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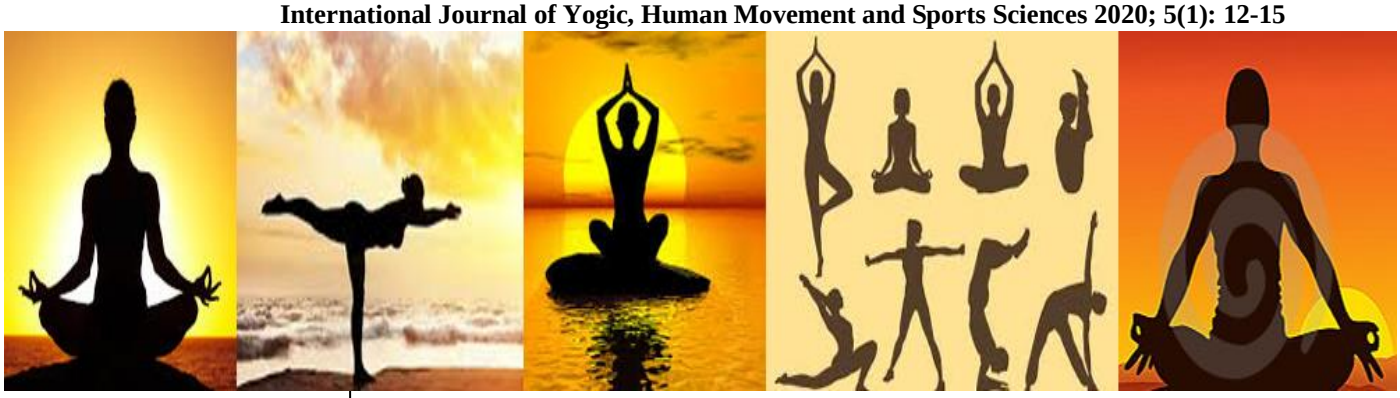

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# Effect of weight lifting exercise session on biochemical parameters of Indian weight lifters

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**Abstract**
This study is an attempt to understand the effect of weight lifting exercise session on biochemical parameters of Indian weight lifters. 12 Indian weight lifters, who were training in Sports authority of India, NSSC, Bangalore were volunteered for this study. They were given weight lifting exercises viz., clean & jerk, snatch and back squat with 75-80% relative intensity. Both pre and post exercise blood samples were collected with all sterility precautions and samples were analyzed for biochemical parameters. The data were statistically analyzed by paired "t"-test by comparing the pre and post-exercise values of selected variables. The results revealed that the levels of urea, creatine phosphokinase (CPK), lactate Dehydrogenase (LDH) and albumin were significantly increased after the training session whereas, Cholesterol, HDL-C and LDL-C levels decreased significantly. The results concluded that the 75-80% relative intensity weight lifting exercise session alters the biochemical parameters by increasing body metabolic activity.

**Keywords:** Weight lifting exercise, muscle enzymes, metabolites, lipid profile, serum protein

## Introduction
Snatch, clean and jerk are the two main exercise form of Olympic weight lifting. These exercises will use every muscle in the human body and they don't just measure a person's strength, they require extreme amounts of speed, power, explosiveness, flexibility, mobility and agility. Snatch needmore flexibility and coordination, while the clean and jerk will enhance strength (http://barbend.com/clean-and-jerk-benefits, 2017) [12]. Apart from Snatch, clean and jerk squat is incorporated often in weight lifting training to enhance the muscle mass, strength and skills. Squat is considered as an effective exercise for building up the muscle mass and strength of the legs and hips. There are many variations in squat, but the most familiar is the back squat, in which you place a barbell or smith machine bar on your upper back as a means of resistance. Some of the largest muscle groups of the body are worked during the back squat, including the quadriceps, gluteus maximus, and adductor magnus. Metabolic changes that take place during these exercises will help to acquire training adaptations and to enhance the performance. To know the actual metabolic changes during exercise some of the blood biochemical parameters play as a marker. The elevation and depletion in certain blood biochemical parameters will indicate the actual metabolic changes occurring due to exercise. Some of the general biochemical parameters are metabolites, muscle enzymes, lipid profile, and serum protein. During exercise, to fulfill the energy requirements carbohydrates, proteins and lipids degradation will take place. Degradation of these major energy sources leads to the increase in the metabolic end products and also increased enzyme activity. Metabolites such as urea and uric acids are the catabolic end product of protein and adenosine nucleotides respectively (Heitkamp *et al*., 2008 and Korgotichs *et al*., 2007) [10, 14]. Muscle enzymes, CPK and LDH are considered as markers of muscle damage (Butova OA, *et al*., 2009) [2]. A serum protein which includes albumin and globulin partially represents the nutritional status and immune system (Michael Gleeson, 2002) [18]. Analysis of these biochemical parameters gives a complete picture of the nutritional, recovery status as well as the adverse changes occurring due to training in athletes. The studies related to general blood biochemical changes in Indian weight lifters are very limited. Thus, to know the actual

biochemical changes occur in Indian weight lifters due to weight lifting exercise the present study have been executed.

