

# Differences in VO<sub>2</sub> Max Based on Age, Gender, Hemoglobin Levels, and Leukocyte Counts in Hajj Prospective Pilgrims in Hulu Sungai Tengah Regency, South Kalimantan

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## ABSTRACT

**Background:** VO<sub>2</sub> max is the maximum volume of oxygen that is processed by the body during intensive activities and is an indicator of the basic concepts of physical fitness. VO<sub>2</sub> max has milliliters per minute per kilogram of body weight. Factors that determine VO<sub>2</sub> max include heart lung function, age, aerobic muscle metabolism, body fatness, state of exercise, genetics, gender, multivitamin.

**Purpose:** To determine the difference in VO<sub>2</sub> max between prospective pilgrims based on age (adult and elderly), gender, hemoglobin level, and the number of leukocytes.

**Methods:** The total sample consisted of 60, each of 30 for gender and age variables. Sampling uses a purposive sampling method with inclusion criteria, namely age 36-55 years, has a normal BMI (18.5-24.9 kg / m<sup>2</sup>), physically fit, cooperative, does not consume stamina enhancing multivitamins, mild physical activity to moderate. VO<sub>2</sub> Max is measured by the Rockport method.

**Result:** Obtained the number of samples with VO<sub>2</sub> max fit in the adult group of 20 people (66.7%) and VO<sub>2</sub> max not fit 10 people (33.3%). In the elderly group sample with VO<sub>2</sub> max fit 11 people (36.7%) and less fit 19 people (63.3%). In the male group there were 20 people (66.7%) with VO<sub>2</sub> max fit and 10 people (33.3%) less fit. Whereas in the group of women found 11 people (36.7%) fit and 19 people (63.3%) less fit. The differences in each variable were analyzed using the Chi Square test, p = 0.02 was obtained so that it can be concluded that there were significant differences in VO<sub>2</sub> max in the age and gender

variables. The average hemoglobin level in the fit group was 14, g / dl, and the unfit group was 13.8 g / dl. Data were analyzed by t-test unpaired test, the results obtained p = 0, 008, which means there are significant differences in blood hemoglobin levels in groups with VO<sub>2</sub> max fitter and less fit. The average number of leukocytes in the group with VO<sub>2</sub> max fit was 7.83 thousand /  $\mu$ l and 7.27 thousand/ $\mu$ l in the less group. Data were analyzed by unpaired t test obtained p value = 0.69, which means there is no significant difference in the number of leukocytes in the fit and less fit groups.

**Conclusion:** There is a significant difference in VO<sub>2</sub> max between prospective pilgrims who are adults and elderly, between men and women, blood hemoglobin levels in the group with VO<sub>2</sub> max fitter and less fit, and there is no significant difference in the number of leukocytes in the fitter and less fit groups.

**Keywords:** VO<sub>2</sub> max, Age, Gender, Hemoglobin Levels, and Number of Leukocytes for Hajj Prospective Pilgrims.

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## INTRODUCTION

Maximum aerobic capacity or maximal oxygen consumption (VO<sub>2</sub> max) is an indicator of the basic concepts of physical fitness. VO<sub>2</sub> max 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. Someone who has good stamina has a higher VO<sub>2</sub> max value, can do heavier exercises, and has higher concentration power compared to someone who is in poor stamina.<sup>1</sup>

Hajj requires good stamina, because the Hajj requires more physical activity compared to other worship. The series of pilgrimage is mostly done on foot, to the mosque, tawaf, sa'i, to places of pilgrimage, throwing pilgrimage, and other activities carried out on foot.<sup>1,2</sup>

Indonesian pilgrims are now able to perform the hajj on average after waiting for about 11-29 years. Based on data from the Ministry of Religion, until February 2017, South Sulawesi Province has the longest waiting period, which is 29 years. Then, followed by South Kalimantan with a waiting period of 28 years. That means if someone signs up

for Hajj at the age of 17, and waits for 28 years, he will leave at the age of 45.<sup>3,4</sup>

Age 20-30 years is the peak age of heart and lung endurance and will then experience a decrease, this is due to increasing age so that a person will reduce various sports activities and tend to choose to work a lot, in addition there are also factors that decrease heart contraction heart muscle mass, total capacity.<sup>5,6</sup>

Based on the above explanation related to the length of the pilgrimage waiting list, then the possibility of pilgrims will leave at the age of 40 years and over. And according to data released by the Ministry of Religion of the Republic of Indonesia, for 2017, it was recorded that more than 50 percent were in the 41-70 year age group. -60 years old.

