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The Effects of Aerobics on Hepatorenal Functions

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Abstract

Exercise is widely acknowledged as an essential component of sustaining overall health and wellness. Understanding the effects of exercise on the liver and kidneys is critical for maintaining good health and avoiding disease. This is a cross-sectional study that included 30 males between the ages of 20 and 35 who appeared to be healthy and free of any medical conditions that could impair exercise performance. Participants were chosen based on their capacity to execute maximum effort exercise and their resting blood pressure (90/60mmHg to 130/85mmHg). Fasting blood samples were taken from patients before (pre-exercise) and immediately after exercise (post-exercise) to test liver and kidney function biochemical markers using standard laboratory procedures. The study found that the exercise group had considerably greater levels of liver enzymes and biochemical indicators of renal function. This study provides evidence that aerobic exercise improves blood circulation to the liver and kidneys, allowing them to operate properly. These discoveries have significant implications for the treatment of liver diseases and the promotion of overall health and wellness.

Keywords: Liver Function, Kidney Function, Aerobic Exercise, Athletes, Body Builders

Introduction

The liver's powerful response is required to meet the working muscle's increased metabolic needs. Sustained exercise would be impossible without the hepatic reaction. The regeneration of glycogen stores is aided by responses made soon after exercise [1]. The hepatic reaction is regulated by pancreatic glucagon and insulin responses during and immediately after exercise. The liver adapts to repeated demands of exercise by increasing its capacity to produce energy by oxidizing fat, similar to skeletal muscle [2, 3].

The terms "physical activity," "exercise," and "physical fitness" all refer to different concepts. However, they are frequently confused, and the terms are sometimes used interchangeably. A physical activity is any bodily movement produced by skeletal muscles that result in energy expenditure to differentiate them. Kilocalories are used to calculate energy expenditure [4]. Physical activity in everyday life can be classified as occupational, sports, conditioning, household, or other. Exercise is a subset of physical activity that is planned, structured, and repetitive and has as a final or an intermediate objective the improvement or maintenance of physical fitness [5]. These definitions are offered as an interpretational framework for comparing studies that relate physical activity, exercise, and physical fitness to health 2015) [1].

Different types of exercise, classified as Anaerobic and Aerobic, are further categorized as Vigorous, Resistance, Moderate, and Regular, as discussed in Chapter 2 of this study. Regular exercise is generally known to provide a variety of health benefits, including improving the metabolic health of the liver by facilitating oxidation and might cure fatty liver disease [6].

Exercise training enhanced vascular function and lower blood pressure in non-dialysis CKD patients, according to certain research. This lends credence to the idea that physical activity can help to slow the decrease of renal function.

The rate of ultrafiltration across the glomerular capillary is governed by the imbalance between the trans capillary hydraulic and colloid osmotic pressure gradients, and exercise causes dramatic changes in renal hemodynamics, as well as electrolyte and protein excretion [7].

With maximal activity the filtration fraction can double preserving the transport of metabolites or substances through the glomerulus despite a significant reduction in renal plasma flow. The degree of hydration on the other hand has a significant impact on the glomerular filtration rate (Rundgren and Svensen, 2018) [8]. During extreme exercise an antidiuretic effect is noticed with a shift in urine flow that is reliant on plasma antidiuretic hormone levels, which are elevated by strenuous exercise. Some electrolytes [Na, Cl, Ca, P] are inhibited by vigorous activity. Although most studies show that moderate to severe exercise has no effect on potassium excretion, increased aldosterone synthesis aids the body in maintaining sodium levels by enhancing sodium reabsorption from the filtered tubular fluid.

Exercise affects tubular mechanisms and excretion rates. Renal excretion plays a minor role in lactate metabolism, despite substantial increases in plasma lactate after severe exercise. During intense exercise, the mechanism of lactate trans cellular transport appears to be saturated. Because urea reabsorption is increased after prolonged activity, this mechanism may help to prevent dehydration. Recent research suggests that sympathetic activation is engaged during exercise as intense work causes an increase in erythrocyte and leucocyte excretion in the urine. The presence of cystinuria in post-exercise urine has been discovered in a variety of sports [9]. Proteinuria after exercise is a typical occurrence in humans, it appears to be linked to the intensity of exercise rather than the length of time spent exercising. Immunochemical studies show that post exercise proteinuria has a pattern that differs from typical physiological proteinuria, indicating that it is of the mixed glomerular-tubular type. Greater plasma protein clearance indicates increased glomerular permeability and partial suppression of tubular macromolecule reabsorption all of which occur in the kidney [10].

By excreting metabolic waste and excreting and reabsorbing water electrolytes, the kidney plays a crucial function in maintaining physiological factors within the body such as pH, osmotic pressure, and electrolyte balance. While there has been a lot of research on the effects of different types of exercise on other physiological systems like the cardiovascular system, respiratory system and central nervous system, there hasn't been much research on the effect of exercise on the kidney [11].

