJ, et al. Intensity and amount of physical activity in relation to insulin sensitivity. *JAMA*. 1998;279(9):669–674.

Citation: Uadia PO, Ifie JE. Continuous and interval training exercise programme: its relationship with biochemical parameters among some Nigerian undergraduates. *MOJ Proteomics Bioinform.* 2016;4(6):325–328. DOI: 10.15406/mojpb.2016.04.00138