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ORIGINAL ARTICLE

Effects of Moderate and Vigorous Physical Exercises on Serum Liver Function Tests of Healthy Male Individuals in Anambra State

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ABSTRACT

Objectives: The objective of this study was to determine and compare results of the effect of moderate and vigorous exercises on AST, Alanine Aminotransferase (ALT), Alkaline Phosphatase (ALP), Gamma Glutamyl Transferase (GGT), Total Bilirubin (TBIL) and Direct Bilirubin (DBIL) before exercise, two weeks after exercise and four weeks after exercise.

Methodology: Serum concentration/activity of AST, ALT, ALP, GGT, TBIL and DBIL of both vigorous exercise group (50 male individuals who played football for 2 hours daily for 5 days/week) and moderate exercise group (50 male individuals who played football for 30 minutes daily for 3 days/week) were determined using enzymatic spectrophotometric method. All data were expressed as Mean ± Standard Deviation (SD) and analyzed with Analysis of Variance (ANOVA) while multiple comparisons were done using Post Hoc test. Pearson's correlation coefficient was used for correlational analysis.

Results: In the moderate exercise group, mean BMI was reduced while ALT, AST, ALP, GGT were increased, with TBIL and DBIL altered but no significance at $P<0.05$ all through. In the vigorous exercise group, mean serum ALT was significantly increased at $P<0.05$ mainly 4 weeks after exercise as compared with results before exercise. Mean serum AST was significantly increased all through at $P<0.05$. However, mean BMI was decreased while mean serum ALP and GGT were increased, with mean serum TBIL and DBIL altered but not significant at $P<0.05$.

Conclusion: Vigorous physical exercise can substantially increase fitness, but, moderate physical exercise, when performed frequently and over an extended period, produces enhanced biochemical parameters and reduced risks of cardiovascular disease.

INTRODUCTION

Physical exercise is any bodily activity that enhances or maintains physical fitness and overall health and wellness. It improves mental health and helps prevent depression.[1] Controversy exists on the specific form of exercise, as well as the intensity, duration, and training intervals of the specific form of exercise chosen as a lifestyle intervention regimen. Moderate and vigorous exercises generally relate to aerobic forms of exercise.[2] The most effective way to participate in a well-rounded physical exercise program is by following a simple short acronym called FITT (Frequency, Intensity, Time, Type). The FITT principle includes how many times a week one should exercise (frequency), how intense the workout should be (intensity), how long the workout is (time), and what modality to use (type of exercise).[3]

The liver is both the largest internal organ and has a wide range of functions, including detoxification and synthesis of biochemicals necessary for digestion. Liver function tests are used to determine if the liver is functioning normally or if it has an injury or disease. They include the liver enzymes as well as total and conjugated bilirubin.[4] AST and ALT are jointly known as transaminases. They are associated with inflammation and/or injury to liver cells. Damage to the liver typically results in a leak of AST and ALT into the bloodstream.[5] ALP is an enzyme in the cells lining the biliary ducts of the liver. ALP levels in plasma will rise with large bile duct obstruction or intrahepatic cholestasis. GGT is although reasonably specific to the liver and a more sensitive marker for cholestatic damage than ALP, GGT may be elevated with even minor, sub-clinical levels of liver dysfunction. Bilirubin is the yellow breakdown product of normal haem catabolism. Bilirubin is excreted in bile and urine.[6] A study on whether muscular exercise can lead to high liver function tests in healthy men reported AST and ALT to be significantly increased for at least 7 days after exercise while GGT, ALP and bilirubin remained within the normal range post-exercise.[7] Meanwhile, a 2012 study on the effect of different doses of aerobic exercise training on total bilirubin levels showed that exercise training significantly increased serum bilirubin levels as compared with the control group.[8] A 2009 study in South-Western Nigeria on plasma biochemical changes during moderate and vigorous exercises reported that the level of AST was significantly elevated.[9]

MATERIALS AND METHODS

Study Site/ Subject Selection/Study Design

The study was conducted at Amawbia training ground, Amudo football training ground and Okpuno football training ground, all in Awka metropolis, Anambra State, Nigeria. Total study size of 100 subjects but 300 samples/specimens was used (males). They were divided into two groups: Group 1 (Vigorous Exercise) – This group consisted of 50 individuals (males) who trained for football playing for 2 hours daily (5 days/week). Group 2 (Moderate Exercise) – This group consisted of 50 individuals (males) who trained for football playing for 30minutes (3 days/ week). A baseline specimen was obtained from each subject before exercise. After two weeks and four weeks of respective training, fresh samples were collected from each subject.

