

# Reduction of LDL Cholesterol through MICT and HIIT in Rats

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**Abstract**—the reduction of obesity is possible through the use of exercise. It can also be used as a treatment in improving health status. Obese people have higher levels of Low-density lipoprotein/LDL cholesterol, which has the probability of leading to risk of degenerative diseases such as hypertension, stroke and coronary heart disease. Exercising with Moderate Intensity Continuous Training (MICT) and High-Intensity Interval Training (HIIT) methods can lower LDL levels. The exercise process was done for 6 weeks (4 times/week). The subjects were 21 male rats, which were equally divided into 3 groups (control, MICT, and HIIT). The MICT exercise was done at 50-60% of total capacity while HIIT was done at 100% of total capacity. Data collection of LDL levels was done through the use of ABX Pentra LDL Direct CP. Data analysis technique used were ANOVA test and Tukey HSD advanced test (Sig. 0,05). A significant difference between control and MICT group was found, therefore, MICT influences LDL levels. In the Tukey Test results, no significant difference between the control-HIIT group was found. The study showed that MICT was effective and safe in lowering LDL levels in obese subjects. It can be interpreted that regular exercise (MICT) gives positive effects on improvement of health conditions, especially on cholesterol levels of the body.

**Keywords**—MICT, HIIT, low-density lipoprotein, obesity.

## I. INTRODUCTION

The prevalence of obesity is on the increase worldwide, both in children and adults. Associated obesity increases the risk of cardiovascular diseases, such as hypertension, type 2 diabetes, and all other diseases that are directly related to blood vessels [1]. This obesity condition should be avoided or reduced. According to the Lancet journal, the number of obese people in the world rose from 875 million people in 1980 to 2,1 billion people in the year 2013. This increment is attached to the pattern of everyday life and lack of sporting activities. In this condition, the intake of calorie is greater than its expenditure, so the leftovers that were not converted into energy are stored as fat. An overweight body has a higher fat content, especially LDL-C (low-density lipoprotein cholesterol).

Lowering and maintenance of the body fat is important for human health. Therefore, every individual need to pay attention to their respective conditions in order to avoid various degenerative diseases. This can be done through physical activity, especially by doing regular and measurable activity. The physical exercise aims at having a positive effect

on the health of the body especially in order to improve metabolism status of fat. According to [2], exercising to reduce the levels of body fat can be done by applying Moderate-Intensity Continuous Training (MICT) method which increases mitochondrial biogenesis activity through activation of metabolic enzymes such as AMPK, CPT-1, and ACC. High-Intensity Interval Training (HIIT) can also reduce body fat levels by activating the cardio-metabolic component so that the adaptation of these conditions can increase the mobilization of fatty acids on mitochondria and affect the improvement of lipid profile.

The influence of MICT and HIIT is quite effective in lowering body fat levels, through their respective mechanisms. The reviews mentioned can be tailored to address some important issues like Moderate Intensity Continuous Training (MICT), High Intensity Interval Training (HIIT), overweight subjects and LDL levels. Determination of the appropriate dose of exercise is a positive action.

## II. METHODS

### A. Design and Sampling

Implementation of data retrieval made use of experimental laboratories method and random control group post-test only designs. The basic use of this method was to provide practice of overweight subjects to know the adaptation of 2 types of exercise on changes of LDL levels.

The method that was used in determining the number of subjects is referred to as the "Guidelines for the care and use of mammals in neuroscience and behavioral research" issued by the Institute for Laboratory Animal Research of the United State of America [3]. This method was selected by the researchers so as to have a representative sample size.

### B. Subject

The subjects used were experimental animals (*Rattus norvegicus* strain Wistar). The use of experimental animals in this study was aimed at facilitating the researchers' control of the overall aspect that was applied in the research in order to have accurate research results.

The sampling technique was carried out randomly based on the following inclusion criteria:

1. Rat type (*Rattus norvegicus* strains Wistar).
2. Male sex.
3. Aged 2-3 months and untrained (untrained).
4. Healthy and not disabled.
5. Overweight status.

The feed used during the research process was Rations 511, 521 and Japfa Comfeed Pellete. The dosage used was based on [4], given as much as 10 grams/100 grams of body weight, so each day about 20-30 grams. The amount of drink was 10-12 ml / 100-gram body weight (20-30 ml). Checking of the amount of drink was observed on the size written in ad libitum.