Male and female max VO<sub>2</sub> are different, this difference in VO<sub>2</sub> max is not apparent at a young age and is most evident during adulthood or middle age. Differences in VO<sub>2</sub> max for men and women are related to differences in composition and body size because the physiological bodies of men and women are different. In addition to 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 a woman's body is more fat than muscle compared to men which causes women to have a smaller VO<sub>2</sub> max. The concentration of male hemoglobin is also higher than in women. The concentration of hemoglobin binds closely to the binding of oxygen needed by the body for the process of burning energy, so that men can optimally produce energy.<sup>7</sup>

## MATERIALS AND METHODS

The method used in this research is analytic descriptive observational with cross sectional approach to determine differences in VO<sub>2</sub>Max based on age, sex, hemoglobin level, and the number of leukocytes in the prospective pilgrims in 2018 Hulu Sungai Tengah Regency, South Kalimantan. The sampling process was carried out using a purposive sampling technique according to the inclusion criteria. Minimum sample sizes of 30 samples per group in accordance with Gay & Diehl guidelines. Samples of elderly pilgrim candidates who meet the inclusion criteria are 64

prospective pilgrims, so a random sampling is done to get a total sample of 30 samples. The sample is a prospective Hajj pilgrims to Hulu Sungai Tengah district with inclusion criteria: 1) aged 26-65 years, 2) Has a Normal BMI, 3) Physically healthy and able to carry out research until completion, 4) Does not consume multivitamins, 5) Has a low level of activity - Medium, 6) Cooperative and willing to fill informed consent. The independent variables in this study were age, sex, hemoglobin level, and the number of leukocytes in the prospective pilgrims. The dependent variable in this study was VO<sub>2</sub> max. VO<sub>2</sub> Max is measured by the Rockport method with a simplified classification of being fit and less fit.

## RESULTS AND DISCUSSION

Samples obtained in this study amounted to 60 people, namely 30 prospective female pilgrims and 30 prospective male pilgrims aged 26-65 years. The detailed characteristics of the samples obtained can be seen in Tables 1 and 2.

Table 1: Frequency Distribution of Sample Characteristics According to Age Group and Gender

Number	Variable	N	Respondent	%
1	Gender	60		
	Women		30	50
	Man		30	50
2	Age	60		
	26-45years		30	50
	46- 65 years		30	50

In this study the age of the sample was categorized into two groups, namely the young adult group aged 26-45 years and the elderly group 46-65 years. From the table data above, it

can be seen the number of samples based on age characteristics obtained 30 people each (50%) in each group.

Table 2: Characteristic Frequency Distribution of Samples based on Hemoglobin Levels.

Variable	Mean	Std. Deviation	Minimum	Maximum
LevelHb(g/dl)	14.43	1.73	10.3	19.9

Each sample in this study was taken data on hemoglobin (Hb) levels and the number of leukocytes. Based on table 2 it can be seen that the average sample has a normal Hb, which

is 14.4 g / dl, with the lowest Hb distribution in the sample that is 10.3 g / dl and the highest Hb is 19.9 g / dl. Graph 1 shows the distribution of hemoglobin in this study.

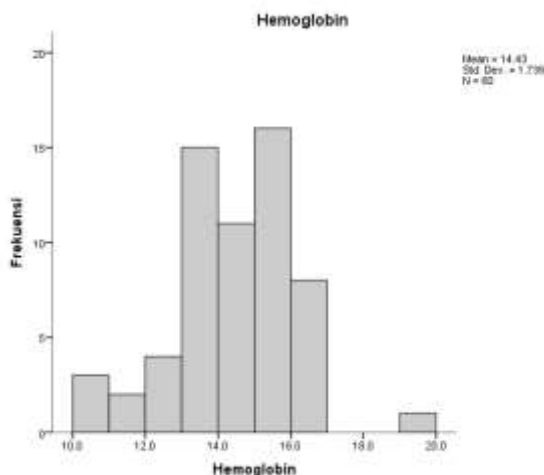


Fig. 1: Frequency distribution of hemoglobin in study samples.

