Effect of Weight Training on Protein Metabolism in Members of the Padang State University Fitness Center

E Yuniarti*, A Rahmah, F Fortuna
Biology Department, Faculty of Mathematics and Science, Universitas Negeri Padang, Indonesia. Jl. Prof. Dr. Hamka Air Tawar Barat, Padang, West Sumatera, Indonesia

*elsayuniarti@gmail.com

Abstract. Weight training on muscles will affect protein metabolism. No studies have been conducted regarding the effect of weight training on keratinin, urea, and total protein levels. This study was an experiment with the pre and post-test group method on 22 male people who met the criteria at the Padang State University fitness center. The results showed that there was an average increase in creatinine levels, where the average value of creatinine before weight training was 0.823 mg/dL and after weight training was 0.959 mg/dL. The total protein pretest value was 8.33 ± 1.72 g/dL while there was a decrease in the average posttest amounting to 6.72 ± 1.54 g/dL. The average pretest urea level was 16.95 ± 9.93 mg/dL, while the posttest average increased by 24.68 ± 16.79 mg/dL. It can be concluded that there is an effect of weight training on creatinine, urea and total protein levels with a p value <0.05.

1. Introduction
Sport is a human effort to achieve health and fitness, which is characterized by a series of regular and planned exercise that is carried out consciously to improve their functional abilities in accordance with the purpose of doing sports. One of them is to have an ideal and proportional body. Having ideal and proportional body muscles is the dream of every individual, especially for men. This is enough to affect his performance or appearance in the eyes of others. The best sport to achieve this goal is weight training [1].

Weight training is a sport that is in demand by various groups of society which aims to increase muscle capacity, maintain body health and form an athletic posture. Weight training carried out for muscle building is highly influenced by the energy generated from the breakdown of creatine and phosphocreatine. Creatine phosphate prevents the rapid depletion of ATP by providing high-energy phosphate which can be used to regenerate ATP from ADP. Creatine phosphate is formed from ATP and creatine when the muscles are resting and when the need for ATP is not too great. This process takes place in the muscles and is irreversible and produces creatinine as a waste product which is present in the blood and excreted in the urine [2].

The amount of creatinine released by a person every day depends more on muscle mass than muscle activity or protein metabolic rate. This causes the creatinine value in men to be higher because the amount of muscle mass in men is greater than the amount of muscle mass in women. Muscle mass and protein metabolism generally have the same effect on the formation of creatinine which is
constant, unless there is severe physical injury or degenerative disease that causes damage to the muscles [3]. There are several causes for an increase in creatinine levels in the blood, like dehydration, excessive fatigue, use of drugs that are toxic to the kidneys, kidney dysfunction accompanied by infections, uncontrolled hypertension, and kidney disease [4].

Exercise programs using external weights will also speed up the process of muscle hypertrophy. Muscle hypertrophy occurs as a result of an increase in the number of myofibrils in each muscle fiber, causing narrowing of the capillaries in each muscle fiber, increasing the amount of protein, and increasing the number of muscle fibers [5].

The end product of protein metabolism that must be removed from the body is urea. Increasing the quantity of protein from the body's metabolism after doing weight training, it will increase the production of urea and creatinine. Uretic metabolism occurs with the release of amino groups from amino acids, when these amino acids are recycled into a portion of protein or broken down and removed from the body, the aminotransferases present in various tissues catalyze the exchange of amino groups between the compounds that take part in the reactions. Oxidative deamination separates the amino group from the original molecule and the released amino group is converted into ammonia. Ammonia is transported to the liver and converted into continuous reactions. Almost all urea is formed in the liver, from the catabolism of amino acids and is the main excretion product of protein metabolism [6].

According to Nikolic et al [7], high levels of urea and electrolyte balance in the blood are signs of muscle, liver, brain and other tissue damage. Then with the presence of protein, it will affect the distribution of amino acids in the blood so that it affects plasma urea levels [8]. Protein functions as a muscle builder so that it is the main requirement for bodybuilding activists. The function of protein is also to build and maintain cells and body tissues [9].

Based on the background, no research has been conducted to determine the effect of weight training on creatinine, urea and total protein levels, so a study was conducted to determine the effect of weight training on creatinine levels in the blood of members of the Padang State University fitness center.

