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Liver Function Markers Response to Different Exercise Intensities in Athletes: A Single Bout Perspective

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ABSTRACT

Exercise provides considerable health advantages through promoting proper body system functioning, healthy growth and development, and quality of life. The present study investigated the effect of single bout High- Intensity Exercise (HIE) compared to Low-Intensity Exercise (LIE) on liver function markers in athletes. This cross-sectional study was carried out in the Department of Physical Education, Banaras Hindu University, Varanasi (UP). A total of 20 healthy male athletes with age range from 22 to 26 years were randomly selected and underwent 5 minutes of HIE and LIE separated by one week. Blood samples for selected liver function markers were taken pre-exercise, immediately, 10 and 20 minutes post-HIE and LIE, respectively. A repeated measures ANOVA with greenhouse-geisser correction found a significant difference between high and low intensity exercises for SGOT ($F=5.881$; $p<0.05$) and SBT ($F=7.154$; $p<0.05$) values, while statistically insignificant in the case of SGPT ($F=1.572$; $p>0.05$). In high intensity exercise there was statistically significant difference for SGOT ($F=7.564$; $p<0.05$) value between different time points. Post hoc analysis with a bonferroni correction showed that SGOT value was significantly increased immediately after the HIE, reducing 10 minutes after the exercise and closely returned to baseline level after 20 minutes of exercise, whereas LIE showed no significant changes. Exercise intensity is important as it triggers liver pathology by asymptomatic modifying liver function markers. These findings can be used to develop and administer exercise training plans for athletes.

Keywords: Acute; Athletes; Exercise; Liver; Biomarker

1. INTRODUCTION

Liver problems are gradually becoming identified as public health issues in India. In 2015, India accounted for 18.3 % of the two million liver disease-related deaths worldwide[1]. India's rapid cultural-lifestyle transition, characterized by a western diet, sedentary habits, and a shift away from alcohol taboos, is leading to a spectrum of liver diseases[2]. This shift emphasises Alcoholic Liver Disease (ALD) and Non-Alcoholic Fatty Liver Disease (NAFLD) as liver disease causes in addition to viral factors[3]. The liver, which is positioned in the right upper quadrant, is responsible for detoxification, digestion, protein synthesis, metabolism, red blood cell regulation, and glucose storage and is interconnected with other vital organs. It acts as the body's engine, which is necessary for athletic performance. Maintaining appropriate liver enzyme levels limits inflammation and damage, but liver malfunction can result in acute or chronic liver disorders and ultimately affect overall performance[4].

Exercise is a common non-pharmacological approach to prevent non-communicable illnesses including cancer, obesity, hypertension, heart disease, liver disorders, type 2 diabetes, etc, by improving the quality of life[5,6,7]. It consists of structured activities that trigger certain physiological and biochemical responses, with the goal of adjusting the organism to the demands of exercise[4]. These acute responses have an ordered sequence of events that affect many organic systems based on exercise intensity[8,9]. Exercise can be described as a deliberate, organized, and repetitive series of physical activities aimed at enhancing one's physical fitness[10]. The World Health Organization recommends 150-75 minutes of moderate to vigorous intensity physical activity per week for healthy adults[11,12], however, 1.4 billion people do not meet these standards[13]. Time is considered an important hurdle to exercise commitment, leading to research focusing on short-term exercise training models[14,15]. Furthermore, a review study[16] shows a linear relationship between physical activity and health status, suggesting that further improvements in fitness can lead to better health.

High-intensity interval training exercise offers several benefits and is distinguished by short periods of vigorous physical activity, usually lasting one to four minutes,

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followed by intervals of lower-intensity exercise or rest[17], and this training program was rated top in the health and fitness trends because of its time-saving nature[18,19]. During training sessions, several types of high intensities are used by varying factors such as intensity, length, interval number, recovery time, and so on[20,21,22]. Likewise, low-intensity exercise is a moderate, comfortable activity that improves aerobic capacity with 40-45 % maximum oxygen consumption[23]. Physical activity or exercise benefits liver function in a variety of ways[24,25,26].

According to available information and the author's knowledge, no study has been undertaken to explore the influence of high and low-intensity exercise on liver function, particularly in athletes. Therefore, this study investigated the effect of single bout high and low-intensity exercise on liver function markers in adult athletes, who may be at risk for liver function abnormalities as a result of increased oxidative stress and inflammation from intensive physical activity.