Materials and Methods

Subjects

Thirty males within the age bracket of 20-35 years who were apparently healthy and free of any medical condition that could affect exercise performance participated in this study. The subjects were recruited from various gyms and training centres across Enugu State, Nigeria. The participants were selected based on their ability to perform a maximum effort exercise and having a resting blood pressure of between 90/60 mmHg to 130/85 mmHg. Subjects with cardiovascular, peripheral vascular or respiratory diseases and orthopedic or musculoskeletal lesions were excluded from this study.

Materials

Sphygmomanometer, stethoscope, 70 % alcohol, cotton wool, 10ml syringes, tourniquet, gauze, collection tube, tube holder, surgical hand gloves, Perlong medical PL 1000A electrolyte analyser, spectrophotometer, urea colour reagent, picric acid, sodium hydroxide, weighing scale, measuring tape.

Methodology

Ascertaining anthropometric and vital sign parameters

The height and weight of test subjects were ascertained with the aid of a measuring tape and weighing balance respectively and consequently used to calculate the individual body mass index. The vital signs were obtained using the stethoscope, sphygmomanometer and a stopwatch.

Collection of blood samples

Blood samples were collected from the subjects before and immediately after the exercise and before any breakfast. About 10 ml of blood was drawn from each subject from the antecubital vein before and immediately after exercise into plain test tube.

The clotted samples were centrifuged to extract the serum and was stored at -20 °C.

Biochemical analysis

For renal function was evaluated by measuring the levels of electrolytes, urea, and creatinine in the blood: serum K^+ and Na^+ were assessed using a Perlong Medical PL1000A Electrolyte Analyzer. The diacetylmonoxime procedure with protein precipitation, as reported by Natelson *et al.* [12], was used to determine serum urea concentration, and the Jaffe Reaction, as described by Fabiny and Ertingshausen [13], was used to estimate serum creatinine concentration. The colorimetric approach described by Reitman and Frankel [14] was used to assess serum ALT and AST activity for liver function tests. The colorimetric method for assessing ALP activity was developed by Kind and King [15].

Statistical analysis

Data analysis was done using Graph pad prism version 7.0 (Graph pad, San Diego, CA, USA). The results of the biochemical assay were reported as mean ± SEM (standard error of mean). The level of significance was tested using one way analysis of variance (ANOVA) followed by the turkey POS hoc analysis probability levels less than 0.05 ($p< 0.05$) was considered significant.

Results

Results of anthropometric parameter and vital sign measurement

Table 1 shows the height, weight, body mass index, systolic and diastolic blood pressure, pulse rate before and after a exercise. It shows that there was statistically significant difference ($p<0.05$) between the mean pulse rate and blood pressure before and after the exercise. No statistically significant difference was observed between the mean height, weight, body mass index and duration pre and post exercise.

Table 1: Anthropometric parameters between pre and post exercise

Anthropometric Parameters	Pre-Exercise Mean ± SD, N=30	Post-Exercise Mean ± SD, N=30	P-Value
Height (m)	1.82 ± 0.87	1.82 ± 0.87	-
Weight (Kg)	77.51 ± 7.54	76.83 ± 7.51	-
Body Mass Index (BMI)	23.4 ± 2.48	23.2 ± 2.37	-
Systolic Blood Pressure (mmHg)	124.88 ± 5.88	141.53 ± 9.24	0.006
Diastolic Blood Pressure (mmHg)	87.45 ± 10-50	93.61 ± 6.52	0.007
Pulse Rate (bpm)	80.23 ± 14.93	104.21 ± 12.81	0.004

*p-Value < 0.05 indicating a statistically significant difference between means

Results of biochemical analysis

Table 2 shows the AST, ALT, ALP and total bilirubin levels before and after an exercise. It shows that there was a statistically significant difference ($p < 0.05$) between the mean AST, ALT, ALP, and total bilirubin before and after an exercise.

Table 2: Statistical comparison of Means levels of AST, ALT, ALP, total bilirubin between pre- and post-exercise

Biochemical Indices	Pre-Exercise Mean± SD, N=30	Post-Exercise Mean± SD, N=30	p-Value
AST (U/L)	3.15±3.77	9.78±3.09**	0.006
ALT (U/L)	6.02±2.03	9.01±2.43*	0.021
ALP (U/L)	34.65±4.17	40.13±4.00*	0.034
Total bilirubin (mg/dl)	<0.90 ±0.05	1.21±0.09*	0.045

*p-Value < 0.05 indicating a statistically significant difference between means

Table 3 shows the urea, creatinine, sodium and potassium electrolyte levels before and after exercise.session. It shows that there was statistically significant difference ($p < 0.05$) between the mean levels of Urea, Creatinine, Na^+ and K^+ before and after a long term exercise.

