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The Effect of Moderate Intensity Continuous Training (MICT) and High Intensity Interval Training (HIIT) on Erythrocytes, Leukocytes, and Platelets Level

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***Abstract*—the purpose of this research is to reveal the effects of moderate intensity continuous training (MICT) and high intensity interval training (HIIT) on red blood cells (erythrocytes), white blood cells (leukocytes), and platelets level. This research is an experimental research with random control group posttest-only designs. The samples used in this research are experimental animals. Experimental animals are chosen with the criteria of this research. The samples consist of 39 male wistar strain rats and they are divided into 3 groups, control (no treatment), MICT group, and HIIT group. The findings are: (1) there was no significant effect of MICT and HIIT methods on erythrocytes level, (2) there was no significant effect of MICT and HIIT methods on leukocytes level, and (3) there was no significant effect of MICT and HIIT methods on platelets level. In conclusion, there was no difference between MICT and HIIT methods on erythrocytes, leukocytes, and platelets level compared to the control group sample.**

Keywords— intensity, training, erythrocytes, leukocytes, platelets.

I. INTRODUCTION

Based on the survey from RISKESDAS (2013, p. 223), the prevalence of overweight category was 13.5% increased by 3.5% from the last survey in 2007. One of the causes of an increase in the overweight category was sedentary lifestyle. The changes of lifestyle and modernization in this era have made people too lazy to move [6]. Almost all the manual work human do can now be completed with the next level of technology which causes the sedentary lifestyle to grow up [4]. The other effect of sedentary lifestyle is impact on energy metabolism, the less activity means the less value of energy metabolism in the human body. According to[1], the balance of energy can be reached when the intake equal to the expenditure. So for people living the sedentary lifestyle, the balance of energy can't be reached. This is because the intake is bigger than the expenditure, then the residual from metabolism will be stored as a fat [1] . The more fat in the people can lead to them being infected by virus or disease an example of the disease is thrombus in blood vessels. Thrombus appears when a person has an abnormality with their blood cells (erythrocytes, leukocytes, platelets). One part of leukocytes (eosinophil) acts as a marker of how the inflammation happened. Inflammation could happen when someone is infected by virus or disease and has a higher chance of happening if the person is overweight or obese.
The way to prevent inflammation when overweight or obesity happens, is with an active lifestyle or by doing exercise routines. Someone who does exercise or has an active lifestyle could make their body's metabolism more balancing than someone who is infected by the sedentary lifestyle. Therefore, people who want to make the body metabolism more balancing could choose this type of the exercise; exercise with moderate intensity or high intensity.

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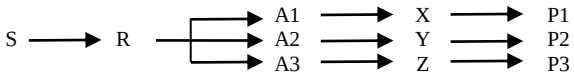
II. METHOD

This research used experimental method with random control group posttest-only design. The experimental animal was a male wistar strain rats and is divided into 3 groups, each group having the same number of wistar rats. The groups are; control group (no treatment), MICT method group, and HIIT method group.



Description:

S	: Sample
R	: Randomize
A1	: control group (no treatment)
A2	: MICT method group
A3	: HIIT method group
X	: no treatment
Y	: MICT method treatment
Z	: HIIT method treatment
P1	: posttest for control group
P2	: posttest for MICT method group
P3	: posttest for HIIT method group

The experimental animals have some criteria: (1) White wistar rats (Rattus novergicus) is used in this research because they have small bodies which makes it easy for the treatment to be given and Rattus novergicus have metabolic and hormonal system similar to those of humans. According

to [3], the parameters of blood, organs, tissues, function, and disease in rats are identical to those of humans likewise the stimulus from exercise, (2) This research made use of male wistar to avoidthe changes in hormonal system during menstruation in female, (3) The wistar rats are between the ages of 2-3 months which is similar to an adult human, (4) The last criteria for this research is overweight, i.e. all the wistar rats should be overweight or obesity (≥ 200 gr).

The formula used to count the total of samples was adapted from Guidelines for The Care and Use of Mammals in [5] below:

$$n = 1 + 2C\,(\frac{s}{d})^2$$

Description:
n : sample
C : significance α and (1-β)
s : standard deviation
d : difference of Mean that considered meaningful

TABLE 1. VALUE OF C ACCORDING TO A AND (1-B)

		α	
		0.05	0.01
(1-β)	0.8	7.85	11.68
	0.9	10.51	14.88

This research used 7.85 for the value of C, with α = 0.05 and (1-β) = 0.8. According to [3], "Adhesion of Erythrocytes to Endothelial Cells after Acute Exercise: Differences in Red Blood Cells from Juvenile and Adults Rats", this research used the value of s = 0.8 and d = 1.42. now all the formulas have values, the total sample would be:

$$n = 1 + 2C\,(\frac{s}{d})^2$$
$$n = 1 + 2 \cdot 7{,}85\,(\frac{0{,}8}{1{,}42})^2$$
$$n = 1 + 15{,}7\,(0{,}5634)^2$$
$$n = 1 + 15{,}7 \cdot 0{,}3174$$
$$n = 1 + 4{,}98$$
$$n = 5{,}98 \approx 6$$

The result from formula above is 6; therefore, the minimal numbers of sample for each group are 6 rats. This research used 13 wistar rats for each group, which means control, MICT, and HIIT method group will each have 13 wistar rats. Total of sample for this research are 39 wistar rats.

