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VO2 MAX VALUE OF ADOLESCENT BASKETBALL PLAYERS AND THE DIFFERENCE IN THE LYMPHOCYTES AND EOSINOPHIL COUNT BETWEEN BASKET TRAINED AND NOT

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Abstract:
This study aims to explain the VO2 max value in adolescents and the differences in lymphocytes and eosinophil levels after moderate aerobic exercise. The study was conducted with a post-test only control group design on 15 basketball player students and 15 non-basketball player students at SMAN 1 Banjarbaru. The sampling technique was carried out by using purposive sampling method. Measurement of VO2 max value was executed on the first day with MFT (Multistage Fitness Tes / Bleep Test) and measurement of lymphocytes and eosinophil levels was executed on the third day by trained medical personnel after the subject did the moderate aerobic exercise. Data analysis used was the Mann-Whitney test for VO2 max value and Saphiro-Wilk test for lymphocytes and the Mann-Whitney test for eosinophil levels. The results of the data analysis is the VO2 max value between groups were significantly different (p = 0.000) and there were no difference in lymphocytes (p > 0.05) and eosinophil (p > 0.05) count between groups after the moderate aerobic exercise. We conclude that basketball players student have a better VO2 max value than non-basketball players and moderate aerobic exercise were unable to make any significant difference between the groups in the number of lymphocytes and eosinophils.

Keywords: VO2 max, Lymphocytes, , Eosinophil, Basketball, Adolescents.

1. BACKGROUND

The transition period occurs in the late adolescent. Usually, the properties and habits carried out at this time will carry over into adulthood.[1,2] It is no exception to have a healthy lifestyle or not. It can also be influenced by several factors, namely spouse, occupation, friends, and others.[3] In adults who do not routinely do physical activity it is known that it is carried away from adolescence.[4]

Epidemiological studies show inactive lifestyles in adolescents have a link to increased mortality and morbidity of chronic diseases in later life.[5] Obesity is one of the diseases in adults related to the habit of not doing routine activities in adolescence.[6] Other diseases related to physical inactivity are coronary heart disease, osteoporosis, and cancer.[5]

Various studies that have been done show that a person who does routine activities in adolescence has many benefits. The short-term benefit is to improve the body's capacity by streamlining the flow of oxygen and blood circulation, while the long term is to avoid various diseases.[1,7]

There are many sports that teenagers love in Indonesia. One of the popular is basketball.[8] Basketball requires someone who plays it to move actively from all sides. The use of all limbs, good breathing arrangement, as well as

the consumption of a lot of energy makes basketball very good for the metabolism of the body when done to the maximum.[8,9,10] Physical exercise or exercising regularly can be beneficial for body fitness. The improvement of body fitness is meant by increasing VO_2 max and inducing changes in the adaptive and innate immune system physiologically.[11,12] Previous research has shown that VO_2 max in trained people is higher than untrained.[12] Then, this change in the immune system can be seen from changes in white blood cells mediated by HMGB1 or HPA cortisol.[13,14]

Apart from increasing VO2 max, aerobic exercises can increase the amount of eosinophil.[15] Eosinophils represent up to 6% of the bone marrow nucleation cells that remain and are routinely measured as a part of the complete blood cells count. Eosinophil plays a role in the immune system such as parasitic.[16] disease. Under conditions of homeostatic, eosinophil in the peripheral blood is obtained in low numbers (<450-500 eosinophil /mL).[17]

Meanwhile, the adaptive immune system, lymphocytes, only increases during training and slowly decreases until after the completion of the exercise.[18] There were differences in results in several studies on white blood cells after physical exercise. Therefore, further research is needed to examine the theory and show new results in physical fitness after physical exercise between trained and untrained people.

