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Original Research Article

Effect of physical and flexibility exercise on certain hormones and fasting blood sugar of some young Nigerian adults

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Abstract

Purpose: *To investigate the effect of six (6) weeks physical and flexibility exercise on fasting blood sugar and some hormones in selected young adult Nigerian students.*
Methods: *A total of 16 subjects (ten males and six females) participated in the study which involved physical and flexibility exercise. Assays for hormones, including follicle stimulating hormone (FSH), luteinizing hormone (LH), prolactin, progesterone, estradiol, testosterone and insulin in the subjects were carried out. Homeostatic model assessment-insulin resistance (HOMA-IR), as well as fasting blood sugar (FBS) were determined in the pre- and post-exercise blood plasma of each participant.*
Results: *There was a non-significant ($p > 0.05$) decrease in the post-exercise plasma levels of prolactin, estradiol, insulin, and HOMA-IR, while testosterone levels increased non-significantly ($p > 0.05$) in both sexes. Progesterone levels increased in male participants and decreased in female participants post-exercise, although both changes were insignificant ($p > 0.05$). The reverse was noticed for plasma FSH which decreased in male and increased in female participants post-exercise; also, both changes were insignificant ($p > 0.05$). The plasma levels of LH decreased significantly ($p < 0.05$) in males and insignificantly in females ($p > 0.05$). However, FBS showed significant ($p < 0.05$) post-exercise increase in males, but the increase was non-significant ($p > 0.05$) in female participants.*
Conclusion: *Physical and flexibility exercise programme alters the physiological levels of hormones and fasting blood sugar in some apparently healthy young Nigerian adult students who are not regular exercisers.*

Keywords: *Physical exercise, Hormones, Fasting blood sugar, Homeostatic model assessment-insulin resistance*

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INTRODUCTION

Exercise has profound effects on the function of a number of glands and their corresponding impact on a number of systems through the release of specific hormones [1]. The effects of exercise on these hormones tend to result in either an increase or a decrease in their blood concentrations. Other factors such as type of exercise, intensity of exercise, lifestyle, diet, etc., tend to influence the direct impact of exercise on hormones and other biomolecules including fasting blood sugar [2].

The effect of these hormones may persist after physical activity. Exercise that modulates hormonal effects will burn more calories during activity and provide greater caloric benefit thereon [3]. By so doing, the body uses up fat through hormonal activity and the resulting excess *post-exercise oxygen consumption* (EPOC). This finely orchestrated hormonal response creates the perfect scenario for fat burning and muscle building and ensures survival by generating a leaner, faster, and stronger body. Glucose in the blood stream is maintained in a seeming equilibrium between its rate of clearance and appearance. Exercise of moderate intensity and duration in healthy individuals favours this equilibrium [4], however, the reverse is the case during intense and prolonged exercise were the rate of clearance exceeds the rate of appearance. Thus, the equilibrium is distorted, glucose level is depleted and fatigue sets in. The availability of blood glucose is determined by breakdown of hepatic glycogen store and from digestion processes in the gut [5].

The gains of exercising are profound. Studies have shown that regular aerobic exercise can mitigate against cardiovascular diseases and diabetes mellitus, burn up excess calories which leads to weight loss, enhance immune and bone function [6,7]. Psychologically, there is a positive relationship between mental alertness and physical fitness [8]. There is an established link between cardiovascular health, longevity and regular exercise. In fact, there exist an inverse relationship between regular exercise and coronary heart disease. Also, the functioning of the heart during exercise is boosted with regular exercise. [9]. A short-term exercise regimen can be helpful in reducing waist circumference, body mass index (BMI), blood pressure, low density lipoprotein cholesterol (LDL-C), hence, improving physical fitness [10,11]. Therefore, this study evaluates the effect of physical and flexibility exercise on some hormones and fasting blood sugar in apparently healthy young Nigerian adults.

METHODS

Subjects

Sixteen (16) apparently healthy Nigerian students (aged 20 – 31 years) from the University of Benin, Benin City, Nigeria, who do not exercise regularly and were willing to undergo the exercise regime participated in this study. Ten (10) of the subjects were males and six (6) were females. All participants were asked to abstain from the intake of pain relieving medications while the exercise lasted. Informed consent was obtained from all patients. This study was approved by the Ethics Committee of Ministry of Health, Benin City, Nigeria (approval ref. no. HMI 1208/149) and followed the guidelines of Helsinki Declaration [12].