## Methodology

Subjects: Twelve participants (5 male and 7 female) aged between 15-20 years, with the training experience of 2-7 years were recruited for this study from Sports Authority of India, Netaji Subhas Southern Center, Bangalore. Participants were informed about the potential risks and discomforts associated with the investigation and written consents were obtained from all the participants.

Weight lifting exercise session: The lifters were given weight lifting exercise viz., Snatch, Clean & Jerk and Back Squat with average of 1-5 repetitions/set, 1-6 sets/exercise of 75-80% relative intensity.

## Sample collection and processing

Approximately 3ml blood was collected from antecubital vein of the participants with all sterility precautions both before and after the exercise session. The samples were transferred into the vacuum tube with clot activator and allowed to clot at room temperature for 30 minutes and centrifuged at 1500g for 10 minutes to separate the serum. These serum samples were analyzed for selected biochemical parameters such as metabolites (Urea and Uric Acid), serum proteins (Total Protein and Albumin, Globulin), lipid profile (Cholesterol, Triglyceride and High Density Lipoprotein Cholesterol (HDL-C)) and muscle enzymes such as Creatine Phospho Kinase (CPK) and Lactate DeHydrogenase (LDH). All these parameters were analyzed by colorimetric method using Erba Chem.-7, semi automatic chemical analyzer. Very Low Density Lipoprotein Cholesterol (VLDL-C) and Low Density Lipoprotein Cholestrol (LDL-C) was calculated using Friedewald equation (Friedwal *et al*., 1972) [6] VLDL- C (mg/dl) = (Triglycerides/5) and LDL-C (mg/dl) = Total Cholesterol – (HDL-C +VLDL -C).

## Statistical analysis

The data were statistically analyzed by paired "t"-test by comparing the pre and post exercise values of selected variables using SPSS Software (14- Version). Gender specific Variables such as CPK and LDH were analyzed separately for both the genders. The significance level was considered as $P \leq 0.05$. The effect size was calculated using Cohen's d equation.

## Results and discussion

**Metabolites:** Serum urea and uric acid levels are often considered as a measure of protein and adenonucleotides degradation (Heitkamp *et al*., 2008 and Korgotichs *et al*., 2007) [10, 14] respectively. It is believed that a pronounced increase in the urea and uric acid concentration indicates strong influence of a training session, whereas normalization of the urea and uric acid level in blood is an index of time to perform subsequent strenuous training sessions (Urhausen *et al*., 2002) [25]. Results of this study have shown a significant increase in urea levels and an insignificant increase of Uric acid level in weight lifters after exercise sessions. The studies done by Stacy *et al.,* (2017) [23] is reliable with the present study results where the uric acid level increased after 4.24hrs of marathon run. The profuse sweating exercise results in a decrease of urinary uric acid excretion amounts and leads to increased serum uric acid after the exercise (Li-Leng Huang *et al.,* 2010) [16]. No studies were found related to changes in urea and uric acid levels in weight lifters after weight lifting exercise.

**Muscle enzymes:** CPK is a catalyzing enzyme of creatine phosphorylation in the phosphagen energy system. LDH is a rate-limiting enzyme to adjust reactions from pyruvate to lactic acid in the glycolysis system of the terminal TCA cycle. Both CPK and LDH are considered as markers of muscle damage. In the present study both CPK and LDH level increased significantly after exercise session both in male and female weight lifters (Fig-2) and also these values were found higher than the sedentary/ normal reference interval. As per the studies done by Vassilis Mougios in 2007 [27] and K. Usha kanigatti *et al*., in 2017 [16] the reference interval of athletes for serum CPK is 82-1086U/L in male and in female it is 47-513 U/L. Similarly the study done by S. Srividya *et al.,* in 2015 [24] shows that the reference interval of athletes for serum LDH is 138.4-746.0 U/L in male and 140.5-599.5 U/L in female. This indicates that the sports training and competition have profound effect on the reference intervals of CPK and LDH. Further, Jonas Pettersson *et al*., in 2008 and G. A. Callegari *et al*., in 2017 [9] found that one hour intense weight lifting exercise elevates CPK and LDH levels in weight lifters.

