

# VO<sub>2</sub> MAX IN RIVER BEACH COMMUNITIES IN HST DISTRICT BY AGE, GENDER, AND MOBILE IMMUNITY (NEUTROFIL AND LIMFOSITE)

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## ABSTRACT

**Background:** Maximum oxygen consumption (VO<sub>2</sub> max) is an indicator of the basic concept of physical fitness (physical fitness). The factors that determine VO<sub>2</sub> max include heart lung function, age, aerobic muscle metabolism, body obesity, exercise state, genetics, gender, multivitamins. The age of 20-30 years is the peak age of heart and lung endurance, then it will decrease due to increasing age, the person will reduce various sports activities. **Methods:** This study was conducted to determine differences in VO<sub>2</sub> Max in riverbank communities in HST Regency based on age, sex, and cellular immunity (neutrophils and lymphocytes). The samples used were 30 samples each based on adult and elderly age, sex, and neutrophil and lymphocyte examination results. Sampling using simple random sampling on samples that meet the inclusion criteria. VO<sub>2</sub> Max is measured by the Rockport method. Data analysis used unpaired t test if the data were normally distributed and Mann Whitney if the data were not normally distributed with a confidence level of 95%. **Results:** VO<sub>2</sub> max values for the less fit and fit men group were 35.7% and 64.3%, respectively. Meanwhile, the VO<sub>2</sub> max value for the less fit and fit women group was 62.5% and 37.5%, respectively. The p value of both groups is 0.03. The neutrophil mean of the less fit and fitter groups were 63.5 and 59.1, respectively. The neutrophil mean for the less fit and fitter groups were 27.6 and 31.1, respectively. **Conclusion:** There are significant differences in VO<sub>2</sub> max in groups of women and men, adults and elderly residents of Hulu Sungai Tengah Regency, South Kalimantan. In addition, there was also a significant difference in the percentage of neutrophils and lymphocytes between the VO<sub>2</sub> max fitter and less fitter groups.

**KEY WORDS:** VO<sub>2</sub> max, age, sex, neutrophils, and lymphocytes.

## 1. INTRODUCTION

Maximum aerobic capacity or maximum oxygen consumption (VO<sub>2</sub> max) is an indicator of the basic concept of physical fitness. VO<sub>2</sub> max consumption is the maximum amount of oxygen that can be delivered from the lungs to the muscles in millimeters, or in minutes per kilogram of body weight. A

person who has good stamina has a higher VO<sub>2</sub> max value, can do heavier training, and has a higher concentration power than someone who is in poor stamina (Madina, 2007). The VO<sub>2</sub> max value is greatly influenced by physical characteristics such as age, gender, height, and weight (Astorin, 2000; Huldani, 2010; Guyton, 2008).

The age of 20-30 years is the peak age of endurance of the heart and lungs and will then decrease, this is due to increasing age, a person will reduce various sports activities and tend to choose to work a lot, besides that there is also a factor in reducing heart contraction. , heart muscle mass, total capacity (Cengiz, 2008; Hodges, 2007).

The VO<sub>2</sub> max of men and women is different, this difference in VO<sub>2</sub> max does not appear at a young age and is most evident during adulthood or middle age. In a previous study conducted by Krisna Augustian et al with the research subjects of elementary school fifth grade students and students, it was also said that boys and girls did not have a significant difference in VO<sub>2</sub> max until puberty (Hodges, 2007).

The difference in VO<sub>2</sub> max of men and women is related to differences in body size and body composition because the physiology of the bodies of men and women is different. Apart from body composition, the difference in VO<sub>2</sub> max is also due to the different hemoglobin concentrations of men and women. The composition of the female body is more fat than muscle compared to men which causes women to have a smaller VO<sub>2</sub> max. The hemoglobin concentration of men is also higher than that of women. Hemoglobin concentration is closely tied to the binding of oxygen that the body needs for the energy-burning process, so that men can optimally produce energy (Katch, 2011).