2. RESEARCH METHODS

This research is cross sectional. The population in this study was all students of State High School 1 (SMAN 1) Banjarbaru. The samples in this study were divided into two, namely samples taken from 15 basketball players and 15 non-basketball players at State High School I (SMAN I) in Banjarbaru. The sample is cooperative and has filled out a consent sheet to be the subject of research. Picking up samples are done by using a purposive sampling technique according to inclusion criteria namely (a) Wants to be subject of research, (b) Male, (c) 15-18 Years Old (d) Healthy Physical (at the time of research is not sick, infection,and does not have history of serious diseases) (e) Cooperative (cooperate to conduct research procedures) (f) Body mass index (BMI) normal (20-25), (g) adolescent who doesn't smoke, (h) Not taking drugs that affect the amount of Lymphocyte and Eusinophyl at least 2 days before the research begin. The sample of adolescent basketball players is a SMAN 1 student who joins a basketball club and regularly conducts basketball practice at least three times a week for one hour per training session for a year. The sample of adolescents not basketball players is students who do not do regular sports. Students feeling signs of fatigue are welcome to stop and not continue training.

The research was conducted for 3 days. On the first day VO_2 Max measurement with MFT (Multistage fitness test). On the second day the research break. On the third day of research, will be done aerobic exercise medium intensity 12 minutes. The study subjects will be calculated their maximum pulse using tanaka formula. Once they have known their MHR, it is calculated 70-79% of their MHR and maintained for 12 minutes with a uniform rhythm. After a 12-minute run, the study subjects would have taken 3 cc of blood in the brachialis vein to measure lymphocyte and eusinophyl levels. The sampling and analysis of blood samples in the subject was carried out by trained personnel from the prodia laboratory. Trained health workers always accompany training sessions to prevent life-threatening occurrences.

3. RESULTS AND DISCUSSIONS

VO2 Max

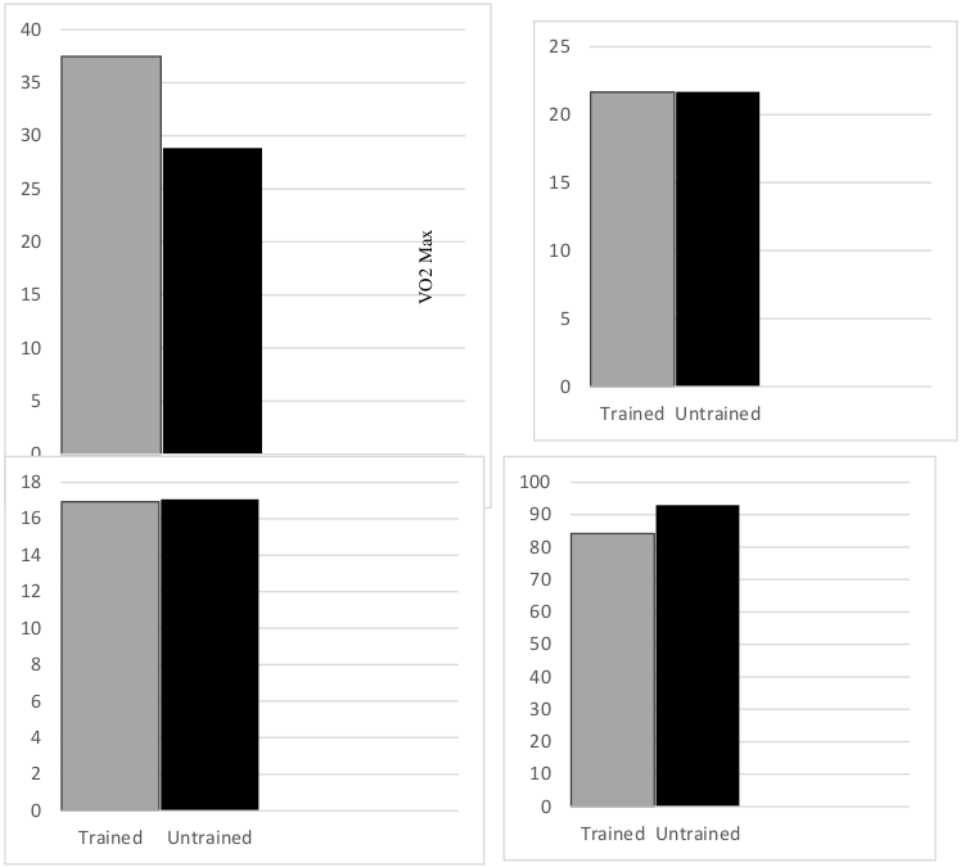
Table 1. Characteristics research subjects