#### C. *Experimental Protocol*

[5,6,7,8,9] An exercise program on MICT and HIIT methods was performed by a special treadmill for mice in 24 times of treatment. MICT was at 50-60% maximum speed capability, while HIIT at 100% maximum speed capability. In knowing the maximum speed capability, increased pattern of 1m/min was used.

#### D. *Blood Analysis*

LDL content analysis made use of ABX Pentra LDL Direct CP test method in the Clinical Pathology Laboratory of Universitas Brawijaya, Malang, Indonesia. The analysis was performed 72 hours after the last exercise.

The Ethical Clearance was issued by the ethical research commission of Brawijaya University (901-KEP-UB).

#### E. *Statistical Analysis*

Anova and Tukey Test were the statistical analysis applied and all the data were tested with 95% significance level (standard error 0,05%) and IBM SPSS Statistics 23 was used.

### III. RESULTS AND DISCUSSION

#### A. *Body Weight Condition*

The control group was found to have an average body weight of 291 grams. The group progressively gained weight from the beginning to the end. This description corresponds to a sedentary where the body condition was not routinely doing physical activity or can be called a passive category. Increased weight coincides with the higher levels of cholesterol in the blood [10]. This condition also corresponds to high levels of LDL control group that is 18.71 mg/dL or about 30% higher than the MICT and HIIT groups. Thus, the increase in the levels of LDL has a positive correlation with weight gain (passive activity).

In the treatment group, the MICT group had a final average weight of 258 gram and 249 gram on HIIT group. This treatment group experienced the same weight loss phase. The weight loss stage occurs during the sixth week. The MICT and HIIT groups did not have a significant difference, but there are significant differences between the treatment group and the control group. So, it clearly illustrated the difference between active subjects and passive subjects. This result agrees with [11], that the weight of the MICT and HIIT groups did not differ.

In another research where an exercise program was carried out for 8 weeks, it was concluded that effective weight loss was performed with moderate intensity and high intensity exercise. The study also illustrated that there was no difference in weight loss between MICT and HIIT groups [12]. It can be interpreted that both types of exercise have the same effectiveness in losing weight on the subject of obesity/overweight.

Weight loss in the MICT group occurs through the process of enhancing the conversion of the fat in the body to energy during moderate intensity exercise. The increasing use of fats triggers the burning of free fatty acids (FFA) and triacylglycerol (TG). Fat oxidation in effective intensity training occurs during the exercise process. Then the needs were lowered after the training process is complete. This caused the decrease of adipose tissue through hormonal stimulation by the sympathetic nervous system. These results were appropriate and reveal that exercise with the MICT method can result in the loss of weight.

In the HIIT group, the condition of weight loss occurs due to the increase in fat oxidation during exercise and it requires lesser time. HIIT can increase fat oxidation and mitochondrial density. Energy sources used are carbohydrates and fats. The higher intensity increasingly made use of carbohydrates because the amount of oxygen decreases and this affect the process of fat metabolism. Increased fat oxidation occurs because the metabolism in the muscle increases so that oxygen consumption rises after completion. HIIT also brings about the stimulation of post-exercise metabolism such as EPOC supplied by fat during the recovery phase [2].

From these results, it was found that MICT and HIIT are equally effective in weight loss programs, therefore, the exercise methods are well suited for obese/overweight subjects.

#### B. *LDL Cholesterol Conditions*

LDL is a lipoprotein which is used in carrying cholesterol to peripheral tissues and also useful for membrane synthesis and steroid hormones. LDL is influenced by many factors such as food, saturated fat content, and the rate of synthesis and disposal of LDL from the body. Blood fats and lipoproteins are the strongest determinants in the risk of cardiovascular disease [13]. The risk is long-term because high levels of LDL causes plaques in the blood vessels [14]. As a result of this attachment, the blood vessels may become hard and block the flow of blood to the heart [15].

Factors affecting cholesterol levels include [15]:

1. Food: saturated fat and cholesterol in food can increase cholesterol levels. Reducing foods that contain high fat will help in reducing cholesterol levels in the blood.
2. Weight: overweight can increase cholesterol levels. Therefore, losing weight can help reduce LDL, total cholesterol, and triglyceride levels, so HDL will increase.
3. Sports: Regular exercise can increase HDL and reduce LDL. Physical activity for at least 30 minutes a day is necessary.
4. Age and gender: the older one becomes, the more the cholesterol increases; before reaching menopause, women have lower total cholesterol levels than men of the same age, but after menopause, the level of cholesterol gradually increases.
5. Heredity: cholesterol in the body is partly determined by family history.
6. Health conditions: this condition can affect the cholesterol levels in the blood such as hypothyroidism, liver disease, and kidney disease.