Inclusion and Exclusion Criteria

Inclusion criteria for subjects were: physically healthy male individuals ages 18 - 35 years, occasional or non-alcohol consumers, non-smokers, as well as, those not on drugs especially that will interfere with the parameters to be studied (e.g. lipid-lowering drugs).

Subjects physically unhealthy (males/females), outside the age range, regular alcohol consumers, smokers and those on drugs especially those that will interfere with the parameters to be studied, were all excluded.

Sample Size

Sample size calculation was done using 95% confidence interval, 0.05 precision and prevalence rate. There seem to be no data available as regards the proportion of Anambra State residents that participate in various forms of physical exercise, but, high physical activity levels assessed in Ibadan, Western Nigeria, reported 3.2%.[10] The formula for sample size when population is more than 1000 is: $\mathbf{n = Z^2PQ/d^2}$.[11]

Where: n = sample size, d = degree of precision (taken as 0.05), Z = standard normal deviation at 95% confidence interval which is 1.96, P = proportion of the target population (estimated at 3.2% which is 3.2/100 = 0.032), Q = alternate proportion (1-P) which is 1-0.032= 0.968. The calculated sample size is **48**

Sample Collection, Storage and Analysis

A 5ml fasting blood sample was aseptically collected into plain sample containers from each of the participating individuals by venepuncture on each of the three occasions sample was withdrawn between 7.30am and 10am. Blood samples were centrifuged at 4000 Revolution per Minute (RPM) for 10 minutes and the serum of each sample was extracted into fresh plain bottle for analysis. Serum samples were analyzed promptly after centrifugation while those not analyzed immediately analyzed were stored at – 20 degree celsius until analysis few days later. Liver enzymes activity were analysed by enzymatic spectrophotometric method while bilirubin was obtained by spectrophotometric method.

Principle of Spectrophotometry (Beer's & Lambert's Law)

When a monochromatic light passes through a coloured solution, its absorbance is proportional to the concentration of the coloured solution and the length of the light path. The intensity of the colour change is proportional to the concentration of the substance being tested.

Statistical Analysis

Data was statistically analyzed using Statistical Package for the Social Sciences (SPSS) for windows version 20.0 software. All data were expressed as Mean ± Standard Deviation (SD). Statistical analysis of the data before exercise, two weeks after exercise and four weeks after exercise was performed by Analysis of Variance (ANOVA) while multiple comparisons were done using Post Hoc test. Significance was fixed at $P < 0.05$ and highly significant if $P < 0.01$. Pearson's correlation coefficient was used for correlational analysis of the test.

RESULTS AND ANALYSIS

Physical and Biochemical Parameters

The mean age for subjects in moderate exercise group was 21.74 years while mean age for subjects in vigorous exercise group was 21.44 years, with the mean age of both groups not significantly different. The mean body mass index (BMI) of both moderate and vigorous exercise groups was reduced but not significantly different before exercise, 2 weeks after exercise or 4 weeks after exercise (Tables 1 & 2).

In the moderate exercise group, the mean serum activity of ALT, AST, ALP and GGT were increased while the mean serum concentration of TBIL and DBIL were altered but not significant at P<0.05all through. In the vigorous exercise group, the mean serum activity of ALT and AST were significantly increased at P<0.05. The significant increase in ALT was observed 4 weeks after exercise as compared with the results before exercise while that of AST was observed all through. However, the mean serum activity of ALP and GGT were increased while the mean serum concentration of TBIL and DBIL were altered but not significant at P<0.05 (Tables 1 & 2).

Table 1: Comparison of BMI, ALT, AST, ALP, GGT, TBIL & DBIL results for moderate exercise group before exercise, 2-weeks after exercise and 4-weeks after exercise