2. Material and methods
2.1. Research Location and Design
This research was conducted at the fitness center, Faculty of Sports Science and Biology Laboratory, Faculty of Mathematics and Natural Sciences, State University of Padang. This research is a type of experimental research pre and post-test group design.

2.2. Collecting Data Methods
Creatinine data was collected before and after undergoing weight training for 16 times. Where the number of samples in this study were 22 people. The place for blood collection is in the mediana cubital vein area that has been disinfected with 70 alcohol, 3 cc of blood was drawn using a syringe and put into a microtube tube for centrifuge in the Biology laboratory. After being centrifuged, the creatinine, urea and total protein levels were measured using a nanofotometer.

2.3. Data Analysis
The data obtained were recorded in a special sheet, and processed using SPSS and presented in tables and graphs. The difference in creatinine levels between before and after weight training was carried out by the first statistical test, the normality test. If the data is normally distributed, the data is
transformed and the normality test is carried out on the transformed data. The data from the transformation results were not normal, so the hypothesis used was the alternative t test, the Mann-Whitney test. The difference was declared significant if the p value was <0.05.

3. Results and Discussion

3.1. Results

Research respondents were members of the fitness center, Faculty of Sport Sciences, State University of Padang who met the inclusion and exclusion criteria. Characteristics of samples taken based on age, height, body weight and blood before and after weight training. In this study, subjects who met the criteria for the study sample were used. The data that has been collected is then analyzed so that the research results are obtained as described below.

| Variabel  | Min  | Max  | Mean  | SD   |
|-----------|------|------|-------|------|
| Height (cm) | 156  | 175  | 165.43 | 4.921 |
| Weight (kg)  | 48   | 83   | 61.10  | 9.808 |
| Age (years)  | 19   | 23   | 20.86  | 0.990 |
| BMI (kg/m^2) | 18.29 | 30.63 | 22.34  | 3.076 |

In table 1. The basic characteristics of the research respondents are described. All respondents in this study were male. In the table it can be seen that the average age of the research subjects was 20 years with the youngest age being 19 years and the oldest being 23 years. Furthermore, the average height of the research subjects was 165 cm with the lowest height of 156 cm and the highest to 175 cm. The average body weight was 61 kg, the lowest body weight was 48 kg and the highest was 83 kg. From the results of the calculation of body weight and height, it was found that the body mass index (BMI) was 22.14 kg/m^2 with the lowest BMI of 18.29 kg/m^2 and the highest was 30.63 kg/m^2.

The results of measuring blood creatinine levels, obtained an average of 0.823 mg/dL before doing weight training, and the average blood creatinine level after exercise is 0.959 mg/dL. There was an increase in the average value of blood creatinine measured after weight training, that is 0.136 mg/dL.

The results of the paired T test statistical test showed that the value of p = 0.01 p <0.05, it can be concluded that weight training has an effect on blood creatinine levels, there is a significant difference before and after weight training.

**Figure 1.** Creatinine levels in members of the UNP fitness center weight training. Note: The value of p = 0.01 (<0.05) indicates a significant difference in creatinine levels before and after weight training.
The average comparison of total protein content to see whether or not the effect of weight training on UNP fitness center students.

![Figure 2](image.png)

**Figure 2.** The average ratio of total protein content. Note: the sig test value is 0.012. Then \( p < 0.05 \).

The average urea level comparison to see whether or not there is a change after weight training on UNP fitness center students.

![Figure 3](image.png)

**Figure 3.** The average urea content ratio. Note: the sig test value is 0.017. Then \( p < 0.05 \).

### 3.2. Discussion

All respondents used in the study were male, this is because in women lower creatinine levels are associated with a smaller amount of female muscle mass due to the presence of more free fat mass than in men \(^{[10]}\). This theory is supported by Thongprayoon \(^{[11]}\) which also mentions the same thing, that blood creatinine levels are influenced by gender, the amount of muscle mass in men is greater than that of women.

The basic characteristics of the research respondents were the average age of 20 years, the average height of the research subjects was 165 cm and the average weight was 61 kg. This is in accordance with the research criteria, where the subjects used were 18-23 years old. According to Rutherford \(^{[12]}\), creatinin levels in older people are lower, this is thought to occur because the aging process is associated with atrophy of the musculoskeletal system. There are various hormonal changes that occur with the aging process which are thought to be one of the causes of muscle atrophy in the elderly.