No	**Characteristics (Average elementary ±)**	**Basketball Group (Trained=15)**	**Non Basketball Group (Untrained n=15)**
1	Age (Years)	16.93±0.258	17.067±0.703
2	BMI (kg/m^2)	21.65±2.10	21.68±5.91
3	Heart Rate	84.2±11.38	92.93±12.98
4	SO_2	97.26±2.57	96.93±3.73
5	VO_2 Max	37.48±3.98	28.85±2.62

Sample characteristics based on age, body mass index, VO_2 max are loaded on table 1. The average sample is 17 years old and body mass index, VO_2 max basketball players are higher than non-basketball players.

VO_2 max data was tested using mann-whitney test and found significant results (p = 0.000). This result is in line with the research of Anggi et al explained that there is a difference in VO2 max scores in male studentsaged 16-17 years after doing physical exercise for 6 weeks with before physical exercise. Stamina, Pola rest, and recovery period of each individual player is an aspect that influences the conclusions obtained. Based on these things, an important aspect is the optimal physical condition of the player. The player's physical condition affects the activity in training and following the training until the end, thus affecting the increase in endurance.[19]

In the study of Huldani et al[20], there was a significant difference in the VO2 max value between men who were fit (64.3%) and not fit (37.5%). Rahman[21] in his research also explained that there are differences in SB-Runners members who regularly do exercises (1-2 times a week) and do not practice regularly (<1-2 times a week). There is a significant difference (p<0.001). This conclusion is also supported by Hatle's research. Hatle examined 21 students with an average of 23-year-old subjects, had a normal BMI, did not smoke, and were physically healthy. The study subjects were divided into 2 treatment groups namely groups with moderate intensity exercise and high intensity exercise. Then the sample was treated with aerobic training 24 sessions conducted for 8 weeks. The group given moderate intensity training increased VO2 max during the training period until the training period ended with VO2 max increasing 10.7% progressively and significant value p< 0.001.



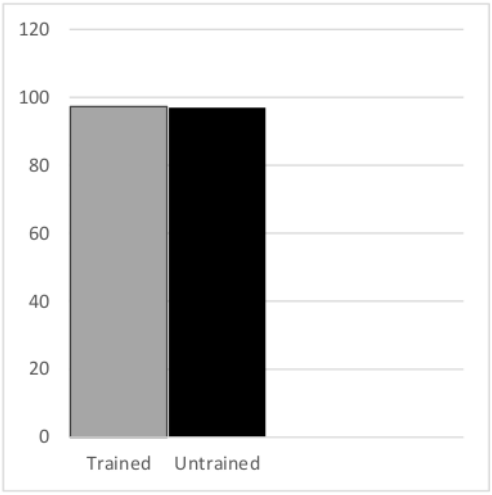


Figure 1.
Bar Chart Average VO2 Max, BMI, Heart Rate, SO2, Ages in Trained Adolescents and Untrained Adolescents

Table 2.
Results of analysis of the number lymphocytes and eosinophil research subjects

	Variable	Average	SD	P
Lymphocyte	Trained Adolescents	42.0267	8.00	> 0.05
	Untrained Adolescents	41.0067	8.10	
Eosinophil	Trained Adolescents	2,20	2.75	> 0.05
	Untrained Adolescents	1,60	1.44	

Lymphocytes

On the third day of research, aerobic exercise was running for 12 minutes and blood collection after doing the exercise. To find out the normality of the distribution of data on the blood lymphocyte levels of adolescent basketball players and not basketball players of each group conducted saphiro-wilk test, obtained normal distributed data for both groups of probandus research. In the amount of blood lymphocytes of these two groups there was no significant difference in blood lymphocyte levels after 12 minutes of moderate aerobic physical exercise. Kasab's study explained that there was an increase in the number of lymphocytes 30 minutes after moderate intensity physical exercise from a group of trained and untrained samples compared to before physical exercise. But the differences between the two groups are meaningless. It can be affected by gender, congenital diseases, and individual fitness. Rooney *et al*.[22] in favor that lymphocytotis occurs at 30-60 minutes after acute exercise.

