Comparison of Blood Cholesterol Profiles Before and After The Measurements of Maximum Aerobic Capacity (VO₂max)

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ABSTRACT

This study is aimed to compare the blood cholesterol profile, before and after the measurement of maximum aerobic capacity (VO₂max) in the students of Jurusan Pendidikan Olahraga dan Kesehatan (JPOK) pada Fakultas Keguruan dan Ilmu Pendidikan (FKIP) Universitas Lambung Mangkurat Banjarmasin. Variables in this study consist of lipid profiles, including total cholesterol, high density lipoprotein (HDL), low density lipoprotein (LDL), triglyceride (TG) and Maximum Aerobic Capacity (VO₂max). The concept of VO₂max according to Kent^(1994:268): “maximum oxygen volume consumed per minute to show total work capacity, or volume per minute relative to body weight (ml/kg.min)”. Operationally, VO₂max referred in this study is the maximum volume of oxygen that can be consumed per minute, as measured at *progressive run (Bleep Test)*. The method used in this study is pre-experimental with one group pretest-posttest design. This design implies that a group of subjects are treated for a specific period and the measurements are taken both pre and post. The results: There are changes in blood cholesterol profile after the measurement of maximum oxygen capacity (VO₂max), shown by significant decrease of total cholesterol variable, increased HDL, and decreased LDL. Changes in triglyceride variable showed no significant decrease despite the statistic differences. Specific HDL sub-class increasing after exercise is a constructive lipoprotein sub-class whereas LDL is destructive lipoproteins sub-class that might damage the body. Therefore, an increase in HDL and decrease in LDL found in this study appears to be advantageous and consequently might alter the risk of coronary heart disease.

Keywords: Cholesterol profile, Maximum Aerobic Capacity (VO₂max)

INTRODUCTION

Most of busy and dynamic individuals underestimate healthy macro-nutrition requirement and consumed fast-food meals instead, where both quantity and quality is uncontrolled. Metabolically, not all of these options provide healthy responses, and they frequently complain pain in their chest (*angina*) which is one indicator of increasing cholesterol level (Soeharto I, 2002:108). Any type of medical treatment requires a substantial fund. On the other hand, specific drugs may drastically decrease cholesterol levels, thus became insufficient for the body. Despite of body requirement, abnormal cholesterol level may adversely affect cardiac

performance. Heart serves as a pump in blood circulation, therefore blood cholesterol profiles before and after measurement of maximum aerobic capacity still need to be examined.

Precursor forming *steroid* hormone that the body need is derived from cholesterol (Vander, Sherman, Luciano, 2001:267; Vella CA, Kravitz L, Jarot JM, 2002:1). Types of these hormones are: cortisol, adrenaline, testosterone, estrogen, etc. Structurally, cholesterol is a required component in the body system. If a person's blood cholesterol is reduced up to 30 percent of the normal range, cell structures disorder possibly to occur (B Sears, 1997:183). High saturated fat diet may increase blood cholesterol concentrations for 15 to 25%. This condition is due to the enhancing fat accumulation in liver which increase KoA-acetyl hepatic cell to produce cholesterol (Gayton & Hall, 1996:1087). Therefore, one possible way to decrease blood cholesterol concentration is

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diet of low saturated fat and low cholesterol (*B Sears, 1997:183*). The concept of energy metabolism to maintain cholesterol at normal concentrations is sporadic. This mainly because busy lifestyle and the idea of instant health without particular treatments. Although many individuals perform certain physical activities, presumably they are not suitably programmed. Otherwise, even if such activities are correct, cholesterol concentration remains increase due to the imbalance nutritional factors with energy expenses. Thus, more frequent pains is coming instead of healthy condition as a result of the increasing cholesterol.