Exercise programme

The subjects were made to participate in both physical and flexibility exercise programs, which were done during the early hours of the day (5.30 – 6.30 am), four (4) days a week for a period of six (6) weeks at the University of Benin Sports Complex. A total of 56,500 m was covered by each participant during the exercise period. The program started every day of exercise with jogging over varied distances, interrupted intermittently with bouts of rest (by walking specified distances), and then calisthenics (which include press-ups, neck, wrist and waist rotation, imaginary cycling, etc) after jogging.

Blood collection and sample analysis

Pre- and post-exercise blood samples (12 ml in total for both sessions) were drawn by a qualified medical practitioner from an arm vein (after a twelve-hour overnight fast), while keeping the subject in a sitting position throughout the procedure. Heparinized tubes were used to collect the samples, which were then centrifuged at 3000 rpm for 15 min and the supernatant recovered were used for all assays. Plasma concentrations of the following; luteinizing hormone, follicle stimulating hormone, prolactin, progesterone, estradiol, testosterone, insulin and fasting blood sugar from each sample were analyzed. Hormone concentrations were determined using the Selectra ProS auto analyzer (Elitech Group, France) and reagent kits were procured from Elitech Clinical Systems (Elitech Group, France). Fasting blood sugar was determined using standard glucose oxidase method as described by Randox reagent kit, (Randox, UK).

Statistical analysis

All statistical analyses were carried out using SPSS (version 22). Descriptive statistics were used to determine the mean, standard error of mean for each of the parameters tested. Student paired *t* test was used to determine differences between the pre-exercise and post-exercise values. All data were expressed as mean ± SEM and significance level was set at $p < 0.05$.

RESULTS

Results of the effect of six (6) weeks physical and flexibility exercise on plasma levels of hormones and fasting blood sugar of male and female participants are shown in the Figures. LH and FBS showed significant ($p < 0.05$) decrease and increase respectively post-exercise (Figure 1 and Figure 3). FSH, prolactin, estradiol, insulin and HOMA-IR decreased non-significantly ($p > 0.05$), while progesterone and testosterone increased non- significantly ($p > 0.05$) post-exercise. On the other hand, FSH, LH, testosterone and FBS increased non-significantly ($p > 0.05$), while prolactin, progesterone, estradiol, insulin and HOMA-IR decreased non-significantly ($p > 0.05$) post-exercise. All the changes were, however, within the normal physiological range (Figure 2 and Figure 4).

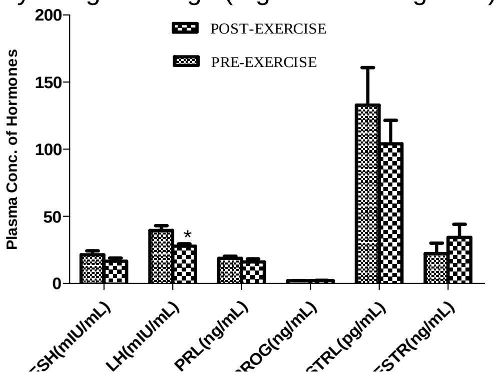

Figure 1: Effect of six (6) weeks physical and flexibility exercise on plasma levels of some hormones in male participants. Data represent mean ± SEM, (n = 10); n = number of male participants. * Significant difference relative to the pre- exercise group at $p < 0.05$. FSH = Follicle Stimulating Hormone (normal range = 2.0 – 10.0 mIU/mL), LH = Luteinizing Hormone (normal range = 3.0 – 12.0 mIU/mL), PRL = Prolactin (normal range = 2.0 – 25.0 ng/mL), PROG = Progesterone (normal range = 0.2 – 1.4 ng/mL), ESTRL = Estradiol (normal range = 10.0 – 36.0 pg/mL), TESTR = Testosterone (normal range = 2.0 – 6.9 ng/mL).