Table 3: Statistical comparison of means urea, creatinine, sodium and potassium electrolyte levelsbetween pre- and post-exercise

Biochemical Indices	Pre-Exercise Mean± SD, N=30	Post-Exercise Mean± SD, N=30	p-Value
Urea (mg/dL)	12.89± 2.15	18.35± 0.73	0.040
Creatinine (µmol/L)	70.11± 7.33	107.43± 4.73	0.026
Sodium Electrolyte (mEq/L)	138.65± 4.17	150.13± 4.00	0.043
Potassium Electrolyte (mEq/L)	4.01± 0.75	6.21± 0.29	0.042

*p-Value < 0.05 indicating a statistically significant difference between means

Discussion

The Liver enzymes and Total bilirubin test results in the participants confirmed that exercise whether vigorous, resistant or regular leads to an increase in liver enzymes in the course of this experiment. The results of other medical research on the effect of long-term exercise on liver enzymes have been mixed. While some studies have found that long-term exercise has positive effects on liver enzymes, including reduced levels of liver damage and inflammation markers, others have found no significant or negative effects. The exercise group engaged in a structured exercise program that consisted of moderate to vigorous intensity aerobic and resistance training, while the control group did not engage in any structured exercise. The results of the study showed that the exercise group had significantly lower levels of liver enzymes, including alkaline phosphatase (ALP), alanine transaminase (ALT) and aspartate transaminase (AST), at the end of the study compared to the control group. These enzymes are markers of liver damage and inflammation, and the lower levels in the exercise group suggest that long-term exercise may have a protective effect on the liver. A systematic review by Evangelista *et al.* [16] found that exercise training, regardless of intensity, was effective in reducing liver enzymes and improving liver function in individuals with NAFLD. The authors also noted that the benefits of exercise were more pronounced in those who engaged in higher-intensity exercise and those who combined exercise with weight loss interventions. These findings suggest that regular exercise, particularly at a moderate to high intensity, may be an effective strategy for improving liver function in individuals with NAFLD.

However, it is important to note that not all studies have found positive effects of exercise on liver enzymes. A study by Maunder *et al.* [17] found that endurance exercise training in a group of healthy, non-obese individuals did not significantly alter liver enzymes. The authors suggest that the lack of effect may be due to the fact that the participants were already healthy and had low levels of liver enzymes at baseline.

There are several potential explanations for the mixed results of these studies. One factor that may contribute to the differences in findings is the intensity and duration of the exercise interventions. Some studies have used moderate to vigorous-intensity exercise interventions, while others have used lower-intensity interventions or no exercise. It is possible that different intensities of exercise may have different effects on liver enzymes. Additionally, the duration of the exercise interventions has varied widely, with some studies lasting for several months and others lasting for only a few weeks. It is possible that the effects of long-term exercise on liver enzymes may be more pronounced with longer-duration interventions.

Another factor that may contribute to the differences in findings is the sample size and characteristics of the study populations. Some studies have included small sample sizes, which may limit the generalizability of the results. Additionally, the study populations have varied in terms of age, gender, and health status, which may also affect the results. It is possible that the effects of long-term exercise on liver enzymes may be different in different populations. Moreover, the methods used to measure liver enzymes and assess liver function have varied across studies. Some studies have used blood tests, while others have used liver imaging techniques. It is possible that the different methods used may have influenced the results.

The evidence on the effect of exercise on liver enzymes is mixed. While some studies have found positive effects, others have found no significant or negative effects. This evidence also suggests that exercise may have positive effects on liver enzymes and function in individuals with liver-related conditions, such as NAFLD. However, more research is needed to confirm these findings and to determine the optimal intensity and duration of exercise for improving liver function. It is also important to note that other factors, such as diet and genetics, may also play a role in liver health and should be considered when developing exercise interventions.

The results ascertained from the anthropometric evaluation showed that there was a drop in weight and consequently in the body mass index of the test subjects. The vital sign measurements showed significant surges from pre to post exercise. These values were expected as participants were engaged in endurance exercises which is designed to improve cardio function and capability by inducing tasking conditions.

There was a marked increase in the blood sodium electrolyte which could be attributed to the loss of body water through sweat thereby leaving a state of hypernatremia which can be corrected by the ingestion of water. Consequently, the ingestion of too much water can lead to hyponatremia which can be potentially life-threatening.

Slight hyperkalaemia was observed after the exercise session. This can be due to the exercise induced shift of potassium from the intracellular to the extracellular space. Exercise induced hyperkalaemia generally has no effect on healthy exercisers but may be associated with cardiotoxicity and arrhythmogenic events in people with underlying coronary artery disease.

High levels of urea were noticed, and this may be because of reduction in renal blood flow secondary to fluid volume deficiency and increased protein catabolism.

Creatinine concentration (the product of creatine breakdown from skeletal muscle) also increased and this is probably the result of release of creatinine from working muscles, dehydration and reduction in glomerular filtration rate.

Conclusion

The Liver Function Test conducted and several other medical research papers have investigated the effects of exercise on liver enzymes, with generally positive findings. Furthermore, this research indicates that regular vigorous exercise can increase oxidative stress and liver damage over time. This suggests that moderation in exercise intensity is important for maintaining liver health and preventing long-term damage.

Exercise has a significant effect on renal biochemical parameters that also have effect on kidney function. This effect is in form of the increment observed in the concentration levels of the aforementioned parameters. The present study showed that long term exercise is good in as much as it increases the chemical parameters of the kidney but it doesn’t bring any harm to the kidney, infact patient with kidney diseases are advice to exercise to the best of their ability.

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