2. MATERIAL AND METHODS

2.1 Study Participants

A total of 30 male athletes from various sports backgrounds, which include team and individual sports, representing a diverse range of training intensities and durations from Banaras Hindu University (BHU), Varanasi, India, with an age range of 22 to 26 years (23.75±1.45 years) were recruited randomly as study subjects. Only 20 athletes completed the required testing procedure and were selected as subjects. Those who weren't able to finish the testing procedure and had a history of liver diseases, diabetes, hypertension, asthma, or were on medication were excluded. The standard testing protocol was used to collect data on selected liver function markers.

All subjects lived in a hostel and had similar eating routines. Before testing, the researcher explained the testing process to authorities and subjects to ensure clarity on the expected effort. All research subjects consented, understood conditions, and signed consent forms confirming their understanding. They were instructed to fast overnight, avoid caffeine, smoking, and exercise before testing. Equipment administration was explained and demonstrated before testing. To ensure similar testing conditions, height, weight, BMI, and blood samples for chosen liver function markers (SGPT, SGOT, SBT) were collected from 5:00 to 9:00 a.m. before breakfast. The subjects' blood pressure ranged between 136 and 118 mmHg, while their heart rate ranged from 54 to 87 beats per minute. The maximum heart rate (HR_{max}) of each participant was computed using an age-based prediction method known as the "220 - Age"(HR_{max} = 220 - Age). The research was approved by the Institutional Ethics Committee, Institute of Medical Sciences, BHU, Varanasi (Letter No.Dean/2022/EC/4043 dated 15/04/2023) and followed the Helsinki Declaration.

2.2 Exercise Testing

To begin, all participants underwent familiarisation trials to get familiar with all the testing procedures to limit the learning effect, as well as the way of completing anthropometric tests and exercise protocol. During the testing day, subjects were taken for a warm-up and light stretching before administrating the exercise to ensure optimum performance and minimize the chance of injury. The subjects were now allowed to run on the treadmill for HIE. The exercise involved progressively incremental treadmill running by increasing the speed at 3 km/hour alternatively after every minute until the subject reached to high intensity zone i.e., 77-95 % of HR_{max}. Now, the subjects are instructed to maintain the same intensity for 5 minutes or until exhaustion. The researcher used a heart rate monitor before and during exercise to control exercise intensity. After one week, the same approach was used for LIE at low intensity zone i.e., 57-63 % of $HR_{max.}$

Before and following treadmill activity, 5ml blood from the antecubital vein of each subject was collected at regular intervals (immediately after activity, after 10 minutes, and after 20 minutes of exercise) by a phleboto mistand kept in EDTA-containing biochemistry tubes. After 30 minutes at room temperature, blood samples were centrifuged for 15 minutes at 3000 rpm. Samples of serum were placed in two 100µl micro-centrifuge tubes using automated pipettes and stored at −80 °C until analysis. Primary care was provided by an emergency physician during functional testing.

2.3 Measurement

Blood samples were drawn by a professional laboratory technician and examined by a NABL-accredited laboratory pathologist for chosen liver function markers viz. SGPT, SGOT, SBT using a semi-automatic analyzer in the Centre for Clinical Investigation (CCI) Laboratory, Institute of Medical Science (IMS), BHU, Varanasi. All research equipments were calibrated prior to the start of the investigation. Height (meters) and weight (kilograms) were determined using a DD-MS01 body composition analyzer (body fat version). Additionally, Body Mass Index (BMI) was computed by dividing body weight by height squared (kg/m^2). IFCC-UV without a P5P test was performed to analyze selected liver function markers.

2.4 Statistical Analysis

Data from various tests and measurements were processed for data analysis using SPSS 25.0 version. The mean and standard deviation (Mean ± SD) were used to represent descriptive statistics. The effects of high and low-intensity exercise on selected liver function markers were examined using repeated measures analysis of variance with time as the within-group factor, t-tests, and bonferroni adjustment for multiple comparisons. Statistical significance was determined at $p < 0.05$ level.