From the results of the calculation of body weight and height, we found the body mass index (BMI) with \( a = 22.14 \text{ kg/m}^2 \). The average BMI value in the sample of this study can be categorized as normal (18.5-24.9 kg/m\(^2\)) according to WHO. According to the American Academy of Pediatrics (AAP), the
BMI value is not effective in assessing the body composition of athletes, because doing exercises with heavy intensity can cause misinterpretation with a high BMI value. A high BMI value caused by large muscle mass does not indicate an overweight condition. Therefore, to assess the body composition of an athlete, the better measurements to do are% fat, fat mass, FFM, prediction weight, prediction fat mass, and fat to gain. This measurement can be done using a Body Composition Analyzer, but in this study it was not carried out on these measurements, because of the limitations of the existing equipment at the Padang State University fitness center.

After obtaining the characteristics of the research respondents (height, weight, and age), then the respondents did weight training. Weight training is a motor stimulation (motion) that can be regulated and controlled to improve the functional quality of various organs of the body, and is usually associated with training components, like intensity, volume, recovery, and intervals \[^5\].

The results of blood creatinine examination before weight training were 0.823 mg/dL and the average blood creatinine level after weight training was 0.959 mg/dL (Figure 2). There was an increase in the average value of creatinine measured in blood after weight training, 0.136 mg / dL. The results of the paired T test statistical test showed that the value of \( p = 0.01 \) \(<0.05\), it can be concluded that weight training has an effect on blood creatinine levels, there is a significant difference before and after weight training.

The increase in plasma creatinine levels after weight training due to weight training requires a large amount of energy. During weight training, muscle metabolism increases to produce the required ATP. Phosphocreatine (also known as creatine phosphate) is a chemical compound with a high energy phosphate bond. This compound can be broken down into creatine and phosphate ions \[^8\]. The phosphate ion will bind with ADP to form ATP. ATP is a high source of energy needed by muscles. This cycle is called phosphogen and will continue to produce large amounts of energy.

This is in line with previous research conducted by Zulkarnain \[^{13}\] where the study showed a significant influence between futsal on the production of creatinine levels. This is in line with the existing theory that the increase in creatinine levels can be caused by several factors, one of which is excessive physical activity \[^{14}\]. In this study, it is possible that given weight training includes excessive physical activity that affects plasma creatinine levels.

Creatinine is a metabolic product of creatine and phosphocreatine. Creatinine has a molecular weight of 113-Da (Dalton). Plasma creatinine is synthesized in skeletal muscle so that levels are dependent on muscle mass and body weight \[^{15}\]. Creatinine is excreted through the formation of urine in the kidneys. The normal value of creatinine levels in men is 0.7-1.3 mg/dL, while in women 0.6-1.1 mg/dL. Although the average respondent's plasma creatinine level showed an increase, some respondents saw a decrease in plasma creatinine levels.

There are several causes for a decrease in creatinine levels including lack of consumption of sodium, protein, foods containing phosphorus (pumpkin, shellfish, nuts, soybeans and low-fat milk), and a lack of eating foods that contain potassium (bananas, spinach, and peas). This study did not participate in regulating the types and patterns of the respondent's food. The decrease and increase in creatinine levels in this study were still within normal limits of blood creatinine levels, that is 0.7-1.3 mg/dL.

According to Yuniarti \[^{16}\], physical exercise in addition to having beneficial effects on health can also result in negative effects if done excessively. The bad effects of overtraining are muscle weakness and muscle fatigue called myasthenia gravis. This condition will affect blood creatinine levels. In
addition, physical exercise that is not in accordance with the principles of exercise causes free radicals that will bind to hemoglobin causing tissue injury \cite{17}.

In Figure 2 it can be seen that the mean total protein pre-test was 8.33 ± 1.72 g/dL, while there was a decrease in the average post test amounting to 6.72 ± 1.54 g/dL. Based on research Acroma \cite{18}, has research related to total protein. Where the average total protein content in body building activists is 7.71 g/dL, while the total protein content in aerobic exercise activists is 7.63. These results are still within normal limits. On average, the total protein content of body building activists is higher than those of aerobic exercise activists. It can be said that body building activists and aerobic exercise activists on average consume sufficient protein for their respective metabolic needs.