The average number of leukocytes in the whole sample is 7,925 thousand /  $\mu$ l, which is also the normal value of the number of leukocytes. The highest number of leukocytes obtained in the sample was 12,900 thousand /  $\mu$ l, and the

lowest number of leukocytes obtained in this study sample was 3,800 thousand /  $\mu$ l. Graph 2 shows the frequency distribution of leukocytes in this study sample.

Table 3: Characteristic Frequency Distribution of Samples based on Leukocyte Amounts.

Variable	Mean	Std. Deviation	Minimum	Maximum
Leukocyte count(thousand/ $\mu$ l)	7.925	1.91	3.800	12.900

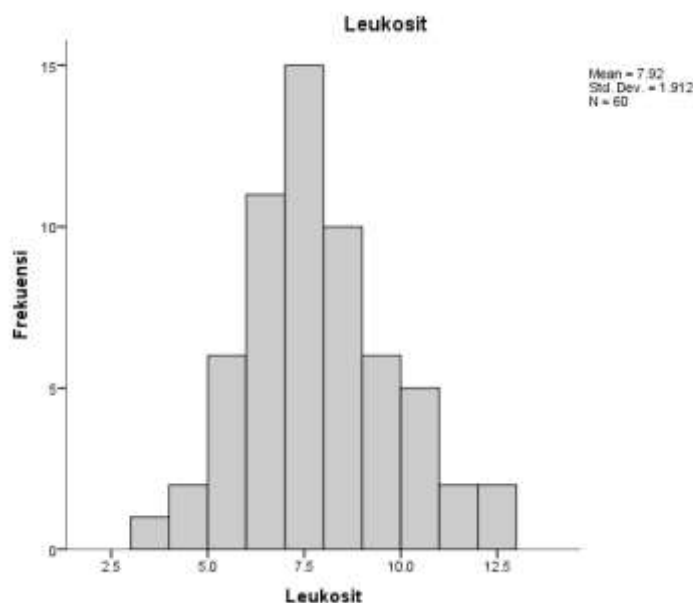


Fig. 2: Leukocyte frequency distribution of study samples.

To assess whether there is a significant difference in the distribution of VO<sub>2</sub> Max fit and not fit in the adult and elderly age groups, a Chi Square test was performed. The significance value of the Chi Square test on this variable is

0.02. Then it can be concluded that there is a significant difference between VO<sub>2</sub> max prospective pilgrims in the adult and elderly groups. This is in accordance with the researcher's hypothesis.

Table 4: Distribution of VO<sub>2</sub> Max fit and unfit for Prospective Pilgrims for Adults and Seniors.

Age	Total	VO <sub>2</sub> max		p-value
		Fit	Less fit	
26-45	30 people	20people (66,7%)	10people (33,3%)	0,02
46-65	30 people	11 people(36,7%)	19 people(63,3%)	

The results of this study are supported by the research of Firman on Nganjuk district soccer athlete who stated that VO<sub>2</sub> max has a strong relationship with age. The Word study uses the Spearman test with a relationship strength of 0.732. The results of the analysis also mentioned that the physical fitness risk of athletes aged 18-35 years had a 42 times fitter risk compared to athletes aged over 45 years.<sup>8</sup> In addition, differences in VO<sub>2</sub> max measurement results can be caused by many physiological factors. Because the heart lungs are different between adults and elderly people. Candidates for elderly pilgrims aged over 46 years have decreased VO<sub>2</sub> max. This decrease occurs because the lungs, heart, and blood vessels begin to decline in function. The Word says that the age of 20-30 years is the peak age of the endurance of the heart and lungs and then will experience a

decrease, this is due to increasing age so that a person will reduce various sports activities and tend to choose to work a lot, After a peak age of VO<sub>2</sub> max then VO<sub>2</sub> max will decrease with age.<sup>8-10</sup>

