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EFFECT OF SHORT-TERM AEROBIC EXERCISE ON LIVER FUNCTION OF APPARENTLY HEALTH STUDENTS OF COLLEGE OF HEALTH SCIENCES, NNAMDI AZIKIWE UNIVERSITY, NNEWI CAMPUS, ANAMBRA STATE, NIGERIA

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Abstract

This study investigated the effect short-term aerobic exercise on liver function of students of the College of Health Sciences, Okofia, Nnewi, Nigeria. A total of 41students aged 18-28years comprising of 22 males and 19 females who volunteered to participate in the study for one week were recruited. Their blood pressure readings and body mass index (BMI) were obtained, 5mls each of baseline (day zero) and post exercise(day 8) samples were collected into lithium heparin containers for estimation of biochemical parameters (ALP, AST, ALT, Bilirubin, Albumin and Total protein) respectively using standard methods. The results showed that the mean plasma activities of ALP, AST and plasma levels of Total bilirubin and Albumin in subjects were significantly higher after exercise when compared to their activities before exercise (P=0.046; 0.017; 0.047; 0.012) respectively. There was no significant difference in the mean plasma level of total protein and ALT activity in subject before and after exercise. SBP was strongly association with exercise in this study (p=0.087). it is important to impose exercise restrictions for at least one week before clinical trials or tests especially liver function tests. Exercise should be considered as a cause of asymptomatic elevations of liver function tests in daily clinical practice to reduce the risk of erroneous attribution of changes in liver function to pathological conditions or drug effects.

Key Words: Aerobic Exercise, Alkaline phosphatase, Aspartate aminotransferase, Alanine aminotransferase, Direct Bilirubin, Total Bilirubin, Total Protein, Albumin.

Introduction

Physical exercise is any bodily activity that enhances or maintains physical fitness and overall health and wellness. Exercise is a process which energy stored as chemical compounds are transformed into mechanical energy (Stampfer *et al.,* 2000). Physical exercise has numerous functions ranging from the Control of body weight; Lowering the risk of certain cancers, Strengthens bones and muscles, Improves mental health and mood, Improves the ability to perform daily activities, Increases ones chances of living longer, Strengthens muscles and cardiovascular system, Helps prevent depression, Helps promote and maintain positive self esteem among other functions (Stampfer *et al.,* 2000). Physical exercises are generally grouped into three types, depending on the overall effect they have on the human body: These include Aerobic exercise, Anaerobic exercise and Flexibility exercises. Aerobic exercise is any physical activity that uses large muscle groups and causes the body to use more oxygen than it would while resting. The goal of aerobic exercise is to increase cardiovascular endurance . Aerobic exercise include cycling , swimming , brisk walking , skipping rope , rowing , hiking , playing tennis , continuous training , and long slow distance training.

Anaerobic exercise , which includes strength and resistance training, can help make the muscles firm, strengthen, and tone muscles, as well as improve bone strength, balance , and coordination . Examples are are push-ups , lungs , and bicep curls using dumbbells, according to national Institute Of health, national heart, lung, and blood institute 2006. Anaerobic exercise also include weight training , functional training, eccentric training , Interval training , sprinting, and high-intensity interval training increase short-term muscle strength (De vos *et al.,* 2005).

Flexibility exercises stretch and lengthen muscles . Activities such as stretching help to improve joint flexibility and keep muscles limbs. The goal is to improve the range of motion which can reduce the chance of injury. (O'Connor *et al.,* 2005).