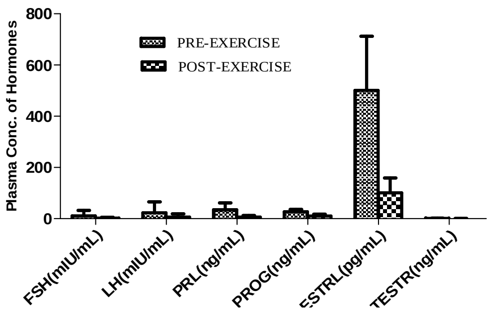

Figure 2: Effect of six weeks physical and flexibility exercise on the plasma levels of some hormones in female participants. Data represent mean ± SEM (n = 6); n = number of female participants. * Significant difference relative to the pre- exercise group at $p < 0.05$. FSH = Follicle Stimulating Hormone (normal range = 2.0 – 10.0 mIU/mL), LH = Luteinizing Hormone (normal range = ≤ 20.0 mIU/mL), PRL = Prolactin (normal range = 2.0 – 25.0 ng/mL), PROG = Progesterone -F/P = Follicular phase (normal range = 0.2 - 1.4 ng/mL); L/P = Luteal phase (normal range = 4.0 – 25 ng/mL), ESTRL = Estradiol (normal range = 13.0 – 191.0 pg/mL), TESTR = Testosterone (normal range = 0.26 – 1.22 ng/mL)

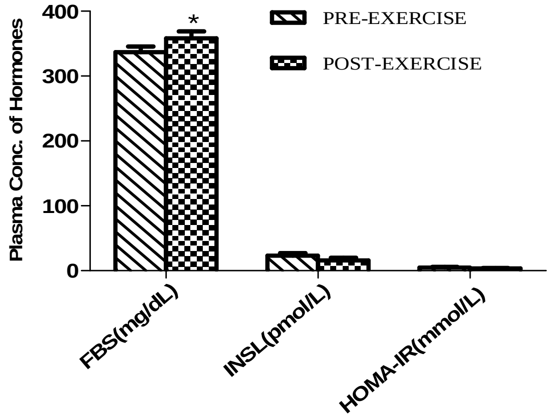

Figure 3: Effect of six (6) weeks physical and flexibility exercise on plasma levels of fasting blood sugar, insulin and HOMA-IR in male participants. Data represent mean ± SEM, (n = 10); n = number of male participants. * Significant difference relative to the pre-exercise group at $p < 0.05$. FBS = Fasting Blood Sugar (normal range = 60.0 – 110.0 mg/dL), INSL = Insulin (normal range = 2.0 – 25.0 pmol/L), HOMA-IR = Homeostatic model assessment-Insulin Resistance (normal range = ≤ 2.60 mmol/L)

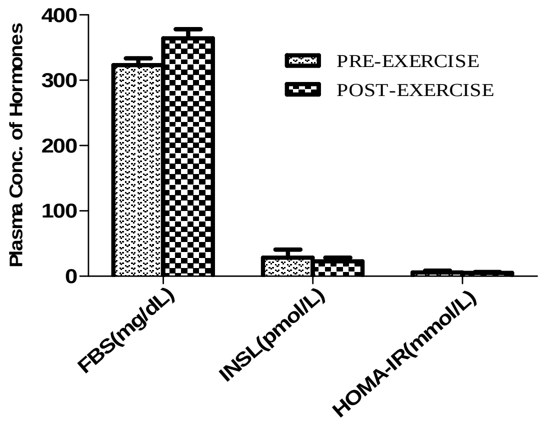

Figure 4: Effect of six weeks physical and flexibility exercise on the plasma levels of fasting blood sugar, insulin and HOMA-IR in female participants. Data represent mean ± SEM (n = 6); n = number of female participants. * Significant difference relative to the pre-exercise group at $p < 0.05$. FBS = Fasting Blood Sugar (normal range = 60.0 – 110.0 mg/dL), INSL = Insulin (normal range = 2.0 – 25.0 pmol/L), HOMA-IR = Homeostatic model assessment-Insulin Resistance (normal range = ≤ 2.60 mmol/L)

DISCUSSION

Luteinizing hormone (LH) and follicle stimulating hormone (FSH) are both gonadotrophic hormones released by the hypothalamus of the brain and responsible for controlling gonadal function in both sexes. In this study, the effects of exercise on plasma levels of LH and FSH post-exercise for both sexes witnessed an inverse trend as seen in Figures 1 and 2. While there was no significant change in the levels of both hormones in female participants, the decrease in male participants was significant for LH and insignificant for FSH. The result obtained for males can be explained by the inhibitory interactions between the hypothalamic-pituitary-adrenal axis (HPA-axis) and the hypothalamic-pituitary-gonadal (reproductive) axis (HPG-axis).