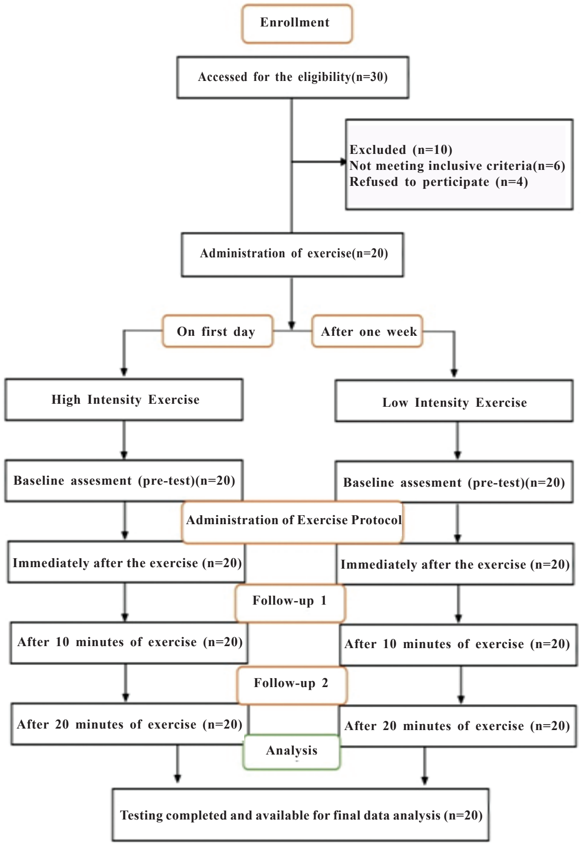

Figure 1. Flow diagram for study subjects' eligibility, testing, and analysis.

3. RESULTS

Table 1 revealed the descriptive statistics (mean and standard deviation) of age, height, weight, and body mass index were 23.75±1.45 years, 1.64±0.34 meters, 68.71±7.35 kilograms, and 23.23±1.93kg/m^2 respectively.

Table 2 depicts the changes in liver markers viz., SGPT, SGOT, and SBT counts immediately following high and low-intensity exercise, ATM, and ATWM. A repeated measures ANOVA with greenhouse-geisser correction found a significant difference between high and low intensity exercises for SGOT ($F=5.881$; $p<0.05$) and SBT ($F=7.154$; $p<0.05$)values, while statistically insignificant in the case of SGPT ($F=1.572$; $p>0.05$). In high intensity exercise there was statistically significant difference for SGOT ($F=7.564$; $p<0.05$) value between different time points. Post hoc analysis with a bonferroni correction showed that SGOT value was significantly increased immediately after the HIE, reducing 10 minutes after the exercise and closely returned to base line level after 20 minutes of exercise, whereas LIE showed no significant changes.

*Significant p<0.05, RMANOVA (*repeated measures ANOVA*), SGPT (Serum Glutamic Pyruvic Transaminase), SGOT (Serum Glutamic Oxaloacetic Transaminase), SBT (Serum Bilirubin Total), BE (Before Exercise), IAE (Immediate after Exercise), ATM (After 10 minutes), ATWM (After 20 minutes), #Significant difference between IAE with BE using bonfferoni' s post hoc test (p< 0.05)

Table 1. Descriptive Statistics

Variables	Mean	Standard Deviation (SD)
Age (years)	23.75	1.45
Height (meters)	1.64	0.34
Weight (kilograms)	68.71	7.35
Body Mass Index (kg/m^2)	23.23	1.93

Table 2. Changes in selected liver markers counts immediately following high and low-intensity exercise, ATM, and ATWM (mean ± SD) (n = 20)

Variable	BE	IAE (BE Vs. IAE)	ATM (BE Vs. ATM)	ATWM (BE Vs. ATWM)	Intensity p-value	Time p-value	Effect (Intensity x time) p-value
SGPT							
High Intensity	28.58 (15.1)	31.85 (18.74)	30.43 (18.17)	29.80 (17.60)	0.225	0.241	0.203
Low Intensity		28.29 (15.61)	27.66 (15.37)	27.61 (15.24)			
SGOT							
High Intensity	30.16 (10.83)	35.66 (10.08)#	34.38 (9.56)	33.41(9.60)	0.028*	0.006*	0.022*
Low Intensity		30.84 (11.54)	29.98(11.21)	30.08 (10.77)			
SBT							
High Intensity	0.67 (0.36)	0.61 (0.34)	0.58 (0.32)	0.57(0.31)	0.015*	0.101	0.012*
Low Intensity		0.70 (0.38)	0.69 (0.37)	0.69 (0.38)			

4. DISCUSSION

The liver is an important organ in the human body that executes a range of functions. Increased liver activity or higher liver enzymes are signs of liver damage. Increased liver function during clinical trials may be drug-related, but other variables, such as exercise, may also have this impact. Mild liver function tests elevations like AST (SGOT) and ALT (SGPT) can indicate serious illness or be temporary. Although transaminases are called "liver enzymes," this is not true actually. They may be increased for extrahepatic reasons[27]. Myocardial infarction, surgery, strenuous exercise, hemolysis, and small bowel ischemia can raise transaminase levels extrahepatically[28].