## 2. METHODS AND MATERIALS

This research method is observational descriptive analytic with cross sectional approach, conducted in Barabai, Hulu Sungai Tengah Regency, in April 2020. The population of this research is people who live on riverbanks in Barabai city, Hulu Sungai Tengah regency. The sampling process was carried out by using purposive sampling technique according to the inclusion criteria. The minimum sample size of each 30 samples per group according to Gay & Diehl's guidelines, all meet the inclusion criteria, namely aged between 26-65 years, have a normal body mass index of 18.5-24.9 kg/m<sup>2</sup>, are physically healthy and capable carrying out the research to completion, meaning that at the time of the study the probandus was not sick and there was no history of chronic heart and lung disease such as COPD, pulmonary tuberculosis, asthma, coronary heart disease, does not take multivitamins, has low-moderate activity levels, and is cooperative and is willing to fill out an informed consent. The instruments used in this study were informed consent, questionnaire, time measurement (stopwatch), 1.6 km running track, digital scale, height measurement.

First, take measurements of height and weight to complement the sample data. Next, measure the maximum oxygen capacity using a running method along the 1.6 km track according to the Rockport method. Before doing the test, the sample can stretch the whole body first, especially the leg muscles and end with a warm-up in the form of walking slowly for about 5-10 minutes. The sample is directed to run as fast as constantly as possible at a predetermined distance. Previously, the samples were each assigned a chest number. The sample stands behind the "start" line, after the "ready" signal, the test taker takes a standing start, ready to walk quickly. The sample starts running as fast as it can afford for the 1.6 km on the provided track. After completing a distance of 1.6 km, Measure the required time (in minutes and seconds) using a stopwatch, record the time and match it to the VO<sub>2</sub> max table. When taking VO<sub>2</sub> max measurements, the sample was accompanied by medical personnel on duty that day, to be on guard and to provide direct treatment for probandus who were unable to take measurements until it was finished or if the probandus felt there were complaints about his health.

## 3. RESULTS AND DISCUSSION

The detailed characteristics of the 60 research samples obtained can be seen in tables 1 and 2.

Table 1.

Frequency Distribution of Sample Characteristics by Age Group and Gender

No.	Variable	N	Respondents
1	<b>Gender</b>	60	
	Women		30
	Male		30
2	<b>Age</b>	60	
	26-45 years		30
	46- 65 years		30

In this study, the age of the sample was categorized into two groups, namely young adults (26-45 years) and elderly people (46-65 years). From the table data above, it can be seen that the number of samples of young adults and groups > 45 years old, respectively 30 people.

Table 2.

Frequency Distribution of Sample Characteristics based on the Number of Neutrophils and Lymphocytes.

Variable	Mean	Std. Deviation	Minimum	Maximum
Neutrophils%	56.6%	9.2	31.4%	78.9%
Lymphocyte%	29.5%	8.6	12.5%	54.9%

The mean percent neutrophils in the whole sample were 56.6% (within normal range). The highest percentage of neutrophils in the sample was 78.9%, and the lowest percentage of neutrophils obtained was 31.4%. The average lymphocyte percentage in this study was 29.5%, still within normal limits. The highest percentage of lymphocytes owned by the sample was 54.5%, and the lowest percentage was 12.5%.

Table 3

Distribution of VO2 Max fit and less fit in samples of Adults and Seniors.

Age	Amount	VO2max		Total	p-value
		Not fit	Fit		
26-45	30 people	9 people (32.1%)	21 people (67.9%)	30 people	0.01
46-65	30 people	19 people (62.2%)	11 people (34.4%)	30 people	

To assess whether there is a significant difference in the distribution of VO2 Max fit and unfit in the adult and elderly age groups, a Chi Square test was performed. The significance value of the Chi Square test for this variable is 0.01. So it can be concluded that there is a significant difference between VO2 max of prospective pilgrims in the adult and elderly groups. This is in accordance with the researcher hypothesis.

The results of this study are supported by Firman's research on soccer athletes in Nganjuk district, which states that VO2 max has a strong relationship with age. The Word research used the Spearman test with a relationship strength of 0.732. The results of the analysis also stated that the risk of physical fitness for athletes aged 18-35 years has a risk of being fitter 42 times compared to athletes aged over 45 years(Retnosari, 2016).