III. Finding And Discussion

The first finding for this research was initial weight of the entire sample. The samples, 39 wistar rats already did weight calculation recorded in the table 2 below:

TABLE 2. INITIAL WEIGHT OF SAMPLE

Group	n	Weight (grams)
Control	13	215±21.7
MICT	13	206±22.8
HIIT	13	200±20.4

According to the table above, the entire sample already fulfill the criteria of overweight. After that, the entire sample did the treatment for 6 weeks with 4 treatment frequency in a week. For each week, the entire sample did the weight control and the result like the table 3 below:

TABLE 3. MEAN OF WEIGHT ALL SAMPLE EVERY WEEK

Group	Weight Every Week						
	0	1	2	3	4	5	6
Control	215± 21.7	243± 24.9	251± 26.4	261± 27.4	274± 27.8	284± 28.3	291± 24.8
MICT	206± 22.8	236± 24.6	247± 23.5	249± 22.8	253± 22.0	268± 22.6	258± 19.7
HIIT	200± 20.4	229± 24.8	238± 24.3	242± 25.2	246± 22.7	257± 23.4	249± 23.8

According to the table above, the control group had the bigger number of weight increase because the control group had no treatment. After 6 weeks of treatment, all groups had the posttest to take the final data and used the blood from the sample. The level of erythrocytes, leukocytes, and platelets are in table 4 to 6 below:

TABLE 4. ERYTHROCYTES LEVEL

Group	Erythrocytes Level (10^6/mm^3)
Control	7.59±0.47
MICT	8.03±0.51
HIIT	8.12±0.49

TABLE 5. LEUKOCYTES LEVEL

Group	Leukocytes Level (10^3/mm^3)
Control	6.16±2.60
MICT	5.83±1.45
HIIT	6.98±1.97

TABLE 6. PLATELETS LEVEL

Group	Erythrocytes Level (10^3/mm^3)
Control	857.43±64.21
MICT	916.67±142.92
HIIT	824.83±94.02

A. Normality Test

This research used Kolgomorov-Smirnov and Shapiro-Wilk normality test with significance level 1% or 0.01.

TABLE 7. NORMALITY TEST (KOLGOMOROV-SMIRNOV)

Variable	Treatment	n	Sig.	Result
Erythrocytes	Control	7	.200	Normal
	MICT	12	.200	Normal
	HIIT	12	.170	Normal
Leukocytes	Control	7	.200	Normal
	MICT	12	.200	Normal
	HIIT	12	.200	Normal
Platelets	Control	7	.200	Normal
	MICT	12	.170	Normal
	HIIT	12	.200	Normal

TABLE 8. NORMALITY TEST (SHAPIRO-WILK)

Variable	Treatment	n	Sig.	Result
Erythrocytes	Control	7	.710	Normal
	MICT	12	.190	Normal
	HIIT	12	.029	Normal
Leukocytes	Control	7	.314	Normal
	MICT	12	.631	Normal
	HIIT	12	.193	Normal
Platelets	Control	7	.872	Normal
	MICT	12	.166	Normal
	HIIT	12	.703	Normal

B. Homogeneity Test

The purpose of homogeneity test was to determine whether the sample had a homogeneous variation or not. This research used levene statistic test to find the results of homogeneity and the results are show in table 9 below:

TABLE 9. HOMOGENEITY TEST (LEVENE STATISTIC)

Variable	Levene Statistic	df1	df2	Sig.	Result
Erythrocytes	0.022	2	28	.978	Homogeneous
Leukocytes	1.658	2	28	.209	Homogeneous
Platelets	2.799	2	28	.078	Homogeneous

Hypothesis Testing

This research used statistic method to test the hypothesis and the data analysis used anova. In the first hypothesis, there is a significant effect of MICT and HIIT method on erythrocytes level, the result showed no significant effect of MICT and HIIT method on erythrocytes level. In the second hypothesis, there is a significant effect of MICT and HIIT method on leukocytes level, the result showed no significant effect of MICT and HIIT method on leukocytes level. In the third hypothesis there is a significant effect of MICT and HIIT method on platelets level, the result showed no significant effect of MICT and HIIT method on platelets level. The results are presented in the table 10 below:

TABLE 10. RESULTS FROM ANOVA

		Sum of Squares	df	F	Sig.
Erythrocytes	Between Groups	1.3	2	1.087	.351
	Within Groups	6.8	28		
	Total	8.1	30		
Leukocytes	Between Groups	8.3	2	2.697	.085
	Within Groups	106.6	28		
	Total	114.9	30		
Platelets	Between Groups	51561.9	2	2.082	.144
	Within Groups	346666.0	28		
	Total	398227.9	30		

According to table 10 above, the value of Sig. is .351 for erythrocytes, .085 for leukocytes, and .144 for platelets. All the values are more than 0.01 ($\alpha = 0.01$), then H_a accepted. Therefore, there is no significant effect of MICT and HIIT method on erythrocytes, leukocytes, and platelets level

IV. Conclusion And Suggestion

a. Based on the data analysis, the conclusion of this research is no significant effect of MICT and HIIT method on erythrocytes, leukocytes, and platelets level compared to the control group.
b. Based on the data analysis, the control group have the number of leukocytes level more than the 2 other variables (erythrocytes and platelets), because one part of leukocytes (eosinophil) play a role as the marker of inflammation.
c. This research should have been developed more deeply especially for the dependent variable.

The authors suggested that the author for next research can control the sample more effectively and make the blood samples stay in good condition to avoid the blood sample damaged like in this research (only 7 blood samples from control group).

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