The Correlation Between Haemoglobine and Body Mass Index With The Changes of Blood Lactate Levels in University of Jenderal Soedirman's Medical Students
A Study at Repeated Sprint Sessional 3

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Keywords: Blood Lactate, Body Mass Index, Haemoglobin, Physical Fitness, Repeated Sprint Sessional .

Abstract: Physical fitness is very important for medical students. The factor that influence physical fitness are haemoglobine and body mass index (BMI). It's expected that there's a correlation between the increment of haemoglobine and BMI with the increment of blood lactate levels which is one of the factor that determine physical fitness. The aim of this study was to understand the correlation between haemoglobine and BMI with the changes in blood lactate levels in University of Jenderal Soedirman's medical students. This research used the quasi-experimental with before and after design. The subject was 32 medical students which were selected used consecutive sampling methods. Haemoglobine level was measured by cyanmethaemoglobine method. Blood lactic acid level was measured by finger prick test method which was measured twice before and after intervention repeated sprint sessional 3. Statistical analysis used were paired t test and Pearson correlation test. This research protocol had been ethically agreed by Ethical Comission of Health Research Padjadjaran University. Paired t test showed that RSS3 could significant increase blood lactid level (p=0,000;p<0,05). Pearson correlation test showed significant correlation between haemoglobine level and changes of blood lactic acid level (p=0,008; p<0,05), with medium correlation and the direction of correlation was negative (r= - 0,461). Higher haemoglobine level, so lower changes of blood lactic acid level. Pearson correlation test showed no significant correlation between BMI with the changes in blood lactate levels (p=0,721; p>0,05).There was medium correlation between haemoglobine level and changes of blood lactic acid level in medical student after RSS3.

1 INTRODUCTION

Recently physical fitness is not only required by athletes but also common community including medical students (Alfarisi et al., 2013). Most of medical students have high academic and non-academic load, consequently they must have good physical fitness. A study shows there is a relationship between the level of physical fitness with medical student achievement. As many as 83.3% of Mulawarman University medical students with good physical fitness have satisfactory and very satisfactory achievement index (Rakhman et al., 2014).

The medical education curriculum of Jenderal Soedirman University run a 'rush' block system education which requires an endurance and good physical fitness. Physical fitness is the ability to perform activities or daily work and adaptation to physical loading without causing significant fatigue (Permaesih et al.,2001). Many factors affect individual physical fitness, some of which are haemoglobine and body mass index (BMI) (Suharjana dan Anggarkusuma, 2010).

Sufficient haemoglobine levels will deliver sufficient amounts of oxygen therefore the muscles can produce enough energy to move (Castelli et al., 2007). The formation of energy under oxygen deficiency over anaerobic pathways will result in lactic acid molecules that will impact on fatigue and decrease work productivity (Grassi et al., 1999). Another factor that is thought to affect blood lactate

Candrawati, S., Fatchurohmah, W., Agus Faisal, A. and Khairunnisa, H.
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In *Proceedings of Surabaya International Physiology Seminar (SIPS 2017)*, pages 280-283
ISBN: 978-989-758-340-7

levels is the BMI. The BMI is the most common and often used indicator to describe body fat (Mei et al., 2002). Body mass index is high due to an increase of body fat associated with physiological changes at the tissue level. When somebody performing physical activity at 65% VO2max level, the primary energy source for producing adenosine triphosphate (ATP) comes from fat. At 40% VO2max level, blood lactate levels increased 2-fold after physical activity (Mulla et al., 2000). Several previous studies have reported that the highest fat oxidation occurs in 33%-65% VO2max (Rami et al., 2012). Fat oxidation produces non-esterified fatty acids (NEFA) or known as free fatty acid (FFA) (Murray., 2009). During long periods of physical activity, the medulla-adrenal gland secrete catecholamine hormone (Greenstein and Wood, 2007). Then the hormone increase blood flow to fat tissue (Frayn et al., 2003). Increased of fat tissue blood flow aims to transport NEFA from fatty tissue to the liver. It contributes to increased oxygen consumption after physical activity (Mulla et al., 2000). Blood lactate increases with increasing exercise workload (Zak-Golab et al., 2010), but the body has a mechanism to remove the resulting lactate. Accordingly, the increase of lactate production does not necessarily increase blood lactate levels. The point at which lactate begins to accumulate is called the lactate threshold (Stellingwerff, 2010).

At rest, individual blood lactate levels are less than 1.0 mmol/L. Consequently, an intervention is required to increase blood lactate level (Powers and Holey, 2009). Repeated sprint sessional 3 (RSS3) is a series of physical activity-intervention which able to increase blood lactate levels significantly (Gharbi et al., 2014). This study aimed to investigate the correlation of haemoglobine and body mass index (BMI) with changes in blood lactate level of medical students of Jenderal Soedirman University study on repeated sprint sessional 3 (RSS3).

2 METHODS

This is an observational study with cross sectional design. This study was conducted from December 2015 to January 2016 at the Campus of Medicine, University of Jenderal Soedirman Purwokerto. The study has received ethical approval from Medical Research and Medical Ethics Commission at Faculty of Medicine Padjadjaran University.

A total of 32 healthy male medical-students from University of Jenderal Soedirman class of 2012, 2013, 2014, and 2015 who met the criteria were participated in this study. Participants should not undertake heavy activity 48 hours prior to RSS3 intervention. Haemoglobine level was measured using cyanmethaemoglobine method before the intervention of RSS3. Body weight and height were also recorded for calculating BMI before the intervention. Blood lactate level was measured before and after intervention, using finger prick test methods (Accutrend Plus Lactate Analyzer®).

