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Pattern of some Liver Enzymes and Cardiovascular Changes during a Trademill Exercise.

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ABSTRACT: ***Background***: *Enzymes have been widely utilized as diagnostic tool. Their use in the assessment of stress induced by exercise need to be further evaluated. This study examined the pattern of some liver enzyme changes as well as cardiovascular changes during exercise in some students of Nnamdi Azikiwe University, Nnewi Campus.* ***Methods***: *Sixty apparently healthy student (30 males and 30 females aged 18- 30 years) participated in the study. The anthropometric indices were taken and their body mass index calculated from their measured height and weight. Their blood pressure and pulse rate were also taken before and after exercise on the treadmill and their physical fitness level were estimated using the Bruce protocol. Their blood samples were collected before and immediately after the exercise for laboratory analysis.* ***Results***: *There was significant increase in the post-exercise values of systolic blood pressure, pulse rate, Alanine aminotransferase (ALT), Aspartate aminotransferase (AST) and Alkaline phosphatase (ALP) compared to the pre-exercise values in both male and female subjects. However, there was significant decrease in the post exercise values of the diastolic blood pressure in both male and female subjects compared to their pre- exercise values.* ***Conclusion***: *This study showed that physical exercise increases liver enzymes. This finding could reflect the physiological changes in the normal life of the students in the stressed condition. However, this effect may be beneficial health-wise, but care need to be taken not to overdrive the changes to deleterious levels. Moreover, exercise should be taken into consideration when interpreting liver enzymes' results.*

Keywords: *Exercise, liver enzymes, stress, treadmill.*

I. INTRODUCTION

Exercise is a process in which energy stored as chemical compound is transformed into mechanical and heat energy.[1] Frequent and regular exercise boosts the immune system and helps prevent the disease of affluence such as heart disease, cardiovascular disease, type 2 diabetes and obesity. It also improves mental health, help prevent depression, promote or maintain positive self-esteem and can even augment an individual sex appeal or body image which is also found to be linked with higher level of self-esteem.[2] It is also beneficial for young women, since it increases cardiovascular fitness and reduces adiposity.[3] People who reported at least 30 minutes of vigorous activity were more than twice as likely to maintain a stable body mass index.[4]

However, physical exercise increases serum level of alanine aminotransferase (ALT) and aspartate aminotransferase (AST).[5] It was also reported that high intensity, short duration exercise resulted in greater enzyme than low intensity, long term exercise and the longest increase corresponded with the perception of muscle soreness.[6] Temporary elevations of the liver enzymes have been seen during and immediately after a routine exercise regimen. However, dehydration and heart strokes are the key word problems with over exercising or the use of Saunas to induce weight loss through massive sweating of the fluid.[5]

Exercise increases serum alkaline phosphate bone isoform B1 and B2, it is suggested that when a young jogged in a moderate temperature of 40°C for 40 minutes, the level of the serum B2 and parathyroid hormone increased, all the changes turn towards baseline within 20 minutes after exercise.[7]

The results of this study designed to assess the acute or short-term effect of treadmill exercise on liver functions of these individuals and the findings from previous multiple studies will provide an empirical evidence that will guide the use of physical exercise to improve the health of both apparently healthy as well as sick individuals in our community and to assess physical state of our students.

II. MATERIALS AND METHODS

2.1. Study population and study design

Nnamdi Azikiwe University, Okofia-Otolo, Nnewi campus comprises the college of Health Sciences having the faculties of Basic medical Sciences, Health Sciences and Technology and Medicine. It is located in the suburb of Nnewi - a popular town in Anambra State Nigeria. The environment is poorly developed and lacking basic amenities such as housing, road, communication, electricity and potable water compared to campuses located in urban areas. The students are always stressed in non-conducive learning environment.

The study population comprised of sixty students (30 males and 30 females) aged 18 to 30 years who were apparently healthy and not having any medical condition. The participants were selected based on their ability to perform a maximum effort exercise test and resting blood pressure of 90/60 to 130/85 mm/Hg. An oral interview was conducted to exclude history of unstable cardiovascular, peripheral vascular, respiratory diseases as well as orthopedic or musculoskeletal lesions. The details about this study were explained to each of the qualified participants. Upon arrival at the venue of the study, each participant rested for 20 minutes after which the age, gender, height, weight, body mass index (BMI), systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate data were obtained. The ethical approval was obtained from ethics committee of the Faculty of Health Sciences and Teachnology, Nnamdi Azikiwe University, Awka.