In addition, differences in VO2 max measurement results can be caused by many physiological factors. Due to different heart lungs between adults and elderly people. In elderly people over 46 years of age, VO2 max has decreased. This decrease occurs because the lungs, heart, and blood vessels begin to decline in function. Firman said that the age of 20-30 years is the peak age of heart and lung endurance and will then experience a decrease, this is due to the increasing age, the person will reduce various sports activities and tend to choose to work a lot. After the peak age of VO2 max is passed then VO2 max will decrease with increasing age(Retnosari, 2016; Woo, 2016; Firman, 2016).

Dewi in her research also stated that the average decrease in VO2 max per year was 0.46 ml/kg/minute for men, and 0.54 ml/kg/minute for women. Thus, at the age of 55 years VO2 max is approximately 27% lower than age 25 years. In addition, there are also factors that decrease heart contraction, heart muscle mass(Retnosari, 2016; Woo, 2016; Firman, 2016).

Ranto's research states that effective physical exercise that is endurance can increase the VO2 max. However, in the elderly, physical exercise routines and activities have decreased, so that VO2 max resistance has also decreased. The state of training in the elderly is actually already formed in adulthood, so if the state of training at adulthood is high then it is likely to have an impact on the elderly. In addition, fatigue is also one of the causes of decreased physical endurance in doing activities that will affect VO2 max. The older a person is, the lower the energy requirements, and there is a decrease in muscle strength which causes fatigue to experience faster (Firman, 2016; Hasiolan, 2017). The VO2 max distribution of fitter and less fit in the male and female samples can be seen in the table below.

Table 4.

Distribution of fit and unfit VO2 max in male and female samples.

Gender	amount	VO2max		Total	p-value
		Not fit	Fit		
Male	30 people	10 people (35.7%)	20 people (64.3%)	30 people	0, 03
Women	30 people	18 people (62.5%)	12 people (37.5%)	30 people	

The results of VO2 max measurement on 30 male samples showed that 20 samples were categorized as fit and 10 samples were categorized as less fit. In the female group, 12 samples were fit and 18 samples were less fit. The difference in the distribution above was assessed for significance using the Chi Square test, the value of  $p = 0.03$ , it can be concluded that there is a significant difference between the VO2 max of men and women in the sample. This supports the hypothesis that there is a significant difference between male and female VO2 max in the HST riverbank community.

The results of this study are different from previous studies researched by Augustian et al. The subjects of the study were students and elementary school class V students said that men and women did not have a significant difference in VO<sub>2</sub> max, where the value of p = 0.724 was obtained. In Huldani's research, with the research subjects of Darul Hijrah pesantren students, there was also no significant difference between male and female VO<sub>2</sub> max, where in that study the p value was = 0.321. Whereas in this study, it was found that there were significant differences in the VO<sub>2</sub> max value between men and women in prospective pilgrims who were on average adult or middle age, the VO<sub>2</sub> max value was influenced by various factors, one of which was gender. The VO<sub>2</sub> max value of men and women is the most obvious difference in adult or middle age (Huldani, 2010; Noor, 2017).

The difference in VO<sub>2</sub> max of men and women is related to differences in body size and body composition because the physiology of the bodies of men and women is different. The composition of the female body is more fat than muscle compared to men which causes women to have a smaller VO<sub>2</sub> max. In addition, differences are also caused by differences in maximal muscle strength where in general the muscle strength of men is greater than that of women. In terms of body composition, women generally have more layers of fat than men. The difference in VO<sub>2</sub> max between men and women apart from body composition is also due to the different hemoglobin levels of men and women. This difference in VO<sub>2</sub> max values between men and women is associated with higher hemoglobin levels as well as lower body fat in men than women. A higher hemoglobin level in men than in women causes a difference in blood carrying capacity which causes men to receive much more oxygen during the exercise process so that their aerobic capacity is better. Hemoglobin levels in adult males normally range from 13.5-18.0 g% and in females ranges between 11.5-16.5 g%, the difference in blood volume and hemoglobin levels between men and women is only slightly at a young age and there is a significant difference after puberty, because of lower oxygen transport and a greater percentage of body fat, women tend to show lower VO<sub>2</sub> max values than men (Ferriyanto, 2010; Hoeger, 2010; Agung, 2015; Yunus, 2011).