Lymphocytes and monocytes will come out quickly and are affected again by intravenous catheter blood retrieval time. Lymphocyte levels depend on hemodynamic factors after cessation of physical exercise, most likely this is also influenced by individual fitness levels.[22]

Stress is a psychological/ physiological tension caused by stimuli. The mechanism of occurrence of stress begins with the increasing Corticotropine Releasing Hormone (CRH). CRH which has a role as a cortisol regulator in the blood will be secreted into the pituitary portal. Then Corticotropine Releasing Hormones will secrete Adenocortical Stimulating Hormone (ACTH).[21]

ACTH triggers the adrenal cortex to secrete the hormone cortisol. High cortisol levels can suppress inflammatory cells. Lymphocyte and macrophag are important cells in immunity and the process of inflamation. Because lymphocytes have a role in the adaptive immune system while macrophags have a role in the innate immune system.[13]

Short-term exercise and Long-term exercise proved to be the stressor of the athlete's redox status change for acute and chronic response in homeostasis. Biomarkers in acute exercise have more effect on redox homeostasis than long-term exercises. Inflammatory mediators such as IL-6 and IL-1ra are the most sensitive cytokine markers in physical exercise for adolescent athletes.[23] This may have an effect in the end with the results of the study so that it is obtained is meaningless.

Harun mentioned in his study there is a difference in IL-6 levels and lymphocytes after mild and moderate aerobic exercise in adolescents. In this study has different results, perhaps because it differs on the division of research subject groups and the form of exercise given. In the study of Harun, the subject of research was divided into 3 groups (plus control variables) and the exercises performed included chronic because it was done for 12 weeks.[24]

Research giacco *et al*.[25] explained that there was no significant change in lymphocytes in professional football athletes after practice. These results may be influenced by male-only gender, narrow age range, and lack of control population. One of the interesting things is that it turns out that aerobic physical exercise decreases the production of IL-4. 12 minutes of aerobic physical exercise can be useful in improving the symptoms of allergy and asthma sufferers if they often do regular physical exercise. So aerobic physical exercise is regularly considered to be a therapy for asthmatics.

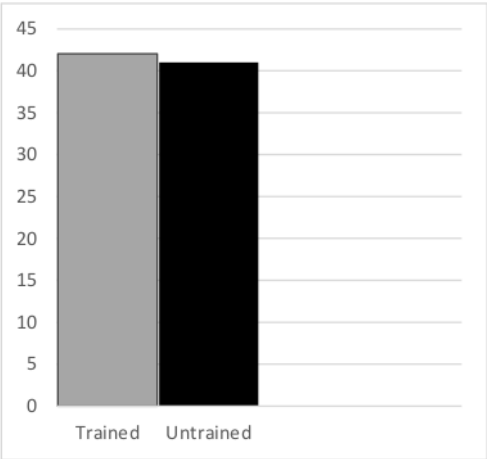


Figure 2.
Bar Chart of Average Lymphocyte Count in Trained Adolescents and Untrained Adolescents

Eosinophil

In research regarding the number of eosinophils. The results of the Mann-Whitney test obtained a P value> 0.05 (table 2).