**Lipid profile:** The current study results shows significant decrease in Cholesterol, LDL-C and increase in HDL-C immediately after exercise session (Fig-3). During exercise carbohydrates and lipids act as a major energy source to fulfill the metabolic energy demand. Strenuous submaximal exercise requiring 65 to 80 per cent of $VO_2$ max will utilize less fat (10 to 45 per cent of the energy expended). Exercise training is accompanied by metabolic adaptations that occur in skeletal muscle and adipose tissue and that facilitate a greater delivery and oxidation of fatty acids during exercise. Trained individuals oxidize more fat and less carbohydrate than untrained subjects when performing submaximal work of the same absolute intensity. This increased capacity to utilize energy from fat conserves crucial muscle and liver glycogen stores and can contribute to increase performance (Askew E W, 1984) [1]. In 2010, Fabio S.L *et al*., [5] concluded that low and moderate resistance training exercise benefits lipid profile rather than higher intensity. According to Yating Wang *et al*., (2017) [12] review article decrease in total cholesterol (TC), LDL-C, triglyceride and elevations in HDL-C are favorable changes observed after exercise in maximum research studies which is consistent with the present study.

**Serum protein:** Albumin and globulin are main components of serum protein. The level of albumin and globulin partially represents the nutritional status and immune system. In present study, significant increase of serum albumin and insignificant decrease of total protein and globulin levels were observed after exercise. Increased Albumin indicates the increased oncotic pressure in blood compartment during exercise and it is proven that albumin maintain the oncotic pressure by regulating blood volume. Insignificant decrease in the total protein and significant increase in urea levels indicates increased protein degradation during exercise and it is proven that some amino acids can be used directly as fuels for ATP production during exercise.

**Table 2:** Effect of weight lifting exercise on biochemical variables

| Biochemical Parameters | Pre- Exercise | Post exercise | "t" | Sig.(2tailed) | Effect Size |
|---|---|---|---|---|---|
| Urea (mg/dl) | 33.26±5.25 | 35.36±5.71 | 2.79* | 0.018 | 0.81 |
| Uric Acid (mg/dl) | 4.82±1.35 | 5.31±1.25 | 2.09 | 0.061 | 0.60 |
| Triglycerides (mg/dl) | 124.21±54.37 | 108.07±40.33 | 1.96 | 0.076 | 0.57 |
| Cholesterol (mg/dl) | 204 ±30.37 | 197.72 ±34.98 | 3.05* | 0.011 | 0.88 |
| HDL-C (mg/dl) | 39.14 ±10.18 | 44.93 ±11.23 | 5.05* | 0.000 | 1.46 |
| VLDL-C (mg/dl) | 78.79 ±76.5 | 76.28 ±75.17 | 1.47 | 0.170 | 0.88 |
| LDL-C (mg/dl) | 87.6 ± 53.79 | 81.05 ±55.08 | 3.04* | 0.011 | 0.42 |
| Total protein (g/dl) | 7.70 ±0.61 | 7.62 ±0.47 | 0.45 | 0.664 | 0.13 |
| Albumin (g/dl) | 4.59 ±0.21 | 4.89 ±0.34 | 2.69* | 0.021 | 0.78 |
| Globulin (g/dl) | 3.11 ±0.57 | 2.74 ±0.59 | 1.48 | 0.168 | 0.43 |
| A/G ratio (g/dl) | 1.52 ±0.28 | 1.89±0.59 | 1.75 | 0.108 | 0.51 |

*Significant @ 0.05 level "t" value to be significant with df (11) =2.113

**Table 3:** Effect of weight lifting exercise on CPK and LDH

| Biochemical Parameters | Gender | Pre- Exercise | Post exercise | "t" | Sig.(2tailed) | Effect Size |
|---|---|---|---|---|---|---|
| CPK (U/L) | Male | 683.74± 411.63 | 913.02 ±644.31 | 2.74* | 0.015 | 1.02 |
| | Female | 284.63 ±209.67 | 370.45 ± 255.65 | 4.98* | 0.002 | 1.76 |
| LDH (U/L) | Male | 406.98 ± 114.03 | 484.50 ±140.26 | 3.21* | 0.033 | 1.44 |
| | Female | 466.34 ±48.72 | 530.51 ±55.96 | 4.92* | 0.002 | 1.74 |