Activation of the stress system (in this case by exercise) may lead to the inhibition of the reproductive axis through direct or indirect inhibition of the gonadotropin-releasing hormone (GnRH) by corticotropin-releasing hormone (CRH), beta endorphin, and glucocorticoids. Thus, inhibiting the secretion of LH and FSH as well as the hormonal secretion of the gonads and rendering target tissues of sex steroids resistant to these hormones [1]. Previous studies have shown that endocrine profile of female athletes involved in sports which emphasize strength over leanness, such as swimming, running, etc., is characterized by mildly elevated LH levels, elevated LH/FSH ratios and mild hyper-androgenism [13,14].

The effect of exercise on plasma levels of testosterone in this study reveals an increase though insignificantly in both sexes. At the moment, the effects of exercise on testosterone levels remain controversial. Some studies [14,15] have reported a marked increase in testosterone levels after moderate-intense exercise lasting 45 to 90 min, while others reported unchanged or mildly decreased levels after exercise at similar level and duration [16-18]. The duration and intensity of the exercise program appears to play a critical role.

Estradiol and prolactin, decreased non-significantly post exercise in both sexes. The decrease in estradiol and prolactin in male participants may be due to a direct consequence of the decline in FSH as seen from Figure 1, apparently due to the suppression (by stress, e.g., exercise) of the hypothalamic-pituitary-gonadal (reproductive) axis (HPG-axis). It has been shown by [14] that the hormonal profile of women engaged in sports which emphasize low weight like gymnastics, ballet, running and skating, is characterized by hypoestrogenism due to disruption of the hypothalamic–pituitary–ovarian axis. Specifically, suppression of hypothalamic pulsatile release of GnRH, limits ovarian stimulation and estradiol production.

According to Dale [19], exercise alters follicular dynamics and hormone concentration. However, progesterone and LH had an inverse relationship in both sexes. In male participants, progesterone increased with a decrease in LH, while the reverse was the case for female participants where progesterone decreased with an increased LH levels, although, all the changes were insignificant. This could also be attributable to a possible feedback inhibition by progesterone on the anterior pituitary gland leading to varied secretion of luteinizing hormone. Since the release of luteinizing hormone is closely regulated by the hypothalamic - pituitary - gonadal axis, increased levels of luteinizing hormone in the bloodstream is suggestive of decreased progesterone secretion from the gonad. This observation agrees with the study carried out by William [20] which revealed boosted levels of progesterone by moderate amount of exercise rather than excessive exercise.

A similar trend in fasting blood sugar (FBS) and insulin was noticed in both sexes which showed a non-significant decrease in insulin and an increase in FBS. However, while the increase in FBS for male participants was significant that for the females was insignificant. The increased fasting blood glucose as a function of exercise may be due to increased demand for fuel, and the reduction in insulin levels, could be an indication of increased efficiency of insulin function.

Homeostatic model assessment (HOMA) is an index for measuring insulin resistance (IR) from basal (fasting) glucose and levels of insulin. Insulin resistance is characteristic of type II diabetes mellitus patients and exercise has been implicated in the reduction of insulin resistance in such patients. This study is in agreement with this fact as results obtained revealed a reduction post-exercise in HOMA-IR levels in both sexes, though these changes were insignificant, apparently due to the short time frame of the exercise program. This is in agreement with the earlier finding by Rachael [21] that regular exercise lowers insulin resistance.

Limitation of the study

In this study, the sample size of participants was small; thus, it may not be accurate to extrapolate the findings to a larger population.

CONCLUSION

The findings of this study indicate that a six-week physical and flexibility exercise regimen is capable of altering plasma levels of some hormones and fasting blood sugar in both males and females, thus indicating a potential beneficial effect to health if well-designed and tailored towards meeting the needs of the individual.

DECLARATIONS

Acknowledgment

The authors are grateful to all the participants for their voluntary involvement in this study.

Conflict of Interest

No conflict of interest associated with this work.

Contribution of Authors

The authors declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by them.

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