Based on the above description, maintenance as well as efforts to reduce blood cholesterol profile that provide healthy responses for each individual are still need to be studied. Increasing cholesterol ingested daily may slightly increase plasma concentrations. However, such increase inhibits *3-hydroxy-3-metilglutaril KoA reductase* enzyme (*Guyton & Hall, 1997:1087*) to form endogenous cholesterol. This mechanism plays as an intrinsic feedback control system to prevent an excessive increase of plasma cholesterol concentrations. As a result, plasma cholesterol concentrations usually do not increase or decrease more than $\pm 15\%$ by changing the amount of cholesterol in the diet, although individual responses differ markedly (*Vander, Sherman, Luciano, 2001:610*). Most of extra-busy workers tend to ignore this balance mechanism where diet of high saturated fat and cholesterol is preferable shortcut. Expensive medical treatment became a "trend" of consumptive lifestyle in expectation of instant recovery. However, the fact that patients with related complaints were increased and in inverse comparison with per capita income. Therefore, revealing physical performance patterns that is safe, inexpensive and able to maintain blood cholesterol profile is a priority.

The solution of those conditions, there should be a careful assessment of physical activities that are safe and easy as well as

favorably effect blood cholesterol concentrations reduction. A specific distance of aerobic run, very popular physical workout, is able to improve physical fitness (*EA Dowling, 2001:47*). Thus, it is necessary to study their effects on blood cholesterol profile, especially after an individual reaches his/her anaerobic threshold. Consequently, the concept of energy metabolism can be used as a pattern to determine blood cholesterol profile for each individual, without having to go through expensive treatments.

MATERIALS AND METHODS

Concept of Approach. This study used physiobiologic paradigm with the concept of energy metabolism; the logic is built based on the application of the predominant energy in continuous aerobic physical performance and its impact on health status, reflected in cholesterol profile in the blood.

Type of the Study. This is an experimental study, which aimed to determine the effect of exercise workload (in the form of $VO_2\max$ test) on blood cholesterol profile.

Design of the Study. The design of this study was **Pretest-Posttest Only Design** (*Suryabrata S, 2003:105*). Operational data collection is described as the following diagram.

T-1----- BLEEP TEST ----- T-2

Description: T-1 = Preliminary Test or control data; BLEEP TEST is the Treatment, T-2 = Final Test.

Population, Sample and Analysis Unit. This study used healthy male students as the population, with characteristics; physically and psychologically healthy, age ranged between 20 -24 year-old. The population is derived from students of Jurusan Pendidikan Olahraga & Kesehatan FKIP Unlam Banjarmasin. Total sample is 12 people.

1. Sampling Technique

Twelve qualified students are chosen with systematic random sampling technique.

Subsequently, assigned both as experimental and control.

2. Sample Criteria

Sample criteria in this study are factors that influence research results. Thus, the following factors are defined; general physical status (age, weight, height) and health status.

3. Unit of Analysis

The unit of analysis in this study is blood extracted from vein (*vena cubiti*). This peripheral blood test is based on the fact that observed components through the analysis unit may circulate and recirculate (AR.Shadiqin, 2001:56).

The variables of this study are; dependent variable Bleep Test, and cholesterol profile is criterion; control variable: SGOT, SGPT, BUN, and creatinine.

Conceptual Definition of Variables.

Cholesterol: A lipid-related compound found in tissue and manufactured in the liver (Kent M, 1994). Blood cholesterol level can be decreased with exercise and dietary fat.

Maximum oxygen volume; Kent M (1994) stated that "maximum aerobic force quantitatively equivalent to the maximum amount of oxygen that can be consumed per unit time during elevating intensity up to exhaustion, expressed as VO_2max ".

Operational Definition of Variables.

Blood cholesterol level is a value that reflects the amount of cholesterol circulating in the blood vessels known through clinical test of analysis unit.

VO_2max is the maximum amount of oxygen in milliliters, which can be used in one minute per kilogram of body weight, measured through the *Bleep Test*.

Technique of Data Analysis. The collected data will be analyzed using computer statistical methods (SPSS-18) with *t-test* analysis.