The present study aims to find out the effects of single bout high versus (77-95 % of HR_{max}) low-intensity exercise (57-63 % of HR_{max}) bouts on selected liver function markers (SBT, SGOT, SGPT) in athletes (22 to 26 years). The result of the study showed a significant difference in SGOT between intensity and time points. However, there was a significant difference observed in SBT across intensity but not between time periods. SGPT, on the other hand, does not demonstrate any significant results in terms of the impact of intensity and time points. Furthermore, a significant difference was observed in SGOT at IAE as compared to BE and returned near to baseline after 20 minutes of exercise in both intensities.

Despite no significant effects of intensity or time, the current study found that SGPT increases immediately post-HIE. Several studies investigated the effect of HIE on SGPT. The findings of these researches suggest that HIE affects liver function markers. This is consistent with previous research that looked at ultra marathon runners' haematology and biochemistry before and after a long-distance race. Following the race, the alanine aminotransferase (ALT), also known as SGPT, increased. The research found that athletes doing high-intensity exercise must monitor their liver function[29]. Another study showed that moderate intensity of physical activity could increase significantly liver function tests[30]. Further, a study evaluated the effects of short-term intensive exercise on liver enzymes in kickboxing athletes and observed an increase in serum ALT (SGPT) enzyme activity following short-term intensive exercise[31].

The present study further revealed a significant difference in SGOT also known as aspartate aminotransferase (AST) between intensity, time point, and intensity x time point interaction. Furthermore, it was found that HIE increases the SGOT level as compared to LIE. These findings partially support the study which also found a significant increase in SGOT (AST) after intensive muscular exercise in fifteen healthy men[28]. Another study examined how moderate-intensity physical exercise influenced liver function by altering SGOT and SGPT levels. SGOT levels significantly increased after moderate-intensity exercise. Elevation of liver transaminase is mainly induced by liver damage owing to liver disorders and also may be enhanced by an extra hepatic process such as physical activity[30]. Overall, the effect of acute exercise on SGOT levels may vary depending on factors such as age, gender, and alcohol consumption[32]. A case study report on an Asian male with abnormal liver enzymes found that exercise may be linked to changes in liver enzymes. After stopping intensive activity, AST and ALT levels came back to normal. This considerable connection in blood results suggested exercise routines as the likely cause of the altered enzymes[33].

Similarly, within the study, findings also showed a significant difference in SBT between intensity but not on time point. Furthermore, when compared to HIE, LIE has a significant increase in SBT and returns to nearly normal after 20 minutes. Similar results were also found in the study that demonstrated aerobic exercise training significantly increased serum bilirubin levels[34]. Since heme is a precursor to bilirubin formation, increased heme metabolism may raise downstream bilirubin levels[35]. Another study shows that exercise increases plasma bilirubin by altering hepatic enzymes and enhancing liver function and concluded that exercise may improve human plasma bilirubin levels and health through several pathways[36]. Likewise, in another research, exercise increased bilirubin, which reduced fat and improved cardiovascular health[37]. In contrast, a study reported that bilirubin remained within the normal range after moderate physical activity[38].

Subsequently, this cross-sectional investigation found that single bout of exercise can cause an inflammatory response in the blood by raising liver function markers. The observed increase in selected markers is intended to restore the body's physiological balance after it has been disturbed. These marker alterations have provided vital insights into the physiological adaptation process and overall health during physical activity. One advantage of our study was that we primarily examined the acute effects of high- and low-intensity exercise on liver function markers. However, the present study has limitations. This study had a small sample size, limiting generalisability and requiring a high alpha level. Second, only athletes and a specific region were studied. Thirdly, no data was gathered about additional environmental and psychological factors that may have had an impact. The present study's conclusions need to be cross-validated with a larger, more diversified sample.

5. CONCLUSION

Improving quality of life through exercise is a frequent non-pharmacological way to avoid non-communicable diseases. There has been little research on the acute impact of high-intensity versus low-intensity exercise on liver function markers in athletes. The present study found that SGPT values increased after HIE and then reverted to normal 20 minutes later, whereas LIE did not. Both intensity and time point have significant differences in SGOT levels. LIE does not enhance SGPT and SGOT liver indicators, whereas HIE does. After LIE, SBT levels increased, whereas HIE decreased. According to the study, exercise intensity asymptomatically changes liver function markers, triggering liver damage and being associated with high levels of oxidative stress and inflammation. These findings can be considered for developing and implementing training plans for athletes.

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