Male: *Significant @ 0.05 level "t" value to be significant with df (4) = 2.531
Female: *Significant @ 0.05 level "t" value to be significant with df (7) = 2.365

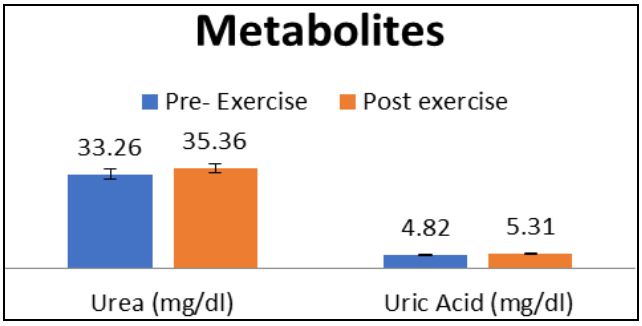


**Fig 1:** Effect of weight lifting exercise on metabolites viz., urea (mg/dl) and uric acid (mg/dl) levels.

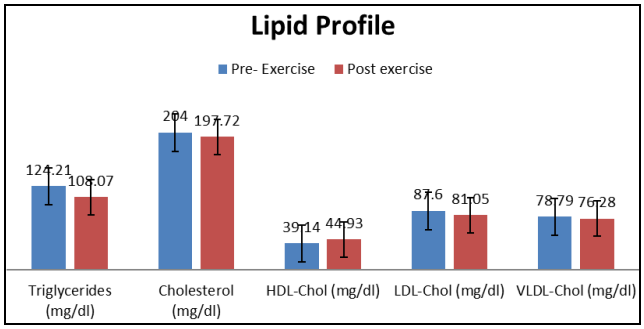


**Fig 2:** Effect of weight lifting exercise on Lipid profile parameters viz., triglycerides, cholesterol, HDL-C, LDL-C and VLDL-C levels in weight lifters.

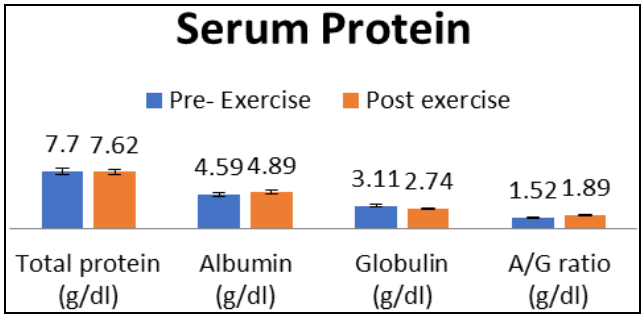


**Fig 3:** Effect of weight lifting exercise on serum protein parameter viz., Total Protein, Albumin, Globulin and A/G ratio in weight lifters.

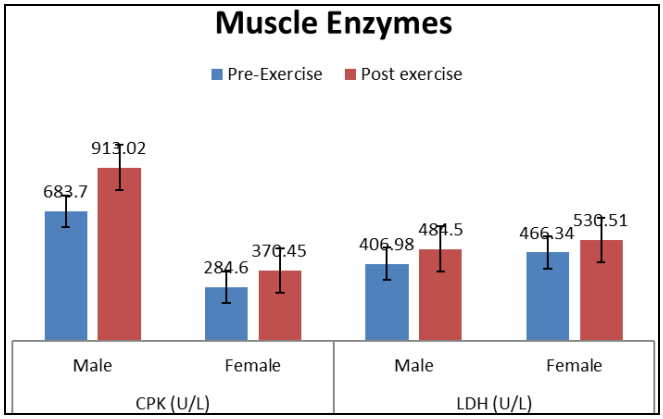


**Fig 4:** Effect of weight lifting exercise on muscle enzymes CPK and LDH levels in male and female weight lifters.

## Conclusion

Increase in the metabolites and muscle enzymes; decrease in lipid profile parameters and changes in the serum protein level after weight lifting exercise indicates increased metabolic activity during exercise in lifters. Thus the study concludes that weight lifting exercise significantly alter the general biochemical parameters in Indian weight lifters to fulfill the body energy requirement during the exercise. The biochemical changes are also dependent on the severity, duration and frequency of exercise as well as physical and physiological status of lifters. This kind of studies will help to rule out the adverse changes or negative adaptations that are taking place in athletes during training and to make necessary modifications in training protocol or dietary habits of the athletes.

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