The effect of jogging exercise to improve hemoglobin levels

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Abstract. A low level of hemoglobin is one of the health and fitness issues often experienced by anyone including students. If a student experiences a disorder of Hemoglobin levels, his physical fitness will be affected. The study aims to examine the effect of jogging exercise to improve students’ hemoglobin levels. A quasi-experiment method was employed in this study. The population of this study is a group of students of the Faculty of Sports Science, Universitas Negeri Padang. The samples of this study were 20 students obtained by purposive sampling technique. The data of hemoglobin levels were measured by the cyanmethemoglobin method. Jogging exercises were carried out 18 times with a frequency of 3 times a week. The results of the study were analyzed statistically using a comparison test (t-test) at a significance level (α) of 5%. The results of this study indicated that the average of hemoglobin level of respondents before being treated was 14.18, while after being given treatment, it was 15.66. This means that there is a significant effect of jogging exercise on increasing students’ haemoglobin level (Hb), with value of tobserved (3.80) > ttable (1.73).

Introduction

The human resources development in a country is determined by various factors, one of which is the healthiness condition of the communities. When health issues are often experienced by the communities, then a country will be difficult to build its resources. This is because unhealthy people will be hard to develop and improve the quality of their knowledge and skills. Therefore, a country needs to carry out health development to obtain quality of human resources.

The level of healthiness is one indicator in gaining good physical fitness. A healthy body is the basis for having good physical fitness. One of the factors that affects one’s physical fitness is nutritional intake. The good physical fitness will be attained if it is supported by the consumption of nutritious foods. One of the nutritional factors related to physical fitness is the hemoglobin level. When consuming insufficient nutritious food, the level of hemoglobin in the blood will be affected.

Hemoglobin is contained in red blood cells, and is a major component in red blood cells. Red blood cells are the blood cells that are mostly in the human body. Red blood cells are the main component of red blood cells Hemoglobin (Hb) functioning to import oxygen (O₂) and carbon dioxide (CO₂). Hemoglobin in the blood transports oxygen from the lungs to all body tissues and brings back carbon dioxide from all cells to the lungs to be removed from the body. So, the function of hemoglobin is to regulate the exchange of oxygen and carbon dioxide in body tissues [1].

Many factors affect a person's hemoglobin levels, namely food, age, gender, activity, smoking habit, and illness. Beside those factors, exercise or physical activities also influence one's hemoglobin level. Exercise and physical activity greatly affect a person's hemoglobin levels because regular exercises...
increase hemoglobin levels. This is because the network or cell will need more oxygen when doing activities so that there will be adaptation in binding oxygen in the blood.

The type of exercise that can be done to increase hemoglobin levels is aerobic exercise. Fox, Bower, and Foss state that aerobic exercise causes the increased of hemoglobin levels and blood volume [2]. According to Dorland’s Medical Dictionary, aerobic exercise is physical activity designed to increase oxygen consumption and improve the function of the respiratory system and cardiovascular system [3].

Physical activities which are included in aerobic exercise is brisk walking, jogging, swimming, dancing, or cycling. The intensity of each aerobic exercise is different. Intensity is the effort given by everyone in doing physical activity. American Hospital Association (AHA) recommends that at least moderate intensity of physical activity should be carried out, i.e. where the target heart rate (THR) or desired heart rate is 60-80% of the estimated maximum heart rate [4]. The estimated of maximum heart rate is 220 minus the current age. The recommended aerobic exercise should be done within 20-30 minutes per day to reduce the risk of striking coronary heart disease. It is also recommended to do aerobic exercise 3-7 days a week.

One easy aerobic exercise is jogging. Jogging is said to be aerobic exercise when it is done for a long time and the intensity of the exercise ranges from 60-85% of the maximum pulse. But people often do and get the benefits of jogging when it is carried out with the intensity of exercise ranging from 70-85% of the pulse maximum. Therefore, one of the factors that greatly influences a person's hemoglobin level is jogging exercises because by regular jogging increases hemoglobin levels as tissue or cells need more oxygen when doing activities so that there will be adaptation in binding oxygen in the blood.