Groups	BMI (kg/m²)	ALT (IU/L)	AST (IU/L)	ALP (IU/L)	GGT (IU/L)	TBIL (µmol/L)	DBIL (µmol/L)
Before Exercise	22.88±0.84	10.72±4.73	15.10±4.21	58.80±9.54	21.50±10.37	14.19±2.50	2.31±0.75
2 weeks after exercise	22.87±0.85	11.20±4.85	15.88±5.09	59.42±9.55	22.20±10.23	13.41±2.44	2.28±0.66
4 weeks after exercise	22.69±0.86	12.32±4.18	17.32±4.98	60.16±9.48	22.82±10.12	13.84±2.25	2.08±0.56
F-value	0.821	1.596	2.782	0.255	0.208	1.315	1.769
P-value	0.442	0.206	0.065	0.775	0.812	0.272	0.174
POST HOC							
a/b	1.000	1.000	1.000	1.000	1.000	0.322	1.000
a/c	0.752	0.251	0.064	1.000	1.000	1.000	0.245
b/c	0.873	0.675	0.401	1.000	1.000	1.000	0.434

a – before exercise; b – 2 weeks after exercise; c – 4 weeks after exercise

TABLE 2: Comparison of BMI, ALT, AST, ALP, GGT, TBIL & DBIL results for vigorous exercise group before exercise, 2-weeks after exercise and 4-weeks after exercise

Groups	BMI (kg/m²)	ALT (IU/L)	AST (IU/L)	ALP (IU/L)	GGT (IU/L)	TBIL (µmol/L)	DBIL (µmol/L)
Before Exercise	22.71 ± 1.20	10.60 ± 4.66	13.48 ± 3.82	62.56 ± 10.01	22.26 ± 8.88	13.80 ± 2.58	2.48 ± 0.53
2 weeks after exercise	22.54 ± 1.23	11.30 ± 4.56	15.82 ± 4.28	64.12 ± 9.24	23.06 ± 9.19	14.11 ± 2.57	2.30 ± 0.40
4 weeks after exercise	22.22 ± 1.29	13.34 ± 4.40	18.76 ± 4.17	64.96 ± 8.51	23.36 ± 8.82	13.34 ± 2.30	2.31 ± 0.38
F-value	2.008	4.91	20.871	0.862	0.201	1.216	2.557
P-value	0.138	0.009*	0.001*	0.424	0.818	0.299	0.081
POST HOC							
a/b	1	1	0.015*	1	1	1	0.141
a/c	0.15	0.009*	0.001*	0.593	1	1	0.173
b/c	0.606	0.079	0.001*	1	1	0.37	1

a – before exercise; b – 2 weeks after exercise; c – 4 weeks after exercise
* = Results compared are significantly different at P-value < 0.05 (P < 0.05)

DISCUSSION

The mean age and body mass index (BMI) of both moderate and vigorous exercise groups were not significantly different before exercise, 2 weeks after exercise or 4 weeks after exercise. In the moderate exercise group, the mean serum activity of ALT and AST were increased but not significant at P <0.05 all through. In the vigorous exercise group, the mean serum activity of ALT and AST were significantly increased at P<0.05. The significant increase in ALT was observed after 4 weeks after exercise as compared with the results before exercise while that of AST was observed all through. This is consistent with a 2009 study on plasma biochemical changes during moderate and vigorous exercises, which reported that there was a significantly elevated AST level.[9] This is also in agreement with a 2008 study on whether muscular exercise can lead to high liver function tests in healthy men, which reported that ALT and AST were significantly increased for at least 7 days after the exercise.[7] The increase particularly in AST for the vigorous exercise group, as well as, ALT, could be due to persistent physical exercise leading to slight leakage of these enzymes from the tissues producing them into the bloodstream probably due to muscle cell injury or damage.

In the moderate exercise group, the mean serum activity of ALP and GGT were increased while the mean serum concentration of TBIL and DBIL were altered but not significant at $P<0.05$all through. In the vigorous exercise group, the mean serum activity of ALP and GGT were increased while the mean serum concentration of TBIL and DBIL were altered but not significant at $P<0.05$. This is largely in agreement with a study on whether muscular exercise can lead to high liver function tests in healthy men, which reported that bilirubin, GGT and ALP remained almost unaltered and within normal range post-exercise.[7] However, this study is not consistent with a 2012 study on the effect of different doses of aerobic exercise training on total bilirubin levels which reported that exercise training significantly increased serum bilirubin levels as compared with control group.[8] This finding of non-significant ALP and GGT may have been due to the fact that these enzymes are not principally present in muscle tissue (e.g. cardiac muscle), involved mainly in the type of exercise used in this study. It could equally be a result of the wide distribution of these enzymes in the body, that is, they are not restricted to the liver, as is the case of ALT which is chiefly found in the liver and AST which is found mainly in the liver, heart and skeletal muscle. This study suggests that exercise did not necessarily affect the bilirubin levels.

CONCLUSION

Vigorous physical exercise can substantially increase fitness, but, moderate physical exercise, when performed frequently and over an extended period, produces enhanced biochemical parameters and reduced risks of cardiovascular disease.

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