RESULTS

Description of Data. The data in the following tables is the result of lipid profile measurement consisting of total cholesterol (TK), low density lipoprotein (LDL), high density lipoprotein (HDL), triglyceride (TG) and maximum oxygen volume (VO_2max). Measurements were conducted with a clinical chemistry analysis, VO_2max with the *Bleep Test*.

The unit of analysis in this research is blood extracted from vein (*venous cubiti*). Blood examination of the peripheral blood is based on the fact that these components can be detected to mark a variable and can both circulate and recirculate. Prior to hypothesis testing, normality and homogeneity tests of the samples were taken.

Table 1. Measurement results of Lipid Profile before treatment

No.	TK	LDL	HDL	TG
1	208.8	149.8	45	70.2
2	117.8	98	45	64.8
3	179.2	95.9	75	45.2
4	195.2	134.9	54	41.5
5	118.6	53.6	58	45
6	191.7	119.9	62	49
7	174.6	113	37	83
8	159.4	102.2	50	36
9	100.2	44.6	49	33
10	150.2	77.4	67	49
11	158.8	95.3	63	75
12	173.2	90.2	75	38
Average	160.64	97.5	56.67	52.47

Description:

No : Number of subjects

TK : Total Cholesterol

LDL : Low density lipoprotein
HDL : High density lipoprotein
TG : Triglyceride

Tabel 2.Measurement results of VO₂max and Lipid Profile after treatment

No.	VO ₂ mak	TK	LDL	HDL	TG
1	38.5	198	144.5	48	70
2	40.1	116	95	46	62.5
3	38.2	167.2	90.2	72	47
4	40.2	169	129	60	41.2
5	40.5	117	53	58	45
6	39.1	176	98	66	48
7	41.2	174	100	47	71
8	39.8	155.8	100.1	54	36
9	43.2	100	44	50	32
10	37.5	148.5	75	67	47
11	40.5	139	85	64	71
12	38.5	158	79	77	39
Average	39.77	151.54	91.07	59.08	50.81

Description:

No : Number of subjects
TK : Total Cholesterol
LDL : Low density lipoprotein
HDL : High density lipoprotein
TG : Triglyceride

Table 3. Result of Normality Test with One-Sample Kolmogorov-Smirnov Test.

		TK	TK	LDL	LDL	HDL	HDL	TG	TG
		first	last	first	last	first	last	first	last
N		12	12	12	12	12	12	12	12
Normal Parameters ^{a,b}	Mean	160.642	151.542	97.900	91.067	56.67	59.08	52.475	50.808
	Std. Dev.	33.7708	28.8416	30.2817	28.0010	12.131	10.326	16.5663	14.1288
	Absolute	.145	.142	.150	.207	.125	.144	.250	.245
Most Extreme Differences		TK	TK	LDL	LDL	HDL	HDL	TG	TG
		first	last	first	last	first	last	first	last
	Positive	.143	.134	.110	.207	.125	.144	.250	.245
Kolmogorov- Smirnov Z	Negative	-.145	-.142	-.150	-.116	-.101	-.103	-.120	-.163
		.502	.492	.518	.716	.434	.498	.865	.850

Asymp. Sig. (2-tailed)	.962	.969	.951	.684	.992	.965	.443	.465
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Description:

- Test distribution is Normal.
- Calculated from data

Based on Table 3, it is known that:

- Kolmogorov-smirnov* value of preliminary TK variable is 0,502 with significance level $0,962 > 0,05$, thus it has normal distribution.
 - Kolmogorov-smirnov* value offinalTK variable is 0,492 with significance level $0,969 > 0,05$, thus it has normal distribution.
 - Kolmogorov-smirnov* value of preliminary LDL variable is 0,518 with significance level $0,951 > 0,05$, thus it has normal distribution.
 - Kolmogorov-smirnov* value offinal LDL variable is 0,716 with significance level $0,684 > 0,05$, maka berdistribusi normal.
 - Kolmogorov-smirnov* value of preliminary HDL variable is 0,434 with significance level $0,992 > 0,05$, thus it has normal distribution.
 - Kolmogorov-smirnov* value offinal HDL variable is 0,498 with significance level $0,965 > 0,05$, thus it has normal distribution.
 - Kolmogorov-smirnov* value of preliminary TG variable is 0,865 with significance level $0,443 > 0,05$, thus it has normal distribution.
 - Kolmogorov-smirnov* value offinal TG variable is 0,850 with significance level $0,465 > 0,05$, thus it has normal distribution.
- Significance level of $X_1, X_2, X_3, X_4, X_5, X_6$ and Y variables is $> 0,05$, thus data from the four variables are normal distributed.