1. Methodology
This is a quasi-experimental research with a one-group pretest-posttest design, in which this study aimed to reveal cause and effect. This study looked at the effect of jogging exercises on increasing hemoglobin levels. The population in this study were students of the Faculty of Sport Sciences, Universitas Negeri Padang who regularly carried out physical activities. The samples were 20 students taken by purposive sampling technique. The purposive sampling technique is a sampling technique with certain criteria set by researchers. The sample characteristics were described as follows:

| Table 1. Characteristics of Samples |
|-------------------------------------|
| Criteria               | Mean  | Standard Deviation (SD) |
| Age (year)             | 19.70 | 0.92                   |
| Height (cm)            | 167.38| 7.21                   |
| Weight (Kg)            | 61    | 10.21                  |

From the table above, it can be seen that the characteristics of the samples were active students who were 19.70 ± 0.91 years old, 167.38 ± 7.21 centimeters tall, and 61 ± 10.21 kilograms of body weight.

The procedure for obtaining data included the following steps:

- **Early Stage**
  Before the stage of the jogging exercise was carried out, the samples were given pre-test to measure the hemoglobin level of the samples.

- **Implementation Phase**
  In this phase, after measuring the initial hemoglobin level, samples were given jogging exercise 3 times a week for 18 meetings or 6 weeks. This exercise was carried out with the intensity of exercise ranging from 70-85% of the pulse maximum for 30 minutes each time of the exercise.

- **Final Stage**
  After being treated for 18 meetings, the final hemoglobin level was measured.

  The instrument used for measuring hemoglobin levels is the sianmethemoglobin method. The principle of the sianmethemoglobin method is the conversion of hemoglobin by K3Fe(CN)6 to methemoglobin and subsequently changed by KCN to hemoglobin cyanide (HiCN). Data were analyzed using the dependent sample t test.
2. Results

Based on the results of the research conducted obtained hemoglobin levels that vary from 11 gr / dl to 17.1 gr / dl. This reflected that the increasing age of the respondents is not always followed by an increase in hemoglobin levels.

Table 2. The Measurement of Samples’ Hemoglobin Level

| Hb Level (gr/dl) | Maximum | Minimum | Mean ± sd |
|------------------|---------|---------|-----------|
| Pre-test         | 15.8    | 11      | 14.18 ± 1.16 |
| Post-test        | 17.1    | 12.3    | 15.66 ± 1.25 |

The table above shows the mean of the respondents’ hemoglobin level in pre-test was 14.18 gr / dl ± 1.16 and the mean respondents’ hemoglobin level in post-test was 15.66 gr / dl ± 1.25. Based on the results of the statistical test analysis through a discrimination test (t-test) obtained a value of \( t_{\text{observed}} = 3.80 > t_{\text{table}} = 1.73 \), so it can be concluded that there was a significant effect of jogging exercises on increasing hemoglobin levels.

Jogging is aerobic exercise carried out for a long time and the intensity of exercise ranges from 70-85% of the maximum pulse. Jogging exercises can increase your heart rate. When the heart rate increases, the blood supply throughout the body increases, then it increases oxygen for body tissues and cells. In addition, regular jogging exercises 3 times a week for 6 weeks also contribute to stimulate the body to adjust physiologically according to the demands of increased activity. This is because jogging is one way to develop more and better mitochondria, so that with the increase in the number of mitochondria and the supply of oxygen, energy is available for physical activity.

Hemoglobin has an important role in the human body that is carrying oxygen to all body tissues along with red blood cells [5]. The ability of the heart, lungs and blood to do physical activity is strongly influenced by VO2max [6]. Therefore, the increased ability of blood to bind oxygen levels in the blood can also increase VO2max in activity.

Hemoglobin and regular physical activity done by a person are two things that are interconnected [6]; [7]; [8]. The relationship between physical activity carried out by someone against a person’s hemoglobin level while doing physical activity, such as exercise, there is a high increase in metabolic activity resulting in a decrease in pH. This causes hemoglobin to release more oxygen, then it increases oxygen delivery to the muscles. Exercise or physical activity can increase hemoglobin levels in the blood. This is in accordance which explains that, exercise can increase total Hb and red cell mass, which enhances oxygen-carrying capacity [9]. Exercise can increase the total Hb and red blood cell mass, which increases oxygen carrying capacity so that with structured exercise the hemoglobin level in the blood which functions to bind oxygen in the blood and relax it throughout the body will also increase.