Physical exercise improves liver function in a number of ways. Continued aerobic exercise strengthens the muscle and allows it to pump blood with less effort. As this occurs, pulse slows down and blood flow improves, making it easier for the heart to get blood to the liver and for the liver to send filtered blood back through the blood system (Meyers *et al.,* 2004). Building lean muscle mass through exercise can delay severe muscle wasting that becomes apparent during advanced stages of liver disease. In addition, physical exercise prevents the build-up of excess body fat that can lead to a fatty liver and result in a medical condition called non-alcoholic steatohepatitis, (NASH). According to the National Institute of Diabetes and Digestive and Kidney Diseases, although NASH initially displays few symptoms, it can cause the liver to become non-functional. It may also help prevent stress and depression, increase quality of sleep and act as a non-pharmaceutical sleep aid to treat diseases such as insomnia, help promote or maintain positive self-esteem , improve mental health, maintain steady digestion and treat constipation and gas, regulate fertility health, and augment an individual's sex appeal or body image, which has been found to be linked with higher levels of self-esteem(wilmone 2003; De

vos *et al.,* 2005). Physical exercise is associated with biological and metabolic changes in the body. In this college, students undergoes informal physical exercise such as steady walking, dancing etc, so this study intends to evaluate if these activities affect the functions of the liver by subjecting students to short term aerobic exercise and evaluating its function on the liver of students. The outcome of this study would be used to educate the society on the importance of exercise to a well functioning liver as well as its role in preventing liver diseases. This study is aimed at evaluating the effect of aerobic exercise on the liver function of students of Nnamdi Azikiwe University, College of Health Sciences, Nnewi Anambra State, Nigeria.

Materials and Methods

Study Area

This study was limited to students in Nnamdi Azikiwe University, College of Health Science, Anambra State, Nigeria**.**

Research Design

A total of forty-one students comprising of 22 males and 19 females who volunteered to participate in any form of sports for one week were recruited. After one week of rest, the subjects were divided into seven teams. Each team was subjected to volley ball exercise for a minimum time of 45 minutes for at least four consecutive times in one week. The pre-exercise blood pressure was measured two times consecutively using the right arm placed at the heart level using an automatic blood pressure measuring device OMRON 907(OMRON, Hoofdorp Netherlands). After the subjects had rested at least five minutes in a sitting position on arrival to the volley court. The measurements were taken sixty seconds apart, and the average systosolic and diastolic blood pressure were taken and used for analyses. After the blood pressure were taken, pre-exercise blood sample were taken of about 5mls from the ante cubital vein of each participating subject before the commencement of the exercise. Post- exercise blood sample were taken after exercise on the last day and dispensed into lithium heparin container and allowed to clot, centrifuged, separated and aspirated into plain tubes and used to assay for albumin, total protein, alkaline phosphatase, aspartate amino transferase, alanine amino transferase, total bilirubin and conjugated bilirubin using standard methods as described by Tietz,1987**;** Ryan and Chopra, 1976; Shephard *et al.,* 1986; Bergmeyer and Bernst, 1963; Shogo *et al*., 1988**)** respectively. Anthropometric parameters (Weight and height) of each subject was measured using standiometer and a weighing scale before the exercising session and their body mass index were calculated from it. Subjects dietary pattern and lifestyle were also obtained using a well structured questionnaire.

Ethical Consideration

Ethical approval was obtained from the ethics committee of Nnamdi Azikiwe University, College of Health Sciences, Okofia, Nnewi, Anambra state, Nigeria. Also Informed consent was obtained from the subjects, recruited for the study.

Inclusion Criteria and Exclusion Criteria

Students within the age range (18-30) years and who were willing to play volley ball were recruited for the study while those who were not within the age range; Smokers and alcoholics and Students who were not willing to participate in the study were excluded from the study.

Statistical Analysis

Statistical package for social science students (SPSS) version 21.1 was used for the analysis of the results. Data was presented as mean ± standard deviation(SD), students paired t-test was used. The level of significance was set at $P \leq 0.05$**.**

Results

The mean levels of age in females (23.23±2.31) was significantly higher when compared to the mean levels of males (21.74±1.37) (P=0.018). The mean levels of weight was significantly higher in females (71.23±7.19) when compared to males (62.37±10.04) (P=0.002). The mean levels of height of in females was significantly higher in females (1.76±0.05) when compared to that of males (1.67±0.57). The mean levels of BMI in females was not significant in females when compared to males (23.05±1.68 vs 22.39±3.22, P=0.413) (Table 1).

