

PAPER • OPEN ACCESS

Effect of Moderate Physical Activity to Muscle Fatigue on Untrained People

To cite this article: T D Santi 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **506** 012028

View the [article online](#) for updates and enhancements.

Effect of Moderate Physical Activity to Muscle Fatigue on Untrained People

T D Santi

Public Health Faculty, University Muhammadiyah Aceh, Banda Aceh

Corresponding author: taharads@yahoo.co.id

Abstract. Muscle fatigue is a condition of discomfort, decreased efficiency due to excessive activity, loses energy / stamina, a common non-specific symptom experienced by many people and is associated with many health conditions which leading to achievement and performance to decrease. This study aimed to determine the effect of moderate physical activity (AFS) to muscle fatigue on untrained people. This investigation compared levels of lactic acid and the Borg scale before and after AFS. Fifteen man ages from 15 to 20 years volunteered to participate in the study. The subjects of the study were given moderate physical activity in the form of stepping up and down test until they reach the targeted maximum heart rate which is 70-79% for 15-20 minutes, 3 times a week for 4 weeks. Muscle fatigue was obtained by looking at the levels of lactic acid and the Borg scale before and after AFS. The results show the decrement after the AFS for the both lactic acid and the Borg scale with the mean levels of 9.02 ± 2.55 before AFS and 6.00 ± 2.76 after the AFS for the lactic acid and 3.70 ± 0.94 before AFS and 1.80 ± 1.0 after AFS for the the Borg scale tightness. It was found that AFS on untrained people can reduce muscle fatigue and the physical ability can be improved by exercise with appropriate intensity, duration and frequency.

Keyword : *muscle fatigue, lactic acid, borg scale, moderate physical activity*

1. Introduction

Physical activity is the movement of the limbs that cause the expenditure of energy (activity). Any movement of the body produced by skeletal muscle requires energy expenditure. Less physical activity is an independent risk factor for chronic disease, and overall is thought to cause death globally. Data of Basic Health Research in 2010 revealed that the prevalence of Indonesian population lack of physical activity was 72.9% and the residents that do not do the physical activity regularly was 42.8% [1-2].

Moderate physical activity is being classify with stepping up and down test at least 15-20 minutes for 3 times a week during 4 weeks. Several factors that influence physical activity are age, gender, calorie intake and nutrient. The benefits of physical activity when done in a healthy state regularly, with mild to moderate intensity will improve health and fitness. The data for the study were obtained through levels of lactic acid and the Borg scale. A physical activity performed in accordance with its basic principles can improve physical quality. Improvement of biological quality parameters as a result of proper physical activity, among others, accumulation of lactic acid is reduced so as to prevent fatigue. [3-5].



Lactic acid is the final product produced from pyruvic acid during anaerobic glycolysis. The build up of lactic acid will inhibit glycolysis, resulting in muscle fatigue. High levels of lactic acid and lack of energy reserves the problems such as cramps, nausea, weakness, and feeling exhausted that are often faced by all people including professional athletes and amateurs because this condition will cause fatigue during the move so that it can lead to a decline in performance and achievement. Efforts to overcome these problems can be done by setting the right exercise program, giving nutrition, emotional and physical environment [6-7].

In a study it was found that regular physical activity with exercise frequency of three to five times per week, exercise intensity 60-80% of maximal heart rate, and duration of exercise 20-60 minutes resulted the smooth flow of blood and speed up the removal of metabolic waste substances so that recovery takes place quickly, and can slow the occurrence of fatigue after exercise. Even the American College of Sports Medicine (ACSM) explains the intensity of physical activity must reach the target zone of 60-90% of the maximum heart rate or Maximum Heart Rate (MHR), this area range is commonly referred to as Training Zone or training area. The intensity of the exercise is said to be mild if it reaches 60-69% of MHR, while it reaches 70-79% of MHR and high if it reaches 80-89% of MHR. The intensity of the exercise can be increased by increasing the burden of exercise by jumping-bob or by speeding up the exercise movement [8-9].

The Borg scale is a simple method to measure the intensity in training. Perceived exertion of exercise intensity by assessing physical signs such as heart rate, breathing rate and perspiration/sweating. Borg scale is based on percentage of maximum pulse. The Borg scale is an excellent tool to use for guiding training intensity. Heart rate and lactate give secondary feedback. If the effort and speed were increased, more lactate will be produced and the body must compensate with increased breathing and raised heart rate. Measuring pulse and lactate level gives excellent feedback and helps us to describe and learn the different intensity levels. Lactic acid measurements are usually taken from blood samples from the tip of the finger. This study is an exercise program designed to introduce students to regular physical activity and intentionally to reduce the muscle fatigue.