The physical fitness level was estimated using the Bruce protocol. The participants performed exercise on a treadmill with an initial speed of 2.74km/hr and a gradient (an incline of 100%). After every three minutes, the gradient was increased by 2% while the speed was increased to 4.02, 5.47, 6.76, 8.05.8.85, 9.65, 10.46, 11.26, and 12.60 respectively. So the maximum deviation for the protocol was 30 minutes. The time of exhaustion was taken using a stop watch and recorded as exercise time (T) in minutes. Time (T) was then substituted in the formulae given below to estimate the participant's maximum oxygen. Consumption $VO_{2\ max}$ which is a measure of cardiorespiratory fitness.

Female: VO_{2max} (ml/kg/min) = $4.38\times T - 39$
Male: VO_{2max} (ml/kg/min) = $3.62\times T + 3.91$.

1.2. SAMPLE COLLECTION

Upon collection of pre-exercise data, each participant embarked on a submaximal exercise on a treadmill, within 30minutes. The exercise blood pressure was recorded within 30 seconds of the exercise. Blood samples were collected before and after exercise into a serum separator tubes from an ante-cubital vein. The samples were allowed to clot at room temperature for approximately 1 hour. After clotting and retraction, they were separated using a centrifuge. The supernatant sera were then stored frozen until analyzed. The samples were then analyzed for alkaline phosphatase, aspartate and alanine amino transferases using the following methods: King and Armstrong method[9] and Reitma and Frankel method[10] respectively.

1.3. STATISTICAL ANALYSIS

The following statistical analyses were carried out: mean, standard deviation, student test correlation, using statistical package for social science (SPSS version 17). Values were taken to be significant at $P < 0.05$.

III. RESULTS

This study involves 30 female subjects within the age range of 15-30 years with mean age of (21.00±1.49) years and BMI of (24.13±2.50) kg/m^2 (table 1), and 30 male subjects within the same age range with mean age of (21.30±1.44) years and BMI of (24.13±2.27) kg/m^2 (table 2).

Assessment of cardiovascular parameters such as SBP, DBP, and Pulse rate showed almost the same results in both male and female subjects. There was a significant increase in SBP and pulse rate in both male and female subjects after the exercise. However, the mean level of DBP significantly decreased after the exercise in both male and female subjects (table 1 and 2).

There was a significant increase in liver enzymes (ALT, AST, and ALP) after the exercise than before the exercise in male subjects (table 2). Also, the mean levels of these liver enzymes increased significantly after the exercise when compared with before the exercise in female subjects (table 1).

The comparison of liver enzymes (ALT, AST, and ALP) between male and female subjects showed no significant difference except in ALT which is significantly higher in male than in female subjects in both before and after exercise (table 3).

Table 1: changes in the levels of SBP, DBP, Pulse rate, AST, ALT, and ALP in female subjects before and after exercise.

PARAMETER	BEFORE EXERCISE	AFTER EXERCISE	P-VALUE
AGE(years)	21.00±1.49		
BMI (kg/m^2)	24.13±2.50		
SBP(mmHg)	124.07±5.09	138.13±7.02	<0.0001
DBP(mmHg)	82.27±6.23	67.07±5.21	<0.0001
Pulse rate(Sec)	85.57±14.66	107.93±11.90	<0.0001
AST (iU/L)	10.10±3.83	12.83±3.82	<0.0001
ALT (iU/L)	6.87±2.27	9.40±2.39	<0.0001
ALP (iU/L)	34.30±4.58	40.67±4.13	<0.0001

Table 2: changes in the levels of SBP, DBP, Pulse rate, AST, ALT, and ALP in male subjects before and after exercise.