Table 1: The Demographic information of subjects

Parameters	Female	Male	T-value	P-value
Age(Yr)	23.23±2.31	21.74±1.33	2.481	0.018
Weight(Kg)	71.23±7.19	62.37±10.04	3.28	0.002
Height(cm)	1.76±0.05	1.67±0.57	5.193	0.000
BMI (Kg/m^2)	23.05±1.68	22.39±3.22	0.828	0.413

Statistically significant at P<0.05

There was a significant difference for the subjects before and after exercise in the systosolic blood pressure(112.71±8.20 vs 116.10±12.74, P<0.05) .The diastolic blood pressure before and after exercise showed a significant difference (76.39±8.20 vs 79.98±11.61, P<0.05). The mean level of alkaline phosphatase after exercise was significantly higher (56.47±24.85) when compared to its level before exercise (52.35±22.41). P<0.046. There was significant difference for aspartate amino transferase before and after exercise (7.29±3.64) and (8.63±4.39) respectively (P<0.05). In alanine amino transferase there was a significant increase after exercise

when compared to that before exercise (11.05±5.0) and (9.76±5.19) respectively (P<0.243). There was a significant difference for total bilirubin before and after exercise (9.83±0.73) and (10.20±1.15) respectively, as well as conjugated bilirubin before and after exercise (2.23±0.29) and (2.77±0.27) respectively. (P<0.529). There was no significant difference in total protein of the subjects before and after exercise(73.45±13.47 vs 71.28±15.01, P=0.498). Albumin level before and after exercise showed a significant difference (36.56±5.84) and (39.40±3.84), (P=0.012) (Table 2).

Table 2: Levels of systolic blood pressure, diastolic blood pressure, alkaline phosphatase, aspartate amino transferase, alanine amino transferase, total and conjugated bilirubin, total protein and albumin before and after exercise.

PARAMETERS	PRE-EXERCISE Mean±SD	POST-EXERCISE Mean±SD	t-test	P-value
Systolic blood pressure(mmHg)	112.71±9.00	116.10±12.74	-1.757	0.087
Diastolic blood pressure(mmHg)	79.98±11.61	76.39±8.20	2.408	0.021
Alkaline phosphatase(IU/L)	52.35±22.41	56.47±24.85	-1.115	0.046
Aspartate amino transferase(IU/L)	7.29±3.64	8.63±4.39	-1.704	0.017
Alanine amino transferase(IU/L)	9.76±5.19	11.05±5.00	-1.186	0.243
Total bilirubin(µmol/L)	9.83±0.73	10.20±1.15	-1.884	0.047
Conjugated bilirubin(µmol/L)	2.23±0.29	2.27±0.27	-0.634	0.529
Total protein(g/L)	73.45±13.47	71.28±15.01	0.684	0.498
Albumin(g/L)	36.56±5.84	39.400±3.84	-2.639	0.012

Statistically significant at P<0.05

Alkaline phosphatase before exercise for males and females showed a significant difference (60.65±25 vs 42.73±13.04, P=0.009) when compared to that level after exercise (67.61±27.13 vs 43.60±13.63, P=0.469). The levels of aspartate amino transferase before exercise for males and females was significantly higher in males (7.68±4.6) than in females(6.84±2.06) when compared to their levels after exercise in males(9.68±5.20) and in females(7.42±2.89). There was a significant difference in alanine amino transferase of male and female subject before exercise(8.59±3.54 vs 6.84, P=0.125) when compared to their levels after exercise in males and females(10.36±4.96 vs 11.84±5.05 P=0.351). There was a slight increase in the total bilirubin levels after exercise in males and females (10.22±1.09 vs 10.16±1.4 P=0.087) when compared its levels in males and females before exercise (10.05±0.10 vs 9.57±0.54 P=0.0368). There ws no significant difference in total protein after exercise in males and females(70.35±18.04 vs 72.31±10.90 P=0.68) when compared to their levels before exercise(75.23±18.04 vs71.38±18.51 P=0.368). Similarly there was no significant difference in levels of albumin before exercise in

males and females(36.99±3.26 vs 36.07±7.93; P=0.623) when compared to their levels after exercise in males and females which was significant (39.72±3.58 vs 39.03; P=0.472) (Table 3).

