COMPARISON OF BLOOD CHOLESTEROL PROFILES BEFORE AND AFTER THE MEASUREMENTS OF MAXIMUM AEROBIC CAPACITY (VO_2MAX)

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Abstract. *This study aimed to compare the blood cholesterol profile, before and after the measurement of maximum aerobic capacity (VO_2max) in the students of Sports and Healthy Department (JPOK) FKIP UNLAM. Variables in this study consist of lipid profiles, including total cholesterol, HDL, LDL, triglyceride and VO_2max. Operationally, VO_2max 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. The study showed that there are changes in blood cholesterol profile after the measurement of VO_2max, 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 (VO_2max)*

Abstrak. *Penelitian ini bertujuan membandingkan profil kolesterol darah, sebelum dan sesudah pengukuran kapasitas aerobik maksimal (VO2max) pada siswa Jurusan Pendidikan Olahraga Dan Kese hatan (JPOK) FKIP Unlam. Variabel penelitian yaitu profil lipid, termasuk kolesterol total, HDL, LDL dan trigliserida dan VO2max. VO2max yang dimaksud dalam penelitian ini adalah volume maksimal oksigen yang dikonsumsi per menit, dan diukur melalui Bleep Test. Metode penelitian adalah pre-eksperimental dengan desain pretest-posttest satu kelompok. Hasil penelitian menunjukkan bahwa ada perubahan profil kolesterol darah setelah pengukuran VO2max, yang ditunjukkan oleh penurunan signifikan dari variabel kolesterol total, peningkatan HDL, dan penurunan LDL. Perubahan variabel trigliserida tidak menunjukkan penurunan yang signifikan meskipun terjadi perbedaan statistik. Sub class HDL yang meningkat setelah latihan adalah sub class lipoprotein yang konstruktif sedangkan LDL merupakan sub clas lipoprotein merusak yang dapat menyebabkan kerusakan tubuh. Oleh karena itu, peningkatan HDL dan penurunan LDL yang ditemukan dalam penelitian ini tampaknya menguntungkan dan akibatnya mungkin mengubah risiko penyakit jantung koroner.*

Kata kunci*: profil kolesterol, kapasitas aerobik maksimum (VO_2max)*

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, Kravistz 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 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 ± 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.

The formulation of this study is: How does the blood cholesterol profile before and after measurement of maximum aerobic capacity (VO_2max)?

The objective of this study is to compare blood cholesterol profiles before and after

measurement of maximum aerobic capacity (VO_2max)

The results of this study are expected to enrich reference literatures of physical activity that is cheap, safe, and beneficial as well as reduce the concentration of cholesterol in a person's blood; and may provide efficient alternative efforts of physical fitness and blood cholesterol concentrations balance.

RESEARCH METHOD

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.

This is an experimental study, which aimed to determine the effect of exercise workload (in the form of VO_2max test) on blood cholesterol profile. 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.

This study used healthy male students as the population, with characteristics; physically and psychologically healthy, age ranged between 20 -2 4 yearold. 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 statuss
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: blood cholesterol level and Bleep Test; control Variable: SGOT, SGPT, BUN, and creatinine. To give a clear understanding about the study, the Conceptual Definition of Variables and Operational Definition of Variables are given below:

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*.

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

RESULT AND DISCUSSION

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*

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 : Trigliseride

Tabel 2. Measurement results of VO_2max and Lipid Profile after treatment

No.	VO2mak	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 : Trigliseride

Normality Test

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

		TK Awal	TK Akhir	LDL Awal	LDL Akhir	HDL Awal	HDL Akhir	TG Awal	TG Akhir
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
Most Extreme Differencs	Absolute	.145	.142	.150	.207	.125	.144	.250	.245
	Positive	.143	.134	.110	.207	.125	.144	.250	.245
	Negative	-.145	-.142	-.150	-.116	-.101	-.103	-.120	-.163
Kolmogorov-Smirnov Z		.502	.492	.518	.716	.434	.498	.865	.850
Asymp. Sig. (2- tailed)		.962	.969	.951	.684	.992	.965	.443	.465

Description:

a. Test distribution is Normal.
b. Calculated from data

Based on Table 3, it is known that: 3.

1. *Kolmogorov-smirnov* value of preliminary TK variable is 0,502 with significance level 0,962 > 0,05, thus it has normal distribution. 4.
2. *Kolmogorov-smirnov* value of final TK variable is 0,492 with significance level 0,969 > 0,05, thus it has normal distribution.
3. *Kolmogorov-smirnov* value of preliminary LDL variable is 0,518 with significance level 0,951 > 0 ,05, thus it has normal distribution.
4. *Kolmogorov-smirnov* value of final LDL variable is 0,716 with significance level 0,684 > 0,05, maka berdistribusi normal.
5. *Kolmogorov-smirnov* value of preliminary HDL variable is 0,434 with significance level 0,992 > 0,05, thus it has normal distribution.
6. *Kolmogorov-smirnov* value of final HDL variable is 0,498 with significance level 0,965 > 0,05, thus it has normal distribution.
7. *Kolmogorov-smirnov* value of preliminary TG variable is 0,865 with significance level 0,443 > 0,05, thus it has normal distribution.
8. *Kolmogorov-smirnov* value of final 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.

Homogenity Test

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

	TK Awal	TK Akhir	LDL Awal	LDL Akhir	HDL Awal	HDL Akhir	TG Awal	TG Akhir
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:

1. 12 cells (100.0%) have expected frequencies less than 5. The minimum expected cell frequency is 1.0.
2. 10 cells (100.0%) have expected frequencies less than 5. The minimum expected cell frequency is 1.2.
3. 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:

1. Chi-Square value of preliminary TK variable is: 0,000 with significance level 1,000 > 0,05, thus it is homogenous.
2. Chi-Square value of final TK variable is; 0,000 with significance level 1,000 > 0,05, thus it is homogenous.
3. Chi-Square value of preliminary LDL variable is; 0,000 with significance level 1,000 > 0,05, thus it is homogenous.
4. 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:

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

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

Test Criteria: "Accept Ho if *t* <t (1 - a) and reject Ho if *t* have any other values. Degrees of freedom for the *t* distribution is (n1 + n2 - 2) with probability (1-a)" (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)
   $H_0 = KT_0 : KT_1 = < 0$ insignificant.
   $H_1 = KT_0 : KT_1 = > 0$ significant.
   Conclusion:
   t-count = - 3,597 > *t* table $_{(11;\ 0.025)}$ = 2,201 , H0 is rejected, thus, decrease in total cholesterol after treatment is significant.
2. HDL_0 (preliminary test result) : HDL_1 (final test result).

$H_0 = HDL_0 : HDL_1 = < 0$ insignificant
$H_1 = HDL_0 : HDL_1 = > 0$ significant
Conclusion:
t-count = 2,504 > t table $_{(11;\ 0.025)}$ = 2,201, H_0 is rejected, thus increase in HDL_1 (after treatment) is significant.

3. $LDL_0 : LDL_1$
   $H_0 = LDL_0 : LDL_1 = < 0$ insignificant.
   $H_1 = LDL_0 : LDL_1 = > 0$ significant.
   Conclusion :
   t-count = - 3,764 > t table $_{(11;\ 0.025)}$ = 2,201
   H_0 is rejected, thus, decrease in LDL_1 (after treatment) is significant.
4. Triglyceride preliminary test (Tg_0) : Tg_1 (Triglyceride final test)
   $H_0 = Tg_0 : Tg_1 = < 0$ insignificant
   $H_1 = Tg_0 : Tg_1 = > 0$ 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.

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_2max) 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_2max) has better value than before.

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