2. Method

This study is a quasi experimental with pretest-posttest group design. The study included selection of subjects according to the criteria and signed informed consent form, lactic acid and Borg scale assessment before moderate physical activity (AFS), medium physical activity training with stepping up and down test to reach the target pulse of 70-79 % maximal heart rate. The subject study is 15 high school students, aged 15–20 year. Subjects underwent 4 weeks of medium physical activity training, 3 days/week, for 15 min. Before stepping up and down test, subjects were introduced the research tool (desk high as 40 cm) and how to do the exercise. A pulse rate meter is attached to the arm the subject to determine the pulse target 70-79 % maximal heart rate. After that the stop watch is executed, for start counting the time needed for medium physical activity training with the metronome rhythm is slow to beat pulse reaches the target already determined. Once achieved, keep it for 2 to 3 minutes then the result of the pulse the target of the pulse. The study was conducted to compare the levels of lactic acid peripheral to fatigue and the Borg scale before and after the exercise program. Research data is processed using SPSS. The mean values obtained were analyzed descriptively, followed by T-test.

3. Results and Discussion

Characteristics of subjects in this study were presented in Table 1. Based on this table, it can be seen that the variable weight, height, body mass index, age and heart ratemax in the study subjects have met the study criteria.

Table 1. Mean \pm SD Characteristics of Research Subjects

No	Variable	Mean \pm SD
1	Weight (kg)	55.90 \pm 4.17
2	Height (cm)	168.90 \pm 4.45
3	Body Mass Index (kg / m ²)	19.70 \pm 0.90
4	Age	16.40 \pm 0.51
5	Heart Rate _{max} (x / min)	203.60 \pm 0.51

n= 15 (man)

Table 2 shown that there is a decrease in lactic acid levels before (pre-test) and after (post-test) the implementation of physical activity exercise is in untrained people

Table 2. Mean \pm SD Lactic Acid Variable

Variable	Untrained People with Medium Physical Activity	
	Pre-Test	Post-Test
Lactid Acid (mmol/L)	9.02 \pm 2.55	6.00 \pm 2.76

From table 3 it can be seen that there are differences of the Borg scale before (pre-test) and after (post test) of physical exercise activity in untrained people.

Table 3. Mean \pm SD Borg Scale Variable

Variable	Untrained People with Medium Physical Activity	
	Pre-Test	Post-Test
Borg Scale	3.70 \pm 0.94	1.80 \pm 1.03

From table 4 normality test results obtained on the pre-test and post-test has a significance p value $>$ 0.05 which means the data is normally distributed. In bivariate analysis using paired t test statistic.

Table 4. Normality Test

No	Variable	Untrained People with Medium Physical Activity	
		df	Sig
1	Pre-Test	10	0.418
2	Post-Test	10	0.943

Table 5. below shows T paired test for lactic acid content and the Borg scale with significance level p = $<$ 0,05 resulted significant difference between pretest and posttest.

Table 5. T test Lactic Acid Levels dan Borg Scale

No	Variable	Pretest		Posttest		t Value	P
		Mean	\pm SD	Mean	\pm SD		
1	Lactic Acid	9.02	2.55	6	2.76	2.32	0.04
2	Borg Scale	3.70	0.94	1.80	1.03	8.14	0.000

P = $<$ 0,05

The body composition should be proportionate between muscle mass and fat. By exercising moderate physical activity in addition to forming an ideal body can also improve performance, fitness and performance. Good physical fitness causes one to not get tired [10-11]. Table 1 shows that the body mass index of untrained persons is included in the normal range of 18.5-25. This is consistent with the normal limit of IMT of Europe according to WHO is 18.5 - 24.9, Asians according to International Obesity Task Force (IOTF) and WHO are 18.5 - 22.9 and Indonesian according to MOH is 18.5 - 25.0 [12-14].

Based on tables 2, 3 and 5 it can be seen that the mean decreases in lactic acid level of pre-test and post-test is 3.02 mmol / L. For the Borg scale, the shortness of pre-test and post-test decreased. The paired t-test results showed significant differences in pre-test and post-test of untrained people given moderate physical activity (AFS). Exercise done regularly based on the accuracy of duration, frequency and intensity impact on the decrease in lactic acid levels so that it can slow fatigue. The buildup of lactic acid will inhibit glycolysis, resulting in muscle fatigue. High levels of lactic acid will cause acidosis in and around the muscle cells, impede coordination, increase the risk of injury, inhibit the energy system from creatine phosphate. High levels of lactic acid in athletes will have a negative impact on athlete performance [8,15].

Physical activity according to ACSM (American College of Sports Medicine) will be more meaningful if performed between 70% and 80% maximum heart rate, regularly three times a week with intensity that increases heart rate. This concept is inline with the results of the study that a significant reduction in lactic acid levels can be seen in untrained people who get moderate physical activity with a 70-79% HRmax workload performed three times a week for four weeks [6,16].