Table 3: Levels of alkaline phosphatase, aspartate amino transferase, alanine amino transferase, total and conjugated bilirubin, total protein and albumin before and after exercise, in male and female subjects

Parameters	Male	Female	T- value	P-value
Pre-Alkaline phosphatase(IU/L)	60.65±25.60	42.73±13.04	2.155	0.009
Post Alkaline phosphatase(IU/L)	67.61±27.13	43.60±13.63	3.496	0.001
Pre- Aspartate amino transferase(IU/L)	7.68±4.61	6.84±2.06	-0.732	0.469
Post- Aspartate amino transferase(IU/L)	9.68±5.20	7.42±2.89	1.683	0.100
Pre-Alanine amino transferase(IU/L)	8.59±3.54	6.84±2.06	-1.577	0.123
Post Alanine amino transferase(IU/L)	10.36±4.96	11.84±5.05	-0.0944	0.351
Pre-Total Bilirubin(µmol/L)	10.05±0.80	9.57±0.54	2.167	0.0368
Post-Total Bilirubin(µmol/L)	10.22±1.09	10.16±1.24	0.164	0.871
Pre-Conjugated Bilirubin(µmol/L)	2.28±0.30	2.18±0.27	1.021	0.134
Pre Total Protein (g/L)	75.23±6.67	71.38±18.51	0.910	0.368
Post Total Protein(g/L)	70.38±18.04	72.31±10.90	-0.408	0.686
Pre Albumin(g/L)	36.99±3.26	36.07±7.93	0.495	0.623
Post Albumin(g/L)	39.72±3.58	39.03±4.19	0.570	0.472

Statistically significant at P<0.05

The mean levels of systolic blood pressure was higher after exercise(116.10±12.74) when compared to its level after exercise(112.7±9.00). The mean levels of diastolic blood pressure was significantly lower after exercise(76.39±8.2) when compared to its level before exercise (79.98±11.61). The levels of systolic blood pressure was significantly higher in males than in females(115.82±82 vs 109.11±8.91 P= 0.015), when compared to their levels after exercise in males and females (119.64±13.77 vs 112.00±10.32). The levels of diastolic blood pressure was not significantly different before exercise in males and females (76.73±8.12 vs 76.00±8.50) (Tables 4 and 5).

Table 4: Showing blood pressure before and after exercise of subjects(mean±SD)

Parameter	Pre-exercise	Post-exercise	t-test	P-value
Systolic blood pressure(mmHg)	112.71±9.00	116.10±12.74	-1.757	0.087
Diastolic blood pressure(mmHg)	79.98±11.61	76.39±8.2	2.408	0.021

Statistically significant at P<0.05

Table 5 : Showing blood pressure before and after exercise of male and female subjects (mean ±SD)

Parameter	Male	Female	t-test	P-value
Pre- Systolic blood pressure(mmHg)	115.82±8.03	109.11±8.91	2.537	0.015
Post-Systolic blood pressure(mmHg)	119.64±13.77	112.00±10.32	1.982	0.055
Pre Diastolic blood pressure(mmHg)	76.73±8.12	76.00±8.50	0.280	0.781
Post Diastolic blood pressure(mmHg)	81.32±11.34	78.42±12.03	0.793	0.433