The human body has a complex defense system called the immune system. This system allows the body to react quickly and specifically to injury, inflammation, and infection. One of the most important components is leukocytes. Therefore it can be said that leukocytes are an indicator of the body's information status. The number of leukocytes is influenced by many things such as infection, inflammation, stress, and physical injury to a person, either in both acute and chronic conditions (Agung, 2015). VO<sub>2</sub> max is not only used to assess fitness status, but is also a good parameter to assess the cardiopulmonary system and the risk of atherosclerosis. Michishita, et al in their study on obese women, showed that there was a negative correlation between VO<sub>2</sub> max and monocytes. The better the fitness status, the lower the monocyte count. From these results, it is believed that a good fitness status can reduce a person's inflammatory status, so that it will have good implications for the number of cardiovascular events (Widiastuti, 2020; Harahap, 2008).

Table 5.

The mean ± standard deviation (SD) and 95% confidence interval for the number of neutrophils in the VO<sub>2</sub> max group were less fit and fitter.

Variable	VO <sub>2</sub> Max		95% confidence interval	p-value
	Not fit	Fit		
	Mean ± SD	Mean ± SD		
Neutrophils (%)	63.5 ± 10.6	59.1 ± 9.5	0.44-8.44	0, 03

Mean percentage of neutrophils in the VO group<sub>2</sub>Max fit was 59.1% and 63.5% in the less fit group, both of which were still within the normal range for the percentage of neutrophils. The data

were then tested by unpaired t test, the value of  $p = 0.03$  was obtained, which means that there was a significant difference in the percentage of the fit and unfit groups, because the p value was  $<0.05$ . The results of this study are in line with the research of Marpaung et al 18 in 2015 regarding the effect of maximum physical activity on the number of leukocytes and the type of leukocyte count in softball athletes. Neutrophils are phagocytic cells that play an important role in the innate immune response. These cells are generally the first cell types to work on the site of infection so that neutrophils are involved in various inflammatory processes, including inflammatory reactions in muscle tissue, caused by physical exercise. In fit people tend to have active physical activity, allowing chronic microtrauma to muscle tissue, causing a decrease in the number of neutrophils in the circulation. This is evidenced by the research of Harahap et al (2017) and Marpaung et al (2015), which measured the number of neutrophils before and after physical exercise in athletes, and showed similar results.

Table 6.

The mean  $\pm$  standard deviation (SD) and 95% confidence interval for the number of lymphocytes in the VO2 max group were less fit and fitter.

	VO2 Max		95% confidence interval	p-value
	Not fit	Fit		
	Mean $\pm$ SD	Mean $\pm$ SD		
Lymphocytes (%)	27.6 $\pm$ 8.9	31.1 $\pm$ 8.2	-6.9 - (- 0.1)	0,045

The comparison of the mean percentage of lymphocytes in the less fit and fitter groups can be seen in Table 6. There is a significant difference between the two. Lymphocytes have an important position in the body's immune system, so that these cells are not only present in the blood, but in a special tissue called lymphoid tissue, which is activated when an antigen or other stimulus appears. The results of this study are in line with research conducted by Yasirin et al (2014) regarding aerobic exercise and an increase in CD4 lymphocytes (immunity) in HIV patients. The results showed that there was a significant increase in CD4 lymphocytes after aerobic exercise in HIV patients. Other research results, by Harun et al in 2017, regarding the comparison of interleukin-6 levels and lymphocyte counts after light and moderate aerobic exercise in adolescents, also showed a similar case (Harun, 2018).

#### 4. CONCLUSION

From the results of the study it can be concluded that there are significant differences in VO2 max in groups of women and men, adults and elderly residents of Hulu Sungai Tengah Regency, South Kalimantan. In addition, there was also a significant difference in the percentage of neutrophils and lymphocytes between the VO2 max fitter and less fitter groups.

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