Decreased scaling of Borg scale can be seen from pre-test and post-test. The finding of this study was consistent with other studies that showing significant differences in Borg scale at week 4 and 5 ($p < 0.05$) through t-test to see the effect of walking practice on Borg scale score and six minutes walking distance test. Scale Borg rate fatigue stage, the greater the value means the higher the level of fatigue. This scale increases slowly during the first hour during exercise. This study illustrates that during pre-test scoring, the score of Borg scale were short around 3.70 and after obtaining moderate physical activity for four weeks scores, the Borg scale decreased to 1.80 and according to statistic t-test both showed significant differences [17-19].

4. Conclusion

The conclusion that can be drawn from this research is based on the result of paired T test for lactic acid concentration and Borg congested scale that has significance level $P = < 0,05$ between pretest and posttest. This shows moderate physical activity with HRmax 70-79% having an effect on slowing fatigue in untrained people. Physical activity is being done in accordance with its basic principles can improve the physical quality, performance, achievement, and performance of a person.

5. References

- [1] McArdle W D Katch F I and Katch V L 2001 Exercise Physiology: Energy, Nutrition, and Human Performance. Philadelphia: Lippincott Williams and Wilkins.
- [2] Departemen Kesehatan Indonesia. Profil Kesehatan Indonesia 2010.
- [3] Singh R 2005 Nutritional Requirements of Athletes Exercising in a Hot Environment *Malaysian Journal of Nutrition* vol.11(2) pp 189-198.
- [4] Warburton D Nicol Chrystal W Bredin Shannon 2006 Health Benefits of Phisycal Activity: The Evidence *Canadian Medical Association Journal* vol 174(6).
- [5] Octa L 2012 Pengaruh Latihan Aerobik Terhadap Pembentukan ATP-Mitokondria (suatu tinjauan intramolekuler) Universitas Tunas Pembangunan Surakarta: Surakarta.
- [6] Sherwood Lauralee 2014 Fisiologi Manusia dari Sel ke Sistem Edisi ke 8 EGC
- [7] Laursen PB 2005 Models to Explain Fatigue during Prolonged Endurance Cycling *Sports Med* vol 35 (10) pp 865-898.

- [8] Hernawati 2010 Produksi Asam Laktat pada Exercise Aerobik dan Anaerobik FMIPA, Universitas Pendidikan Indonesia Bandung.
- [9] Ratmawati Y 2013 Latihan Aerobik Intensitas Sedang Dengan Diet Rendah Kolesterol Lebih Baik Dalam Memperbaiki Kognitif Daripada Intensitas Ringan Pada Penderita Sindroma Metabolik Dalam Pollock M.L & Wilmore J H Exercise in health and disease Evaluation and Prescription for Prevention a Rehabilitation 2nd Ed Saunders
- [10] Irawan AM 2007 Nutrisi Energi & Performa Olahraga *Polton Sports Science & Performance Lab* vol 01 No 04
- [11] Stolen T Chamri K Costagna C Wisloff U 2005 Physiology of soccer an update *Sport Med* vol 35 (6) pp 501
- [12] Chrisly M Djon W Shane H 2015 Manfaat Latihan Olahraga Aerobik terhadap Kebugaran Fisik Manusia *Jurnal E-Biomedik (Ebm)* vol 3 No 1
- [13] Susilowati 2010 Burnout Pada Atlet. Tersedia dalam: <http://bgmpsikologi.blogspot.com>
- [14] Heryudarini H Yekti W Sri M 2005 Penggunaan Berbagai Cut-Off Indeks Massa Tubuh Sebagai Indikator Obesitas Terkait Penyakit Degeneratif Di Indonesia Pusat Penelitian dan Pengembangan Gizi dan Makanan, Badan Penelitian dan Pengembangan Kesehatan Depkes. Gizi Indon pp 31
- [15] Guntara P 2014 Pengaruh Recovery Aktif Dengan Recovery Pasif terhadap Penurunan Kadar Asam Laktat Universitas Pendidikan Indonesia Bandung
- [16] Guyton A C and John E Hall 2008 Buku Ajar Fisiologi Kedokteran Edisi 11 Editor Irawati Setiawan *Jakarta Penerbit Buku Kedokteran EGC*
- [17] Gusbakti R 2006 Pengaruh Pemberian Minuman Berkarbohidrat Berelektrolit dapat Memperlambat Kelelahan Selama Berolahraga Bagian Ilmu Faal Fakultas Kedokteran Universitas Islam Sumatera Utara. *Majalah Kedokteran Nusantara* vol 39 no.1
- [18] Powers S Edwar H 2007 Exercise Physiology Theory and Application to Fitness and Performance (Sixth Edition) McGraw-Hill Companies Inc Newyork
- [19] Adams Scott and S Delorey Darren and Davenport Margie and S Fairey Adrian and North Scott and S Courneya Kerry 2018 Effects of high-intensity interval training on fatigue and quality of life in testicular cancer survivors *British Journal of Cancer* 118.doi 10.1038/s41416-018-0044-7