Statistically significant at P<0.05

Discussion

There was an observation of effect of exercise on physical parameters of the subjects, they include their systolic and diastolic blood pressure. The increased systolic blood pressure observed after exercise is in agreement with previous studies, transition from rest to exercise, systolic blood pressure initially rises rapidly, then levels off once steady state is attained (Brooks *et al.,* 2005). Typical systolic pressures during exercise range from 140 to 160 mmHg. Exercise normally produces a progressive increase in systolic pressure, and values can reach as high as 250 mmHg during maximal exercise. Diastolic pressure may show a very slight decrease during exercise due to a redistribution of blood flow to the capillary beds in the large exercising muscle groups (Brooks *et al.*,2005). The effect of exercise on liver enzymes aspartate amino transferase, alanine amino transferase, alkaline phosphatase was also observed, as it was higher after exercise. This could be associated with leaking of the enzymes from mechanically leaking damaged muscles cells into the interstitial fluids. This agrees with the study done by Veenestra *et al.,* 1994, Veenstra reported that after exercise there was an increased serum liver enzymes levels. This study done showed that weightlifting resulted in profound increases in the liver function parameters,(Veenestra *et al.,* 1994). The mean levels of ALP of both male and female subjects after exercise was significantly higher than their mean levels before exercise. This elevated levels of ALP after exercise could be as a result of haemoconcentration that occurs during the exercise due to sweating, splenic contraction and elevated body temperature. Higher ALP activity observed after exercise could be due to increased bone mass in physically active subjects. There was an observed slight increase in bilirubin levels after exercise this is in concord with a study done by Damon *et al*.,2013 on the effect of different doses of aerobic exercise training on total bilirubin levels. The finding of this investigation is that exercise training

resulted in a modest but significant elevation in serum bilirubin levels. Since exercise training may increase the activity of heme oxygenase-1 system, it is possible that this could lead to an increase in bilirubin production(Abraham and Kappa *et al*., 2008). Another plausible mechanism is elevated heme catabolism via exercise induced hemolysis due to increased heel strike, elevated core temperature, and oxidative stress during aerobic training (Sentürk *et al*.,2005). Since heme is the pre-cursor to bilirubin production, greater heme bio-availability may promote elevated bilirubin levels downstream (Franchini *et al*.,2010).

The mean levels of albumin levels of both male and female subjects after exercise was significantly higher ($P<0.05$) than their mean levels before exercise. This is in agreement with findings in previous studies. The increase in plasma albumin content after exercise occurs within the first hour of recovery. Thus a redistribution of albumin from the interstitial to the intravascular space is the most likely mechanism for this response (Gillen *et al.*,1991; Nagashima *et al*.,1999). This redistribution of albumin could be the result of increased lymph flow during and after exercise. In addition, the major driving forces for increased lymph flow and muscle pumping, should return to control levels within several hours after exercise. It was estimated that the immediate increase in plasma albumin content after exercise (~8–12 g of albumin) would eventually return to the control state within 24 h if no other compensatory mechanisms existed (Nagashima *et al.*, 1999). The total protein of subjects before and after exercise was also noted. The mean total protein of the subjects after the exercise was not significantly lower than their mean levels before exercise. The exact mechanisms to explain this findings and their clinical significance remain to be determined.

Conclusion

Liver function parameters are significantly increased after exercise. In accordance with these results and to exclude potential exercise related effects on liver function it is important to impose exercise restrictions for at least one week before clinical trials or tests especially liver function tests.

Recommendation

Exercise should be considered as a cause of asymptomatic elevations of liver function tests in daily clinical practice to reduce the risk of erroneous attribution of changes in liver function to pathological conditions or drug effects.

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Authors' Contributions

All authors (Amah U.K, Okoli S.N, Ogbodo E.C, Ezeugwunne I.P, Analike R.A, Onuegbu A.J, Olisekodiaka M.J, Njoku C.M, Oguaka V.N, Meludu S.C.) contributed to the completion of this research work and were actively involved in the presentation of this manuscript.