The possibility of this happened because the training given by the researcher did not cause skeletal muscle injury to basketball players and not basketball players according to Setyohadi research. The results were not statistically significant and the difference in the number of eosinophils after treatment was carried out in the three groups, namely the light aerobic exercise group, moderate aerobic exercise group and control group ($p > 0.05$) .[26] It is also supported in the Harahap NS study. There was a significant difference between swimming exercise as hard as possible in mice ($p = 0.000$), because it was in accordance with the training that was able to provide muscle lesions.[27] In the study of Sodique et al., Significant results were obtained by doing strenuous physical exercise on subjects of average age. 22 years ($p < 0.01$) and eosipenia occurs due to excessive physical activity.[28] Yuliarto H's research found insignificant results in moderate intensity aerobic exercise ($p > 0.05$) .[29]

The cause of meaningless results of the eosinophil count probably comes from physical exercises performed by basketball players and non-basketball players who experience an increase in cortisol, which suppresses the inflammatory process resulting in hindering the number of eosinophil. Exercises can be considered as a trigger for muscle injury which activates the hypothalamic-pituitary-adrenal axis. There will be an increase in number of cortisol as young basketball players and non-basketball players are given training. Cortisol enhancement is a common response to muscle injury. Therefore, light-intensity exercises will not cause muscle injury which results to no change in cortisol. Exercises that can be a cause to muscle injury increase cortisol enhancement. Cortisol circulates in the plasma. It mobilizes substances needed for cells metabolism. Cortisol also affects protein metabolism. Cortisol has a metabolic effect which increases the rate of synthesis of RNA protein in some parts of the body and increases the rate of lipogenesis in other parts such as the face and body. The effect of lipids on tissue is quite specific because not all parts show an increase in lipid deposition or lipolysis. Cortisol works as an immunosuppressant by suppressing protein synthesis including immunoglobulin synthesis. Cortisol also reduces the population of eosinophil, lymphocytes, and macrophages in the peripheral blood. Glucocorticoids decrease the number of eosinophil in blood by increasing their sequestration in the lymph and lungs. The typical effect of cortisol distribution on white blood cells reduces the number of eosinophil from normally 270 cells/aL to 20 cells/aL. Therefore, there is a cortisol enhancement in acute exercises on moderate intensity exercises resulting in suppression in the number of eosinophil in blood or eosinopenia. Though it seems contradictory because other opinion claims that the occurrence of eosinopenia is relatively related to the presence of signs of lymphocytosis or the suppression of the inflammatory process so as to hinder the increase in the number of eosinophil in the blood.[29,30,31]
Therefore, in this study, there is an anti-inflammatory effect resulting from cortisol which causes suppression in the number of eosinophil, so that there is no significant difference between basketball players and non-basketball players.

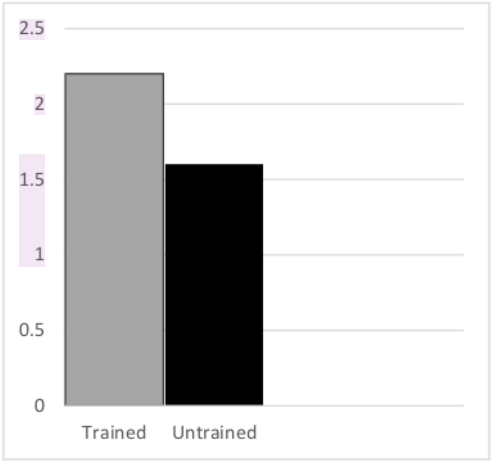


Figure 3.
Bar Chart of Average Eosinophil Count in Trained Adolescents and Untrained Adolescents

4. CONCLUSION

The results of this study concluded that the fitness level (VO_2 Maks) of adolescent basketball players is better than that of non-basketball players. In addition, there was also asignificant difference in the number of lymphocytes and eosinophils levels between adolescent basketball players and non-basketball players after a 12-minute moderate-intensity aerobic exercise.

Based on the weaknesses of this study, researchers suggest that researchers may further explain between adolescent and adult body responses to inflammation during physical exercise or during exercise, exercise duration, type of exercise, exercise intensity, and what frequency can cause optimum differences in lymphocytes and eosinophils levels of basketball players and not basketball players after aerobic physical exercise. Further researchers can also continue similar research models in order to look for differences in cortisol hormone response.

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