Dewi in her research also mentioned that the average decrease of VO<sub>2</sub> max per year was 0.46 ml / kg / min for men, and 0.54 ml / kg / min for women. Thus, at the age of 55 years VO<sub>2</sub> max is approximately 27% lower than the age of 25 years. In addition there are also factors that decrease heart contraction, heart muscle mass.<sup>8,10</sup>

Ranto's research states that effective physical exercise that is endurance can increase the value of VO<sub>2</sub> max. However, in prospective elderly pilgrims, physical exercise routines and activities have decreased, so that VO<sub>2</sub> max resistance also decreases. The state of exercise in the elderly has actually

been formed as an adult, so if the state of exercise during adulthood is already high then it is likely to have an impact on aging. In addition, fatigue is also one of the causes of decreased physical endurance in carrying out activities that will affect VO<sub>2</sub> max. The older a person is, the energy

requirements also decrease, and there is a decrease in muscle strength which causes faster fatigue.<sup>10,11</sup> The distribution of VO<sub>2</sub> max fitter and unfit for prospective male and female pilgrims can be seen in the table below.

Table 5: Distribution of VO<sub>2</sub> Max fit and unfit for male and female prospective pilgrims.

Gender	Total	VO <sub>2</sub> maks		p-value
		Fit	Less Fit	
Man	30 people	20people (66,7%)	10people (33,3%)	0,02
Women	30 people	11 people (36,7%)	19 people (63,3%)	

The results of VO<sub>2</sub> max measurement in 30 male samples found 20 samples categorized as fit and 10 samples categorized as unfit. In the group of women, 11 samples were fit and 19 samples were less fit. The difference in distribution above was assessed as significant using the Chi Square test, obtained p = 0, 02, it can be concluded that there is a significant difference between VO<sub>2</sub> max male and female in prospective pilgrims. This supports the hypothesis that there are significant differences between male and female max VO<sub>2</sub> in pilgrim candidates.

The results of this study differ from previous studies studied by Augustian et al. With the subject of research of students in grade V elementary school students said that men and women did not have a significant difference in VO<sub>2</sub> max, where in the study the value of p = 0.724 was obtained. In Huldani's research, the subjects of the Darul Hijrah Islamic Boarding School students also found no significant difference between VO<sub>2</sub> max for men and women, where in the study the value of p = 0.321 was obtained. Whereas in this study found significant differences in VO<sub>2</sub> max values between men and women in prospective pilgrims who were on average mature or middle-aged, VO<sub>2</sub> max values were influenced by various factors including gender, maximal VO<sub>2</sub> values for men and women most clearly there is a difference in adulthood or middle age.<sup>12,13</sup>

Differences in VO<sub>2</sub> max for men and women are related to differences in body size and body composition because the physiological bodies of men and women are different. The composition of a woman's body is more fat than muscle compared to men which causes women to have a smaller VO<sub>2</sub> max. Besides these differences are also caused by differences in maximum muscle strength where in general male muscle strength is greater than women. In terms of body composition of women in general, more layers of fat compared to men. The difference in VO<sub>2</sub> max between men and women apart from body composition is partly due to the different hemoglobin levels of men and women. This difference in VO<sub>2</sub> max values between men and women is related to higher hemoglobin levels and also lower body fat in men than women. Higher hemoglobin levels in men than women cause differences in blood transport capacity which causes men to get far more oxygen during the exercise process so that their aerobic capacity is better. Hemoglobin levels in adult men normally range from 13.5 to 18.0 gr% and in women ranging between 11.5-16.5 gr%, differences in blood volume and hemoglobin levels between men and women are only slightly at a young age and there is a significant difference after puberty, because of the lower oxygen transport and a higher percentage of body fat, women tend to exhibit lower VO<sub>2</sub> max values than men.<sup>14-17</sup>

Table 6: Mean ± standard deviation (SD) and 95% confidence intervals for hemoglobin levels in the VO<sub>2</sub> group are fitter and fitter.