Saphiro-Wilk test was done to examine normality of haemoglobine, BMI and blood lactate levels data. Blood lactate levels before and after intervention was compared using paired t-test. Pearson correlation test was performed to examine the correlation of haemoglobine and BMI with changes in blood lactate levels.

3 RESULTS

The subjects that met the inclusion criteria and the exclusion criteria were 32 people. All characteristics of the study subjects were normally distributed (p> 0.05) with the Saphiro-Wilk test, as in table 1 below.

Table 1: Distribution of study subject data.

Variable	Saphiro-Wilk (p)
BMI	0,324
Hb	0,109
Lactate Before RSS3	0,290
Lactate After RSS3	0,088
Changes in Lactate	0,292

*p < .05; **p < .01; ***p < .001

Characteristics of study subjects indicated that the study subjects were within the normal range as shown in table 2. The mean BMI of subjects 22.39 ± 3.86 kg / m2 was still within normal BMI criteria (18.50 - 22.90 kg / m2). The mean Hb subjects 14.63 ± 1.39 g / dl was still in normal Hb criteria (13, 2 - 17.3 g / dl).

Table 2: Characteristics of study subjects.

Variable	*Mean* ± *SD*	95% *CI*
BMI	22,39 ± 3,86	21,00 – 23, 78
Hb	14,63±1,39	14,13 – 15,13
Lactate Before RSS3	2,75±0,60	2,54 – 2,97
Lactate After RSS3	9,47±2,91	8,41 – 10,51
Changes in Lactate	6,71± 3,16	5,57 – 7,85

The following table 3 showed that the RSS3 intervention had been shown to significantly increase blood lactate levels (p = 0,000) with changes in lactate levels of 6.71 ± 3.16 mmol / L.

Table 3: Bivariate test blood lactate level.

Variable	*Mean* ± *SD* (95% *CI)*	Paired t test (p)
Lactate Before RSS3	2,75±0,60 (2,54 – 2,97)	p = 0,000***
Lactate After RSS3	9,47±2,91 (8,41 – 10,51)	

*p < .05; **p < .01; ***p < .001

Table 4 showed that between haemoglobine levels and changes in blood lactic acid levels there was a significant correlation with moderate correlation and negative correlation (p = 0.008; r = -0.4461). The higher the Hb level, the lower the lactate level changes. However, this study also showed that there was no significant correlation between BMI and changes in blood lactate levels (p = 0.721).

Table 4. Correlation Bivariate Test

Variable	*Mean* ± *SD*	Pearson test (p ; r)
Hb Changes in Lactate	14,63±1,39 6,71± 3,16	p= 0,008** r = -0,461
BMI Changes in Lactate	22,39 ± 3,86 6,71± 3,16	p = 0,721 r = 0,066

*p < .05; **p < .01; ***p < .001

4 DISCUSSION

Intervention RSS3 proved to increase blood lactate levels significantly (p = 0,000) with changes in lactate levels of 6.71 ± 3.16 mmol / L. This was in line with the study of Gharbi et al.(2014) which showed that there was a significant increase in blood lactate levels in RSS3 of 7.6 mmol / L, slightly higher than this study.

The results of this study indicate that someone with high Hb levels, the more not easily tired during physical activity. This is consistent with the research of Calbet et al.(2002) in eight subjects aged 24 years with submaximal activity intervention. The results showed that blood lactate acid levels after intervention were lower in conditions of highhaemoglobine levels. Research of Koskolou et al.(1997) also supports the results of this study. Research that conducted in Denmark on seven subjects aged 21-30 years by measuring lactic acid levels performed at different haemoglobine levels in basal conditions and after isovolumetric hemodilution which resulted in decreased haemoglobine levels. Changes in lactic acid levels were higher in isovolumetric hemodilution than in basal haemoglobine. This showed that there was a relationship between haemoglobine levels and changes in blood lactic acid levels. Another supporting study was the study of Xu et al.(2011) in terms relationship of the muscle oxygenation and blood lactate acid levels in submaximal activity, indicated a decrease of oxyhaemoglobine levels at the end of physical activity rather than the initial condition of physical activity. Research of Xu et al.(2011) also showed a decrease in oxyhaemoglobine occurs earlier than elevated levels of lactic acid blood. The study confirms the function of haemoglobine as an oxygen-carrying molecule to the tissues. Decreased oxyhaemoglobine levels will decrease the amount of oxygen. When the oxygen is not sufficient, the energy metabolism will turn into anaerobic metabolism that will produce more lactic acid.

The results of this study could not prove BMI correlation with changes in blood lactate levels because BMI does not properly present body fat levels. BMI measures body composition based on body weight and height only. This can be explained also by research conducted by Goonasegaran et al.(2012) which states that BMI has limitations in defining the fat presentation in men. According to the study, lean body mass more composes male body composition compared to fat tissue. The muscle tissue is 18% heavier than the fat tissue, which is 1.06 g / ml for muscle tissue and 0.9 g / ml for fatty tissue (Melanie et al.,2001; Ross et al.,1991), so it can be said that in males with larger muscle proportions may be have higher BMI (Goonasegaran, 2012). More study is needed to measure the fat presentation, especially men by using other methods.

Limitations of this study were the methods of measuring the fat presentation using BMI and the genetic confounding variables of the study subjects. Another limitation in this research was that the implementation of repeated sprint sessional 3 (RSS3) interventions was conducted on the outdoor track so it could not be controlled external environmental factors such as weather and track conditions.

5 CONCLUSIONS

There was a correlation of haemoglobine levels with changes in lactic acid blood levels of medical students with moderate and negative correlation direction. The higher the haemoglobine level, the lower the change in blood lactic acid level.

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