Table 4. Result of homogeneity test with *Chi-Square* Test.

	TK first	TK last	LDL first	LDL last	HDL first	HDL last	TG first	TG last
Chi-square	.000 ^a	.000 ^a	.000 ^a	.000 ^a	1.333 ^b	.000 ^a	.833 ^c	1.333 ^b
Df	11	11	11	11	9	11	10	9
Asymp. Sig.	1.000	1.000	1.000	1.000	.998	1.000	1.000	.998

Description:

- 12 cells (100.0%) have expected frequencies less than 5.
The minimum expected cell frequency is 1.0.
- 10 cells (100.0%) have expected frequencies less than 5.
The minimum expected cell frequency is 1.2.
- 11 cells (100.0%) have expected frequencies less than 5.
The minimum expected cell frequency is 1.1.

Based on table 4 it is known that:

- Chi-Square* value of preliminary TK variable is: 0,000 with significance level $1,000 > 0,05$, thus it is homogenous.
- Chi-Square* value of final TK variable is; 0,000 with significance level $1,000 > 0,05$, thus it is homogenous.
- Chi-Square* value of preliminary LDL variable is; 0,000 with significance level $1,000 > 0,05$, thus it is homogenous.
- Chi-Square* value of final LDL variable is; 0,000 with significance level $1,000 > 0,05$, thus it is homogenous.

5. *Chi-Square* value of preliminary HDL variable is; 1,333 with significance level $0,998 > 0,05$, thus it is homogenous.
6. *Chi-Square* value of final HDL variable is; 0,000 with significance level $1,000 > 0,05$, thus it is homogenous.
7. *Chi-Square* value of preliminary TG variable is; 0,833 with significance level $1,000 > 0,05$, thus it is homogenous.
8. *Chi-Square* value of final TG variable is; 1,333 with significance level $0,988 > 0,05$, thus it is homogenous.

Significance level of $X_1, X_2, X_3, X_4, X_5, X_6$ and Y is $> 0,05$, it is concluded that data from the seven variables are homogenous.

Hypothesis Test

t -test was used for hypotheses testing, establishing the similarity and difference of two average values using two-side test (right-side and left-side tests). The hypotheses tested are as follows:

$$H_0: \mu X_1: \mu X_2 = 0$$

$$H_1: \mu X_1: \mu X_2 > 0$$

Test Criteria: "Accept H_0 if $t < t_{(1-\alpha)}$ and reject H_0 if t have any other values. Degrees of freedom for the t distribution is $(n_1 + n_2 - 2)$ with probability $(1-\alpha)$ " (Sudjana, 2005: 238-241).

Hypotheses testing of compared variables:

1. Preliminary test result of Total Cholesterol (KT_0) : Final test result of Total Cholesterol (KT_1)

$$H_0 = KT_0 : KT_1 = < 0 \text{ insignificant.}$$

$$H_1 = KT_0 : KT_1 = > 0 \text{ significant.}$$

Conclusion : t -count = - 3,597
 $> t_{table (11; 0,025)} = 2,201$, H_0 is rejected, thus, decrease in total cholesterol after treatment is significant.

2. HDL₀ (preliminary test result): HDL₁ (final test result).

$$H_0 = HDL_0 : HDL_1 = < 0 \text{ insignificant}$$

$$H_1 = HDL_0 : HDL_1 = > 0 \text{ significant}$$

Conclusion: t -count = 2,504 $> t_{table (11; 0,025)} = 2,201$, H_0 is rejected, thus increase in HDL₁ (after treatment) is significant.