Variable	VO <sub>2</sub> Max				p-value
	Fit		Less Fit		
	Mean±SD	95% Confidence intervals	Mean	95% Confidence intervals	
Hemoglobin (g/dl)	14,9 ±1,67	14,5-15,6	13,8 ±1,62	13,2-14,4	0,008

Saphiro-Wilk data normality test was performed on the Hemoglobin and Leukocyte variables, each p value > 0.05, which means the data on both variables were normally distributed. The average hemoglobin level in the fit group was 14, g / dl, and the unfit group was 13.8 g / dl. The mean of the two groups was assessed for differences with the unpaired t-test, the results obtained p = 0, 008, which means there was a significant difference in blood hemoglobin levels in groups with VO<sub>2</sub> max fitter and less fit.

These results are in line with Sinaga's research on the relationship of hemoglobin levels with VO<sub>2</sub> max levels of PPLM athletes in North Sumatra province in 2017. To assess the significance and correlation of differences in Hb levels in

both groups the Pearson test was obtained, the p value was 0.005 and the correlation value between variables was 0.687, which shows that the higher the hemoglobin level (within normal limits) the higher the VO<sub>2</sub> max level of PPLM athletes in North Sumatra Province.<sup>18</sup> The research conducted by Wahyudin on the Makassar SSB soccer player in 2016 also has similar results, namely there is a significant relationship between hemoglobin levels with VO<sub>2</sub> max.<sup>19</sup> Hemoglobin (Hb) contained in red blood cells functions as a carrier of oxygen, explaining that the number of red blood cells and the amount of hemoglobin (Hb) in the blood is very important in determining the body's ability to produce energy in physical and working activities.<sup>20</sup> The better the

hemoglobin level, the more oxygen that can be transported, so that the body will be more optimal for producing energy. But if the hemoglobin level in the body is lacking, the performance of athletes when competing will be less than

optimal because the body cannot meet the oxygen requirements to produce the energy needed by the athlete.<sup>21,22</sup>

Table 7: Mean ± standard deviation (SD) and 95% confidence intervals for leukocyte counts in the VO<sub>2</sub> group are max fitter and fitter.

Variable	VO <sub>2</sub> Max				p-value
	Fit		Less Fit		
	Mean±SD	95% Confidence intervals	Mean	95% Confidence intervals	
Leukosit (thousand/ μl)	7,83±1,88	7,14-8,52	8,02±1,97	7,27-8,77	0,69

The average number of leukocytes in the group with VO<sub>2</sub> max fit was 7.83 thousand / μl and 7.27 thousand / μl in the less fit group. Both of them were tested by unpaired t test, obtained p value = 0.69, which means there was no significant difference in the number of leukocytes in the fit and less fit groups, because the p value > 0.05. The results of this study are in tune with Tenorio's research in 2014 concerning the relationship of leukocyte counts, nutritional status, and fitness status in adolescents, which actually shows a negative correlation between leukocyte counts and adolescent fitness status.<sup>23</sup>

The human body has a complex defense system called the immune system. This system allows the body to be able to react quickly and specifically to injury, inflammation, or infection. One of the most important components is leukocytes. Therefore it can be said that leukocytes are an indicator of the body's infamation status. Leukocyte count is influenced by many things such as infection, inflammation, stress, and physical injury experienced by a person, both in acute and chronic conditions.<sup>24</sup> VO<sub>2</sub> max is not only used to assess fitness status, but is also a good parameter for assessing the cardiopulmonary system and risk atherosclerosis. Michishita et al. In their study of obese women, showed a negative correlation between VO<sub>2</sub> max and monocytes. The better the fitness status, the lower the number of monocytes. From these results, it is believed that good fitness status can reduce a person's inflammatory status, so that it will have good implications for cardiovascular events.<sup>25,26,27</sup>

## CONCLUSSION

From the results of the study it can be concluded that there are significant differences in VO<sub>2</sub> max in the group of women and men, adults and elderly candidates for the 2018 Hajj Hajj Regency in Central Kalimantan, South Kalimantan. In addition, also found significant differences in hemoglobin levels in the VO<sub>2</sub> max fit and less fit group. However, no significant difference was found in the number of leukocytes in the VO<sub>2</sub> max fit and less fit group.

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