The total protein has a sig of 0.012 which means P <0.05 so that pre and post have an influence on the given weight training. Physical exercise causes muscle protein synthesis, resulting in protein breakdown, when the balance is not suitable, urea synthesis will occur \cite{19}.

Exercise affects any protein mass recovery. Then able to influence protein metabolism in organs other than muscles. From Mougios \cite{20}, research in dogs has shown that the gut is a major visceral source of increased release of exercise-sensing connective tissue protein amino acids. Experiments show that prolonged running can decrease the rate of collagen synthesis and increase the breakdown of the achilles tendon. However, the next few days experienced a higher synthesis from the beginning, so this change was related to the mechanical stress in exercise.

So that the average total protein content in weight training students is still within normal limits according to previous research. Then with this it can be seen that the weight training students on average consume sufficient protein according to their respective metabolic needs.

When you exercise hard enough, the rate of protein synthesis will increase. If the amino acids in the contracting muscle fibers it can function as a substrate. The stimulus will last one to two days. If the exercise is carried out with moderate intensity, the synthesis rate does not change too much. Meanwhile, high intensity exercise will increase the rate of protein synthesis. While exercise with moderate or low intensity, there is a combination of a decrease or no change \cite{20}.

Based on the research by Puspitasari \cite{21}, the average value of urea levels for body building activists is 27.63 mg/dL and the average urea level for aerobic exercise activists is 22.49 mg/dL so that an average value of levels is obtained. Urea for body building activists is higher than those for aerobic exercise activists. There was no significant difference in urea levels between body building activists and aerobic exercise activists. According to Nikolic et al \cite{7}, high levels of urea and electrolyte balance in the blood are signs of muscle, liver, brain and other tissue damage. Then with the presence of protein, will affect the distribution of amino acids in the blood so that it affects plasma urea levels \cite{8}.

In Figure 3 it has an average pre-test urea level of 16.95 ± 9.93 mg/dL while the average post-test has increased by 24.68 ± 16.79 mg/dL. The average increase in pre and post urea was quite high. So that it has a significant difference between urea results before being given weight training, and urea that has been given weight training. The same result was also shown by Sokal \cite{19}, who looked at changes in blood creatinine levels and urea levels, where he divided his research subjects into several blood draw groups after a 30-minute bicycle ergometer exercise intervention into 4 blood draw groups, namely blood sampling, before intervention, then 15 minutes after intervention, 30 minutes after intervention, and 40 minutes after intervention.

The urea has a sig 0.017, which means P <0.05, so pre and post have an influence on the weight training given. So that after being given weight training it has an influence on total protein levels and urea. The rate of urea production does not change during exercise for a short period of time. The
increase can be seen if the occurrence of prolonged training with training duration and intensity.\textsuperscript{[20]} Excessive physical exercise can have a negative effect on the body's homeostatic condition, which in turn affects the body's organ work system.\textsuperscript{[2]} So regular physical exercise is needed to provide beneficial effects on health, such as reducing various cardiovascular diseases, metabolic syndrome disorders and osteoporosis.\textsuperscript{[23]}

4. Conclusion
The results of blood creatinine tests before weight training was 0.823 mg/dL and the average blood creatinine levels after weight training was 0.959 mg/dL (Figure 2). There was an increase in the average value of creatinine measured in blood after weight training, 0.136 mg/dL. The results of the paired T test statistical test showed that the value of \( p = 0.01 \ p < 0.05 \), it can be concluded that weight training has an effect on blood creatinine levels, there is a significant difference before and after weight training. The average pre-test urea levels were 16.95 ± 9.93 mg/dL, while the average post-test levels increased by 24.68 ± 16.79 mg/dL. The average increase in pre and post urea was quite high. The urea has a sig of 0.017, which means \( P < 0.05 \) so that pre and post have an influence on the weight training given. The average pre-test total protein was 8.33 ± 1.72 g/dL while there was a decrease in the average post test amounting to 6.72 ± 1.54 g/dL. The total protein has a sig of 0.012 which means \( P < 0.05 \) so that pre and post have an influence on the given weight training.

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