PARAMETER	BEFORE EXERCISE	AFTER EXERCISE	P-VALUE
AGE(years)	21.30±1.44		
BMI (kg/m^2)	24.35±2.27		
SBP(mmHg)	125.70±6.56	142.93±8.58	<0.0001
DBP(mmHg)	80.47±6.80	66.63±8.46	<0.0001
Pulse rate(Sec)	74.90±13.41	100.50±12.79	<0.0001
AST (iU/L)	9.33±2.37	13.47±3.77	<0.0001
ALT (iU/L)	24.70±14.81	28.60±2.51	<0.0001
ALP (iU/L)	35.00±3.78	39.60±3.87	<0.0001

Table 3: Comparison of liver enzymes before and after exercise in female and male subjects

Parameter	Female (N=30)	Male (N=30)	P-Value
AST Before	10.10±3.83	9.33±2.37	0.340
AST After	12.83±3.82	13.47±3.77	0.520
ALT Before	6.87±2.27	24.70±14.81	0.0001
ALT After	9.40±2.39	28.60±2.51	0.0001
ALP Before	34.30±4.58	35.00±3.78	0.521
ALP After	40.67±4.13	39.60±3.87	0.306

IV. DISCUSSION

Exercise has both beneficial as well as deleterious effects on liver depending on its intensity. Moderate exercise enhances both nutrient metabolism and antioxidant capacity. [11] However, liver cell injury after exhaustive exercise has been reported.[12] This study observed significant changes in the levels of some liver enzymes after a high intensity exercise. The levels of ALT and AST were significantly higher in post exercise than before exercise. These findings are in agreement with other previous studies.[5,13]

Likewise higher ALP level was observed in the post exercise values when compare with the pre-exercised values. The higher plasma ALP activity observed in both the male and female subjects after the exercise as compared to their pre-exercise value could be as a result of haemoconcentration that occurs during the exercise due to increased sweating, increase body temperature or splenic contraction.[7] This finding may also be associated with leaking out of ALP from mechanically damaged muscle cells[5] or increased bone mass in physically active subjects.[14]

It has been reported that physical exercise increases the blood flow in working skeletal muscles, while it decreases blood supply to the liver[15] and portal vein.[16] This causes damage to the liver with a resultant increase in the leakage of these liver enzymes into the blood stream. Praphatsorn et al, has shown that high intensity exercise caused changes in liver function and in the number of damaged hepatic parenchymal cells in rats.[17] It has also been reported that high intensity exhaustive exercise leads to hepatic hypoxia-reperfusion and promotes an adverse effect from free radicals and lipid peroxidation.[18] Latour et al showed that liver in exercised rats displayed 15% decrease in the hepatocellular hydration level compared with normal rest conditions.[19]

Aminotransferases (ALT and AST) and ALP are naturally in different kinds of tissues like liver, heart, kidneys, muscle, bone and brain. If each of these tissues is damaged, these enzymes enter into circulation.[20] This implies that other tissues as well as liver account for this raised enzyme levels found in these subjects since exercise can affect almost all these tissues. Rudberg et al, revealed that serum isoforms of bone ALP increased during physical exercise in women.[14] This calls for more caution in interpreting enzymes results of people under exercise in both routine check-up or in pathological cases. Pettersson et al, concluded in their study that liver function parameters (AST and ALT) were significantly raised for at least seven days after muscular exercise in healthy men.[13]

The effect of exercise on some physical parameters of the subjects were also observed, they include their blood pressure and pulse rates. The systolic blood pressure and pulse rates were found to be higher while diastolic blood pressure was lower immediately after the exercise. The higher systolic blood pressure observed after the exercise is in line with a previous study.[21] The slight decrease in the diastolic blood pressure is primarily due to the vasodilation of the arteries from the exercise bouts. Thus the expansion in the artery size may lower blood pressure during the diastolic phase.[21] After exercise the pulse rate between the female and male subject increases because the heart pumped in more oxygenated blood to the body. The faster the heart pump blood, the higher the pulse rate.[22]

V. CONCLUSION

Findings from this study revealed that physical exercise increases the liver enzymes, therefore the result of liver enzyme investigations in patient who have been exercising should be interpreted bearing in mind the effects of exercise to these enzymes. We also suggest further study to measure these liver enzymes a week or more after the exercise in order to ascertain if this increase is long term or short term.

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