3. LDL₀ : LDL₁

$$H_0 = LDL_0 : LDL_1 = < 0 \text{ insignificant.}$$

$$H_1 = LDL_0 : LDL_1 = > 0 \text{ significant.}$$

Conclusion : t -count = - 3,764
 $> t_{table (11; 0,025)} = 2,201$, H_0 is rejected, thus, decrease in LDL₁ (after treatment) is significant.

4. Triglyceride preliminary test (Tg_0) : Tg_1 (Triglyceride final test)

$$H_0 = Tg_0 : Tg_1 = < 0 \text{ insignificant}$$

$$H_1 = Tg_0 : Tg_1 = > 0 \text{ significant.}$$

Conclusion: t -count = - 1,605 $< t_{table (11; 0,025)} = 2,201$, H_0 is accepted, thus decrease in Triglyceride after treatment is insignificant.

Complete analysis of the results can be seen in the following graph below.

a. Graph of changes total cholesterol before and after the Bleep-Test.

b. Graph of changes triglisride before and after the Bleep-Test.

c. Graph of changes HDL before and after the Bleep-Test.

d. Graph of changes triglisride before and after the Bleep-Test.

DISCUSSION

This study used both normality and homogeneity tests. The results indicate that research samples are in normal distribution where homogeneity analysis result in homogenous conclusion. Thus, the conditions of analysis were met and may proceed to hypothesis testing.

The study results showed a significant decrease in total cholesterol, and high density lipoprotein (HDL) increased significantly immediately after the attainment of maximum aerobic capacity of the subjects. Using standard examination (clinical test) showed that low density lipoprotein (LDL) level was decreased significantly. Changes in triglyceride variable showed no significant decrease although statistically differ, shown in smaller average value of triglyceride final test results (after treatment). Thus, in this study, aerobic exercise shown by measurements using maximum aerobic capacity, is not only dramatically alters cholesterol level but also become significant due to the favorable changes in the distribution of lipoprotein sub-class.

The above mentioned specific sub-class is similar to increased HDL and decreased LDL after exercise. It is known that HDL is a favorable lipoprotein sub-class for the body whereas LDL is not. Therefore, significant increase in HDL and decrease in LDL in this study appear advantageous to the body which consequently alter the risk of coronary heart disease due to one of HDL functions is to eliminate LDL from the blood vessels.

The results of this study also showed that trained individuals in endurance exercise intensity or during measurement of their maximum aerobic capacity will have higher fat oxidation. The increase in fat oxidation induced by exercise is (mainly) due to increased fatty acid oxidation. Fat oxidation is lower in high-intensity exercise compared to moderate-intensity. This is partly due to the

decreasing fatty acid transfer to the working muscles.

Despite no significant decrease in the triglyceride variable, the measurement was statistically differ (Tables 1 and 2), such as the lower mean value of triglyceride final test results (after treatment). Other studies showed a decrease in blood triglyceride level. Harry H. Yu, Geoffrey S. Ginsburg, Mary L. O'Toole, James D. Otvos, Pamela S. Douglas, Nader Rifai (1999), shown that the decrease was quite obvious due to increasing fatty acid metabolism related to the duration of exercise or race. Thus, aerobic activity in those studies was positively correlated with the duration of exercise. This study shows a decrease in mean value and statistically insignificant, indicates that duration of exercise (on aerobic capacity measurement) is not acutely affected the triglyceride level. If the objective is the decrease in blood triglyceride level, the bleep test (to measure $VO_2\text{max}$) may not correlate with the expected decrease. This requires further study, because it has been known that base level of triglyceride serum found to be lower in endurance athletes.

CONCLUSION

Based on data analysis and discussion in this study, the conclusion is drawn as follows:

Blood cholesterol profile after the measurement of maximum oxygen capacity ($VO_2\text{max}$) has better value than before.

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