During exercise and physical activity, the body needs more oxygen than usual daily activities. All the need for oxygen is obtained from the bloodstream in the muscles. This is in accordance which explains that, during exercise the increased demand for oxygen is met by increasing muscle blood flow [10]; [11]. Furthermore, explain that Hb-mass are therefore different physiological parameters, which may exert different effects on endurance performance [12]. This means that the hemoglobin level will have a different effect on a person’s endurance. This is because hemoglobin will spread oxygen throughout the body through blood.

In addition to physical exercise, hemoglobin levels in the blood will also be increased in addition to the support of nutritional factors is also very influential in training [11]. Physical exercise such as jogging causes the amount of blood volume and hemoglobin (Hb) that flows and is bound by blood to increase. Based on this fact, we can know that regular exercise can increase hemoglobin levels in the blood, so that with the exercise along with good nutrition can increase hemoglobin levels in the blood.

Exercises that can improve fitness as well as hemoglobin are exercises that are carried out regularly and pay attention to the intensity of the exercise, frequency, duration of the exercise performed. Astrand and Rodhal explain that the increase in ability that caused by exercise, is influenced by intensity, frequency, resting, and duration of training [2].
3. Conclusion
Jogging can improve physical fitness and hemoglobin level. The exercises that can improve physical fitness as well as hemoglobin are exercises that are carried out regularly and pay attention to the intensity of the exercise, frequency, duration of the exercise performed.

References
[1] Eko, Y.M. (2013). "Hubungan Kadar Hemoglobin (Hb) dengan Kebugaran Jasmani pada Siswa Ekstrakurikuler Sepak Bola". Jurnal Pendidikan Olahraga dan Kesehatan. Vol. 01. No. 03 halaman 637-640. Fakultas Ilmu Keolahragaan Universitas Negeri Surabaya.
[2] Apri Agus & Sepriadi. (2018). Manajemen Kebugaran. Padang: CV Sukabina Press
[3] Dorland, W.A Newman. 2007. Dorland’s Illustrated Medical Dictionary. Philadelphia: PA Saunders
[4] Randolph, A. G., Gonzales, C. A., Cortellini, L., & Yeh, T. S. (2004). Growth of pediatric intensive care units in the United States from 1995 to 2001. The Journal of pediatrics, 144(6), 792-798.
[5] Laura Kosasi, Fadil Oenzil, dan Amel Yani. (2014). Hubungan Aktivitas Fisik terhadap Kadar Hemoglobin pada Mahasiswa Anggota UKM Pandekar Universitas Andalas. Jurnal Kesehatan Andalas. 2014; 3(2)
[6] Otto, J. M., Montgomery, H. E., & Richards, T. (2013). Haemoglobin concentration and mass as determinants of exercise performance and of surgical outcome. Extreme physiology & medicine, 2(1), 33.
[7] Ekblom B, Berglund B. (1991). Effect of erythropoietin administration on maximal aerobic power. Scand J Med Sci Sports. 1991;1:88–93.
[8] Thomsen JJ, Rentsch RL, Robach P, Calbet JA, Boushel R, Rasmussen P, Juel C, Lundby C Eur J Appl Physiol. 2007 Nov; 101(4):481-6.
[9] Hu, M., & Lin, W. (2012). Effects of exercise training on red blood cell production: implications for anemia. Acta haematologica, 127(3), 156-164.
[10] Laughlin MH, Davis MJ, Secher NH, van Lieshout JJ, Arce-Esquibel AA, Simmons GH, Bender SB, Padilla J, Bache RJ, Merkus D, Duncker DJ Compr Physiol. 2012 Jan; 2(1):321-447
[11] Mairbäurl H. (2013). Red blood cells in sports: effects of exercise and training on oxygen supply by red blood cells. Frontiers in physiology, 4, 332. doi:10.3389/fphys.2013.00332
[12] Schmidt, W., & Prommer, N. (2010). Impact of alterations in total hemoglobin mass on V’O2max. Exercise and sport sciences reviews, 38(2), 68-75.