7. Drugs: consumption of drugs such as steroids and progestins can increase "bad" cholesterol and reduce "good" cholesterol.

Exercise is assumed to bring about the reduction of the amount of LDL in the blood. This was reflected in the mean results of control group LDL levels 18.71 mg/dL, MICT is 13.57 mg/dL and HIIT is 16.29 mg/dL. It can be observed from the treatment group that has a lower average compared to the control group. It appears that exercise has a positive effect in lowering LDL levels statistically. The decreasing LDL is a condition that comes from the fact that results from treatment groups are lower than the control group because the control group was used as an illustration/depiction of subjects without exercise treatment.

ANOVA test showed a sig value of  $0,017 < 0,05$ , so it means that Moderate-Intensity Continuous Training (MICT) and High-Intensity Interval Training (HIIT) have effects on low-density lipoprotein (LDL) levels. Tukey test gave a sig value of  $0,013 < 0,05$  in the control and MICT group, which means that the control and MICT group was different. For control and HIIT group, sig value of  $0,309 > 0,05$  and for MICT and HIIT groups, sig values of  $0,236 > 0,05$  were observed. These values are  $> 0,05$  and this indicates that there was no significant difference between the control-HIIT group and MICT-HIIT group. So, Moderate-Intensity Continuous Training (MICT) have more effect on change adaptation of Low-density lipoprotein (LDL).

Lower LDL results was found in the exercise treatment group, as well as an illustration that HDL in the blood has increased. This result is similar to [16] that aerobic and anaerobic exercise are known to alter lipoprotein profiles and increase HDL, associated with anti-oxidant enzymes. The amount of LDL in the blood should always be controlled because it is associated with foam cell formation and other defects in the blood vessel [17].

Regular exercise has been proved to have good and positive influence. Therefore, exercise has effect of either improving or lowering LDL levels in overweight/obese subjects.

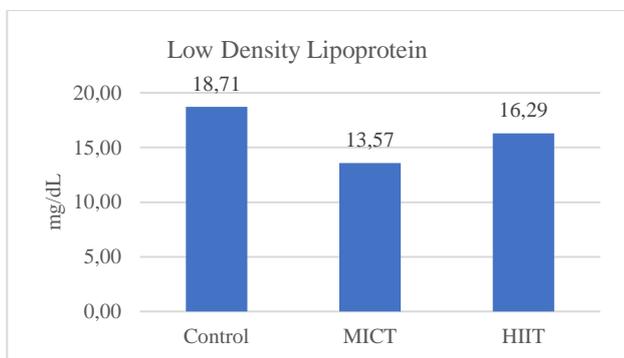


Fig 1. LDL Condition

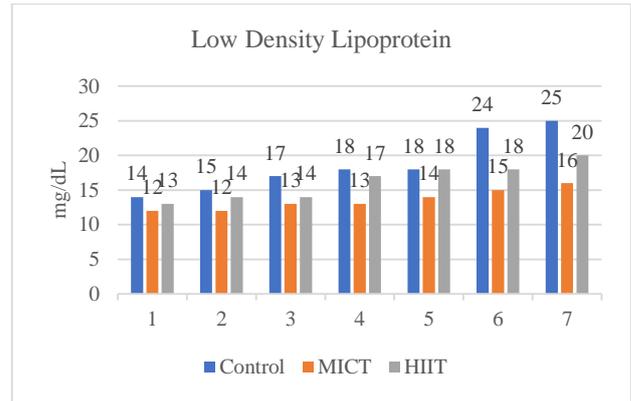


Fig 2. LDL on Each Subject

**IV. CONCLUSIONS**

Moderate-Intensity Continuous Training (MICT) and High-Intensity Interval Training (HIIT) both have positive effects on the adaptation of low-density lipoprotein (LDL) levels and changing of body weight. The adaptation works well with decreased LDL levels after the exercise process. The MICT has a more effective influence in lowering LDL than HIIT.

1. Exercise with moderate intensity is suitable and safe to use on the subject of overweight and effective in the process of reducing cholesterol and weight.
2. Maintenance of food intake with balanced nutrition to support the continuity of body metabolism is better.
3. Maintenance of body fitness through exercise is good for the healthy body and ensures protection from various diseases.

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